Environmental Impact Assessment

Olympics Industries Limited

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UNIVERSITY OF LIBERAL ARTS BANGLADESH

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PART ONE

GREENHOUSE GAS EMISSIONS REPORT FOR THE OLYMPIC BISCUITS PRODUCTION PLANTS OF LOLATI AND MADANPUR

Olympic Biscuits

It is projected that implementing sustainable practices into business to manufacture goods in conformity with the natural environment will certainly pave the way to the future of the Bangladesh food industry in the coming decades. Bangladesh has gone a long way in becoming a promoter of economic and social factors, but in terms of chemical and environmental sustainability for a sound business setting, the country should focus on moving towards becoming a centre of excellence. Social compliance has already been recognised in business operations, but chemical and environmental sustainability is going to be an essential element in industrial processes in the days to come in Bangladesh.

An Environmental Impact Assessment (EIA) is an important management tool for ensuring optimal use of natural resources for sustainable development. The first step for any organisation's sustainability/carbon management programme is to gain an independent & thorough understanding of its current green-house gas (GHG) emissions. Bangladesh an environmentally fragile and climate affected country has seen organizations and companies including the government move towards green and clean practices. Still at a nascent stage, the number of environmental impact assessments undertaken in Bangladesh by the private sector are growing but yet to be an established process. Green growth, sustainable development and the current SDGs make the EIA process imperative for the country's growth.

Olympic Industries Limited founded in June 1979 as Bengal Carbide Limited, a battery manufacturer is one of the company's in Bangladesh, which focuses on sustainability. As Olympic industries expanded into diverse products, they served as the largest manufacturer of biscuits in Bangladesh and biscuits and confectionery products represent 95%+ of their annual revenue.

Over the last 30 years, Olympic has grown to be the one largest manufacturers, distributors and marketers of fast moving consumer goods in Bangladesh. What makes Olympic so popular is the quality of their products. They believe that a good business must be sustainable. The goals set out by the company not only give back to society, but also help maintain a higher standard as corporate citizens. In order to better guide their decisions, they have tied all of the projects to the Sustainable Development Goals set out by the United Nations. Nutrition, education, equity, and climate change are areas of focus for Olympic Industries CSR initiatives. Their commitment to CSR involves them taking up such scientific studies that will be made available to stakeholders and their partners. This will also help them design better CSR programs and work in an efficient and sustainable manner.

Reporting Period

The defined reporting period is the most recent complete yearly set of data, namely 2016. Full data sets in previous reporting periods are not readily available, as a proportion of the data has been collated using qualified 'expert' workers from the Olympic factories to quantify some of the emission producing activities. In reference to this another issue with analysing previous years is the integrity of gathered data is harder to legitimise due to the data collection methodology. The data collection is a factor that is an important requirement to ensure that future reporting is kept in line with and to at least the same standard of, the period that this report is covering as well as the baseline year.

Measuring and reporting approach

We have decided to follow the approach used by the UK governments department of Energy and Climate Change [1] which is based upon the Green House Gas (GHG) Protocol developed by the World Resources Institute (WRI) and World Business Council on Sustainable Development (WBCSD).

In correlation with this approach we have had one eye on the ISO 14001, which is used by small and large organisations across the world to reduce their environmental impact. It is an excellent framework to help implement an environmental management system (EMS) which helps organisations reduce their impact while still achieving growth. The requirement to achieve ISO 14001 have been a secondary factor in the design and scope of this report.

For a more intricate level of detail, where necessary we have followed the paradigm defined by the British Standards Institute (BSI) Publicly Available Specification 2050:2008 or PAS2050, which allows for the calculation of supply chain GHG emissions. These include those associated with processes not controlled by the company itself, and can be measured at either a company level or the level of an individual product. Where we have drawn from external sources where it has been possible we have used work that has used the afore mentioned models to generate reports, all of the secondary data used has been cross checked and analysed for robustness.

Organisational Boundary

The Olympic Organisation has a more complex setup than the production of biscuits. There are other products manufactured and sold by the company over multiple sites around Bangladesh. In addition to this the supply chain and its products are a massive and fluid entity, and one which it would be multifaceted to quantify in a report such as this, albeit ultimately useful.

Therefore this report expressly deals with the emissions related to the production of biscuits at the Madanpur and Lolati factory sites in Bangladesh. The defined boundaries of what is included and the reasons behind this will be expanded on in the following sections. It is based upon the recommendations defined by the GHG protocol guidelines, in line with the most widely used international standard of reporting.

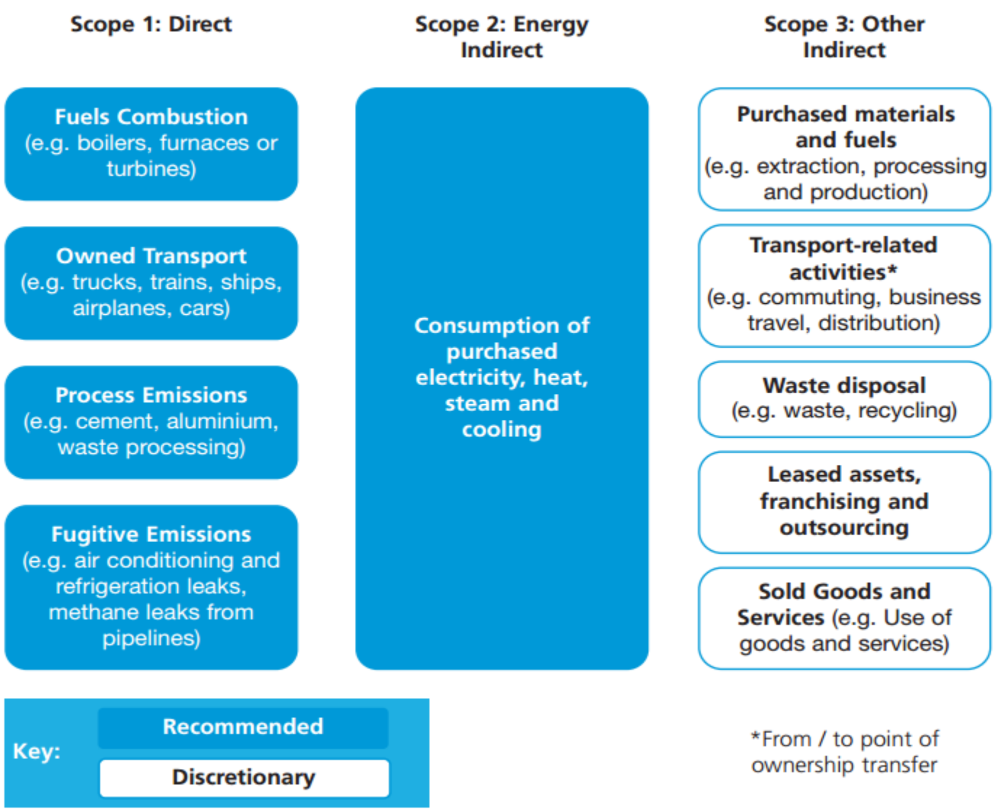
[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69282/pb13309-ghg-guidance-0909011.pdf

Operational Scopes

We needed to identify which activities in the organisation that were and are responsible for GHG emissions being released into the atmosphere. The widely used approach is using the GHG Protocol's 'Scope' framework which consists of three groups[2]. These are:

- **Scope 1** Direct Emissions; Activities owned or controlled by the organisation that release emissions straight into the atmosphere. Examples of these include emissions crated by the combustion process from boilers or generators, vehicle emissions, or emissions from chemical production.
- **Scope 2** Energy Indirect; Emissions being released into the atmosphere associated with your consumption of purchased electricity, heat steam and cooling. These are indirect emissions that are a consequence of your organisations activities which occur at sources you do not on or control.
- **Scope 3** Other indirect; Emissions that are a consequence of your actions, which occur at sources which you do not own or control and which are not classed as Scope 2 emissions. Examples of these are business travel by means not controlled by your organisation, waste disposal or purchased materials or fuels.

Under the GHG Protocol, all organisational footprints must include scope 1 and 2 emissions. There is more flexibility when choosing which scope 3 emissions to measure and report, and it is important to tailor these to reflect the environmental and commercial goals of the report.



[2] WRI / WBCSD The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)

Here follows a table that in simple terms shows the selected contributing factors to the emissions from both factories, and the scope category that they fall under.

Scope	Activity
Scope 1	Gas consumed in the generator to produce onsite electricity
	Oil consumed in the generator produce onsite electricity
	Gas consumed in the oven / boiler
Scope 2	Electricity consumed from the Bangladesh National Grid
Scope 3	Input of flour
	Input of sugar
	Input of palm oil
	Input of palm kernel oil
	Input of wrapping for packaging
	Input of high impact polystyrene (HIPS) tray
	Input of cardboard cartons for packaging

In addition to the factors included it is important to outline the factors that were not included within the study and the reasons behind their omission. What follow are the significant omissions, and a detailing of the reasons.

Water Treatment- Although there is a significant amount of water used in the processes related to the production at the factories, the emissions produced are already covered by other factors. The water bought up for the ground is pulled by pumps from the water table, these are run by the electricity either produced by the generator or by electricity drawn straight from the grid, these are reflected in the emissions shown coming from each different energy source. This is the same as any energy used to pump water around the factory complex, or any related process. This is also the case for the water used in the production of ingredients for the factory processes; this is reflected in the scope 3 emissions for each input.

Ingredient materials / Factory Inputs – There are a large number of ingredients that go into the biscuit production process which are used in a relatively small quantity. These trace inputs have not been included as anything that has less than 1% of an impact on the overall calculation are automatically omitted to ensure that the overall figure is not corrupted by and watered down by minor factors.

These ingredients include Lecithin, Malt, Liquid Glucose, Milk Powder (SMP), Sodium Bicarbonate, Ammonia Bicarbonate, Citric Acid, Malic Acid, Sodium Lactic Acid, Whey Powder, Dextrose, Starch, Ethyl Vanillin, Dry Gluten, Calcium Bicarbonate, Coconut Power, Salt, Cocoa Powder, Titanium Dioxide, Cookie Magic, Dough Magic, Cracker Magic, Cake Magic, Cake Gel, and Egg.

Transportation – The process of bringing in raw ingredients and distributing the finished product at Olympic is completed by external organisations and therefore are being placed outside of the scope of this report. A separate environmental report of the wider impact of this network is more fitting, or one that is included within the carbon footprint of the distribution companies themselves. There are a number of vehicles that are used by the Olympic organisation for transportation between factories for example but there are also being omitted as their use is party or wholly in the other departments of the organisation which this report does not reflect.

Waste Disposal – In balance to the inputs, there is very little outputted waste at the factories. Waste disposal also falls in to scope 3 which is a category which is defined by a flexible approach and an objective balancing of whether is useful to include. Due to the small amount of waste produced, the lack of robust data of what it is made up of, and the fact that it is processed by an external organisation, it is being omitted.

On site office factors - On the two factory sites there is a small complex of office buildings present. Included in these are housed management staff, which have inputs of office materials. Due to some rudimentary calculations using the International Life Cycle Database (ILCD)[3] it has been shown to be less than the 1% boundary requirement for inclusion. Additionally there are other similar office segments of the organisation and the division of what should be included is not clear enough to produce a fair figure so it has been omitted.

Solar Panels – Present on the roofs of both of the factory complexes are a small array of solar panels which are connected to the lights of the factory. The arrays are less that 4KW in size, and produce at maximum approximately 3400 KWH per year in an average case scenario. The electricity input alone from the grid is over 1,000,000 KWH which means that the effect of the solar panels on the emissions is less than 1% and therefore they have been omitted, this is not even taking into account the electricity generated onsite. If the panels were connected to the system as a whole, and fed into the complex's main loop, as does the generator, then we would reconsider and put as part of the calculation.

Defined Conversion Factors used in KG/C02

For each factor used in the emissions calculation below is the conversion factor used from the respective unit to KGCO2e. This a useful simplification tool for producing figures in the selected unit which are accurate and directly represent the different inputs into the organisation, and subsequently their individual emissions. The conversion factors have come from different sources, each one has a footnote if it was generated from external sources where it originated, and shown if relevant in the working to convert it from the unit that the source in question is reported in by Olympic.

Where possible the figures have been taken using data from Bangladesh but in some cases this has had to be drawn from other countries. In all cases the data source has been cross checked with other relevant similar sources to ensure consistency, and if a number of suitable sources found the most relevant one to Bangladesh, and Olympic has been selected.

Here follows a list of the conversion factors, and where suitable the brief workings shown to define the output.

Natural Gas

53.12 KGC02 per 1000 cubic feet of Natural Gas. [4]

[3] http://eplca.jrc.ec.europa.eu/
[4] https://www.eia.gov/environment/emissions/co2_vol_mass.cfm

53.12 x 35.315 = 1875.9328/ 1000 = 1.8759 = 1.88

Conversion Factor = 1.88

Oil

11.79 KGC02 per Gallon of Residual Heating Fuel [5]

1 Gallon = 3.79 Litres

11.79 x 3.79 = 44.6841

Conversion Factor = 44.68

Electricity

0.63714323 KGC02 / KWH [6] = 0.64 KGC02 / KWH

Conversion Factor = 0.64

Factory Inputs

1 KG of Wheat Flour – 0.6864 KGC02e [7]

Conversion Factor = 0.69

1 KG of Sugar = 0.54 KGC02e

Conversion Factor = 0.54

Palm Oil 1.67kgc02 [8] / KG Palm oil

Conversion Factor = 1.67

Palm Kernel Oil – 678.73 KGC02 / 1000KG Palm Kernel Oil[9]

Conversion factor = 0.68

(Figure taken from mill close to port without carbon capture facility being used)

[5] https://www.eia.gov/environment/emissions/co2_vol_mass.cfm - Residual Heating Oil
[6] https://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf - 2011
[7] http://www.revagrois.ro/PDF/2011-2/paper/pagini_38-41_Moudry.pdf
[8] http://www.sensorproject.net/sensorwp/wp-content/uploads/2016/09/SEnSOR-science-for-policy-paper-RSPO-GHG-calculator-August-16.pdf
[9] http://jopr.mpob.gov.my/wp-content/uploads/2013/09/joprv24dec2012-Vijaya1.pdf

Wrappers – Linear low Density Polyethylene (LLDPE) – 1.89KGC02 / 1 KG Wrappers[10]

Conversion factor = 1.89

High Impact Polystyrene (HIPS) Tray – 3.46 KGC02 / 1 KG HIPS[11]

Conversion Factor = 3.46

Cartons (cardboard)

Average weight calculated by average (mean) weight of sample selection of boxes.

490KGC02 / 1000kg Cardboard[12]

Conversion factor = 0.49

Base Year

The establishing of a base year is an important aspect in the reporting process. It defines a starting point from which the development of a robust and organisationally specific report can be produced. It enables a clear and direct comparison to other reporting periods, and it maintains a meaningful and consistent evaluation of emissions over time.

There may be a case in the future that the base year should be reset or revaluated, for example if there is a significant inorganic growth in factory production, a large expansion to the facilities, significant change in outsourcing or insourcing or a financial milestone such as a merger. External factors could also prompt a recalculation, for example if the usage of energy in the factory shifted towards the electricity from the national grid and the government significantly expanded its use of non-renewable sources of generation.

Below is a matrix to help define the need of a base year recalculation.

Base Line Recalculation Matrix

Change Scenario	Base Line Recalculation
Mergers, Acquisitions, Divestitures.	
1. Acquisition or outsourcing of a facility from or to another company. This facility existed in your base year (2015)	Recalculate your base year to include the emissions from the new facility.
2. Acquisition or outsourcing of a facility that did not exist in your base year.	No base year recalculation required.

[10] http://www.plasticseurope.org/Documents/Document/20100312112214-FINAL_LLDPE_270409-20081215-019-EN-v1.pdf

[11] http://www.plasticseurope.org/Documents/Document/20100312112214-FINAL_POLYSTYRENE_GPPS_111209-20090428-003-EN-v1.pdf

[12] https://emissionfactors.com/factor/126747/

Organic Growth and Decline	
3. Organic Growth - Increase in production output - Change in product composition	No base year recalculation required.
4. Organic Decline - Decrease in production output - Changes in product composition	No base year recalculation required.
Changes in Quantification Methodologies / Errors	
5. Changes in emission factors or methodologies that reflect real changes in emissions. For example change of fuel type or technology.	No base year recalculation required.
6. Changes in measurement methodologies, improvements in the accuracy of emission factors/ activity date, or discovery of previous errors/ number of cumulative errors.	Recalculate base year emissions to be consistent with new approach o to correct errors.

In the Olympic case the year 2015 was selected as the baseline. There were a number of contributing factors to this.

- The data source was the earliest complete and robust set we had access to.
- The comparison in production was very close to the current year of 2016 so provided an excellent insight.
- The company undertook some changes in the previous years in regards to growth and financial structure. Earlier data sets would provide a lack of clarity in certain areas when used for comparison.
- The data on emission factors for earlier years was much less reliable and verifiable, and data for Bangladesh specific aspects is non existent

Due to the main calculating year and the base year being so close, the exact same mechanisms for calculating both were used. This provides us with the double benefit of an excellent direct comparison for clarity, and an intrinsic quality assurance tool to ensure the value of reporting. To ensure clarity in past reporting and to establish an straight forward future reporting procedure the conversion factors generated are not year specific more era specific so they can be used with a certain level of accuracy for the near future. Therefore the emission factors used for the base year and reporting year are identical.

Target

This report is to be used as part of an Environmental Impact Assessment (EIA) to establish an on-going reporting paradigm, which will allow Olympic Industries to keep track of its carbon footprint. The establishing of a baseline year, and the data from the reporting year will give the organisation all of the tools it needs to set out a future proofed reporting mechanism, and to pave the way for attaining an ISO 14:0001 accreditation.

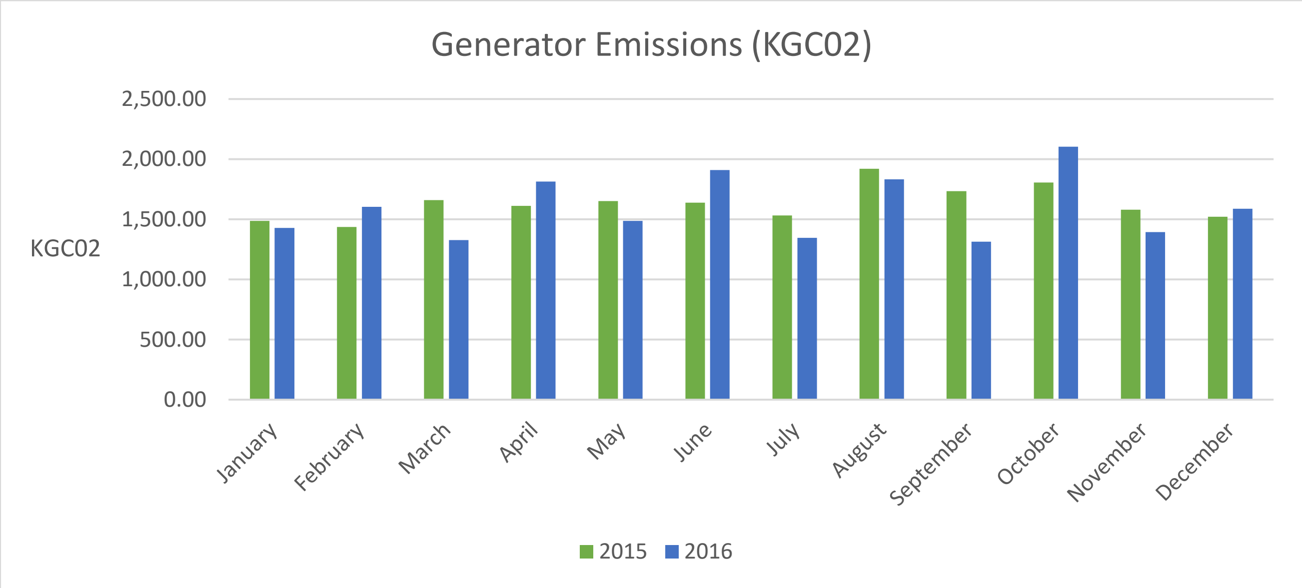
The assessment study will help Olympic fulfil the following objectives:

- Provide baseline metrics to assess the company’s environmental footprint.
- Set realistic and achievable targets to reduce greenhouse gas emissions, increase energy efficiency, and increase the use of renewable energies.
- Provide a comprehensive template that Olympic will use in the future to assess and update data on its environmental footprint in the future including training session with small group of employees to adapt the changes.
- Identify opportunities from the existing production process.

In line with this the process itself wants to become self-sufficient as it were, so that an in house team can continue the reporting with ease and with a suitable level of accuracy.

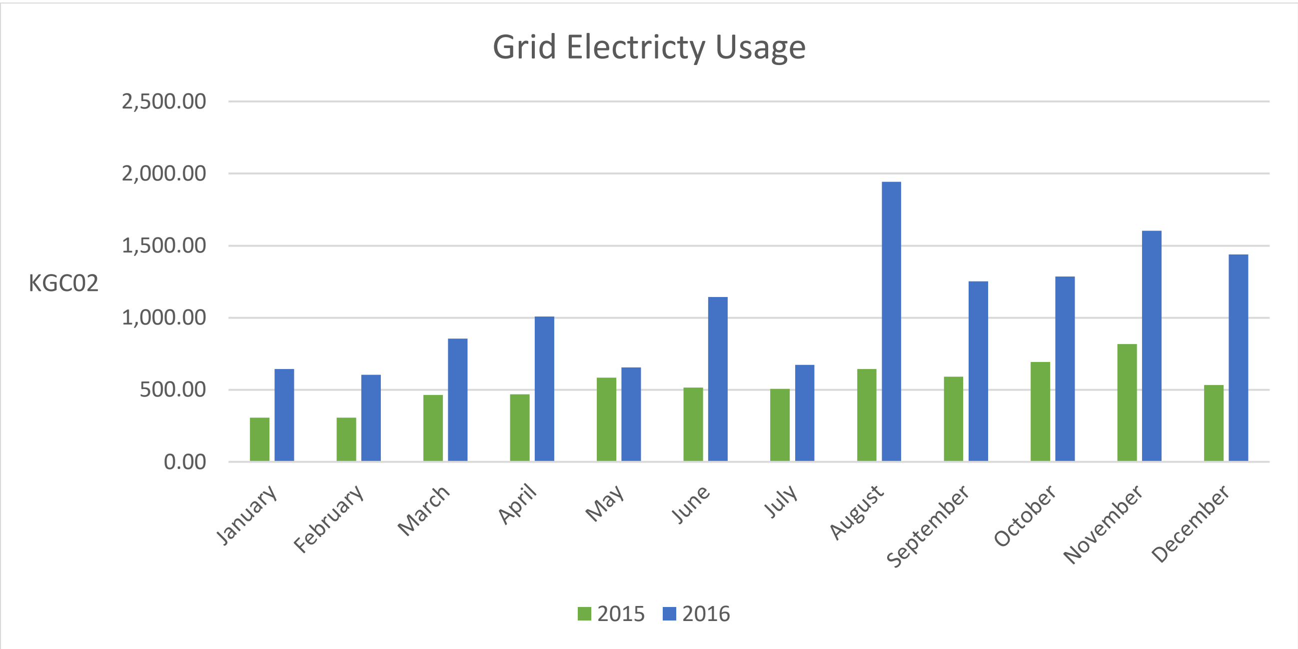
GHG Emissions Data

Generator usage



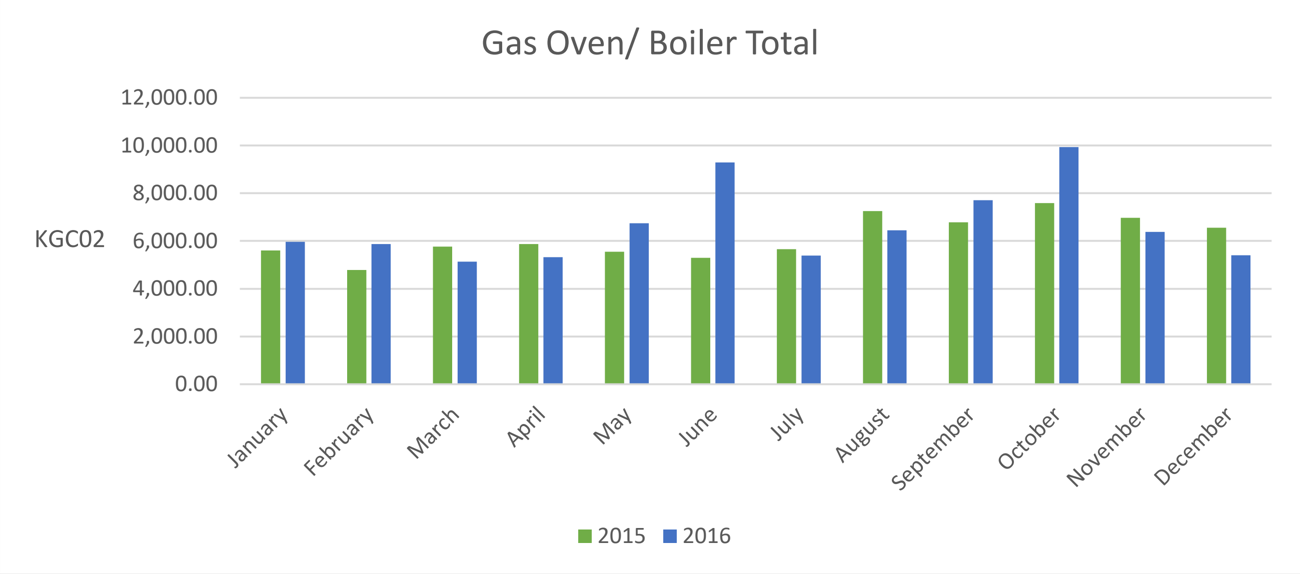
Showing the emissions produced by the generator, 2015 alongside 2016.

Electricity from grid



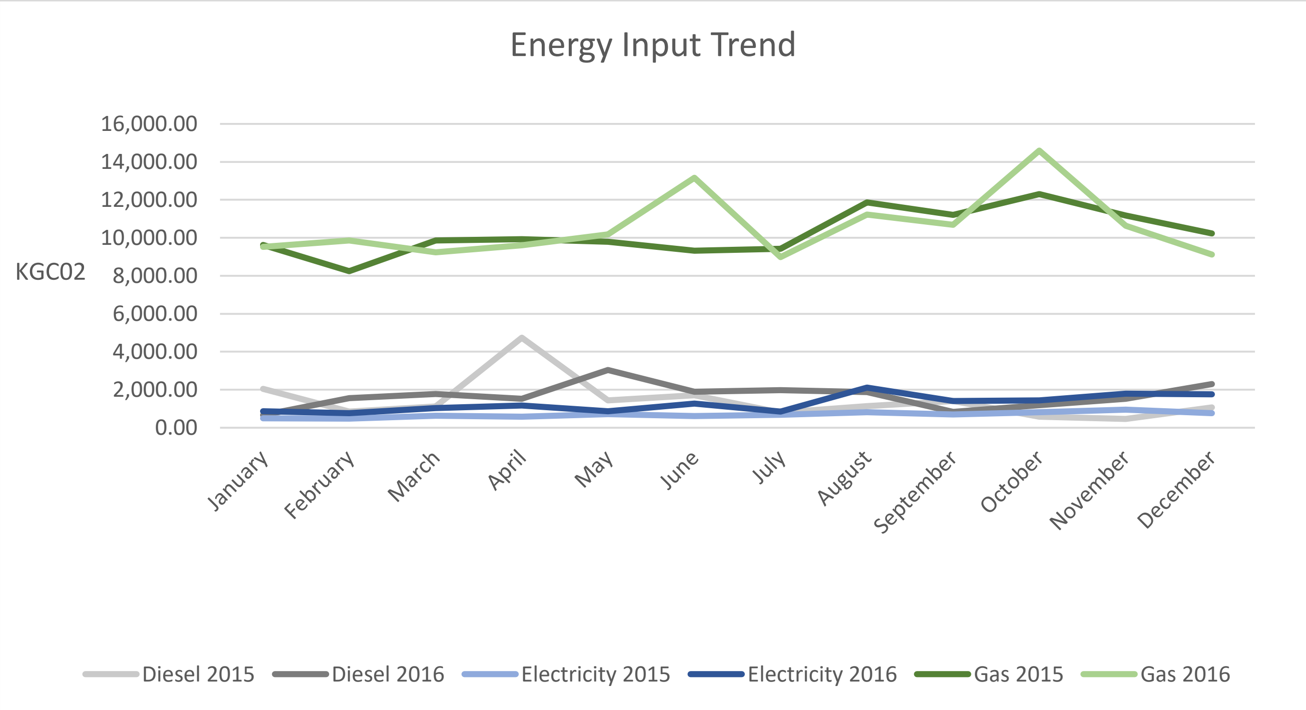
Showing the emissions produced by the electricity pulled from the grid, 2015 alongside 2016.

Gas oven usage



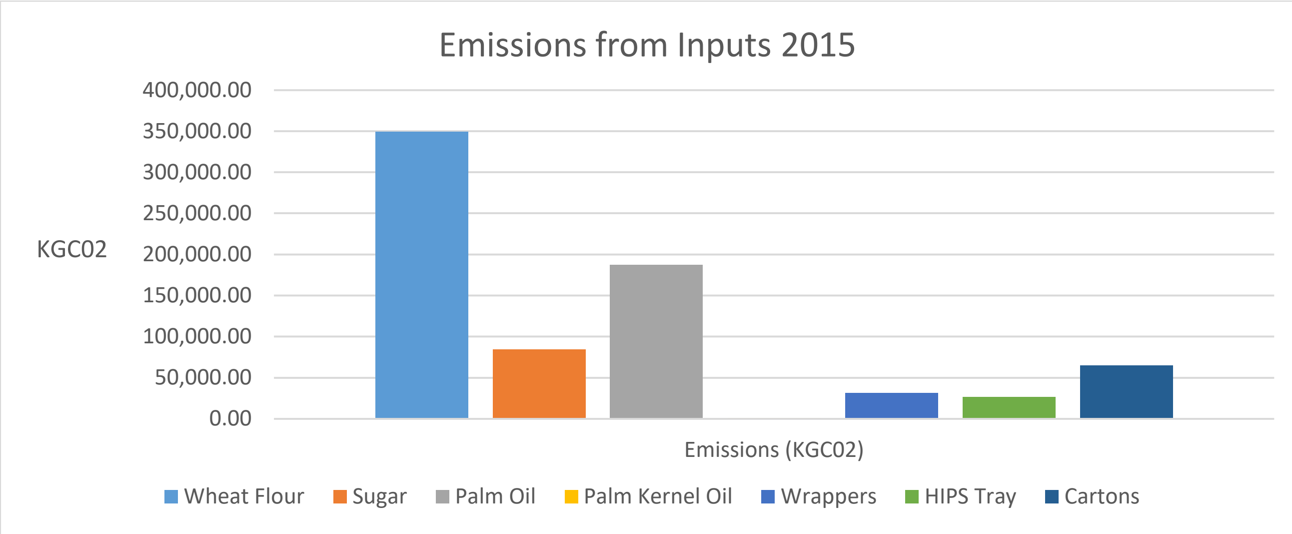
Showing emissions from the combined use of the gas ovens from both factories, 2015 alongside 2016.

Total Energy Inputs

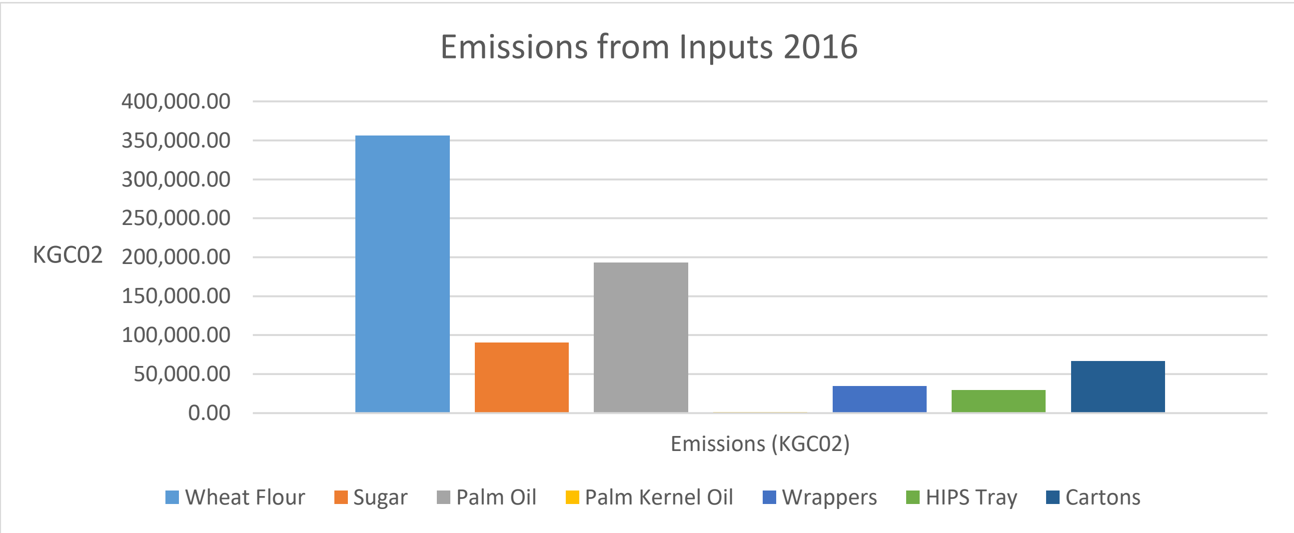


Showing the emissions from the three different energy sources and the trend over the span of a year, 2015 alongside 2016.

Emissions from Inputs

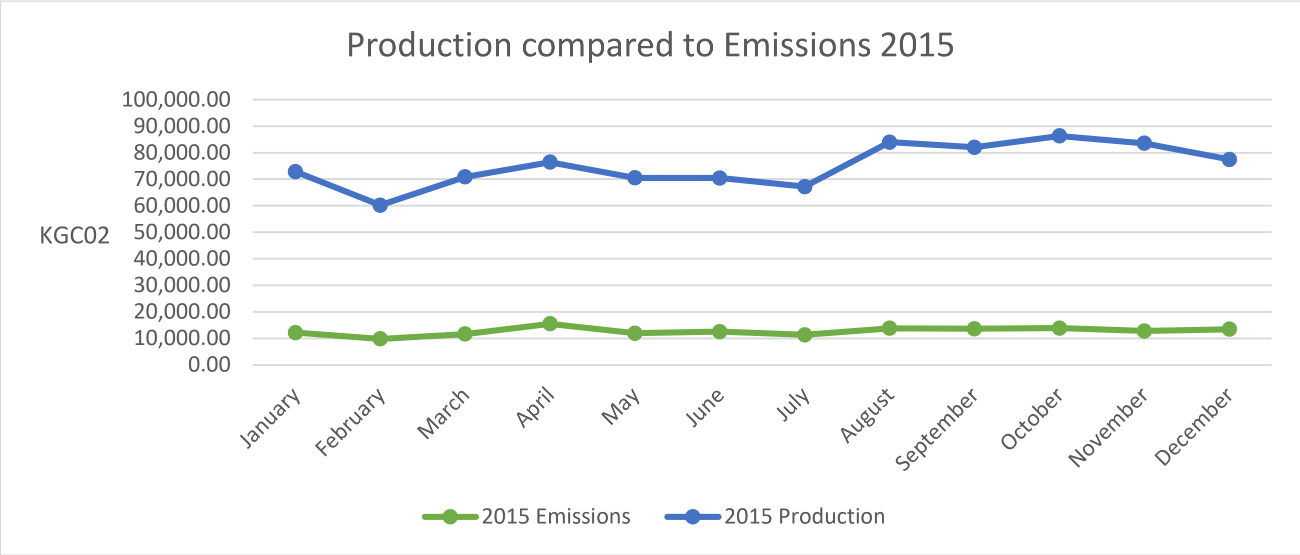


Total yearly emissions from the major inputs into the factory, in comparison with each other, 2015 only.

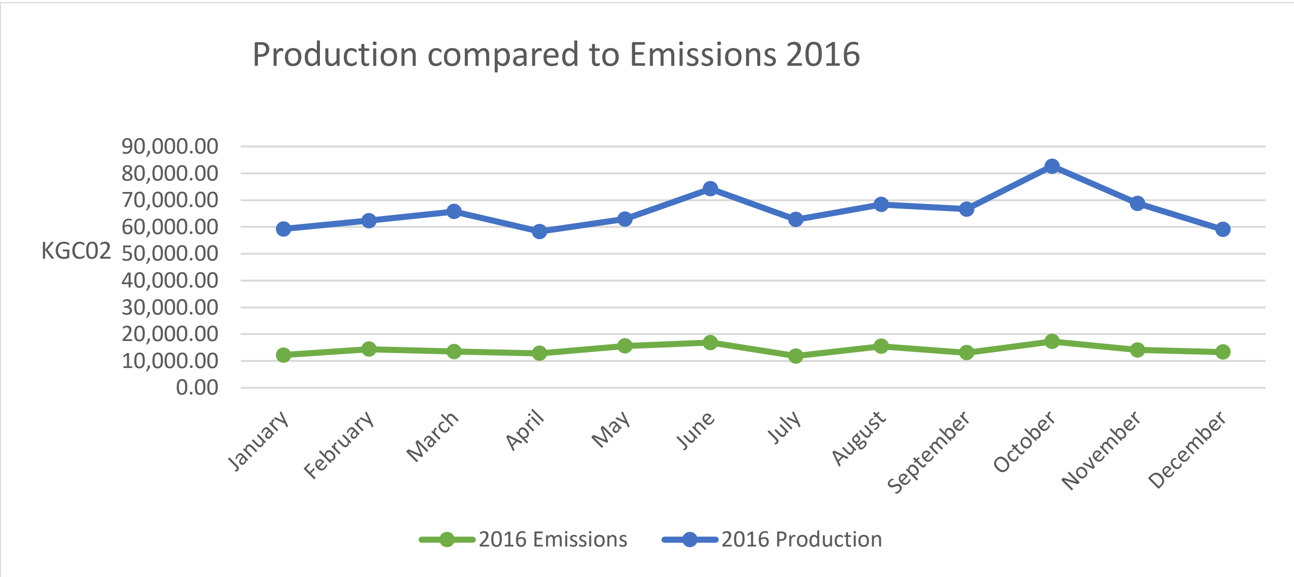


Total yearly emissions from the major inputs into the factory, in comparison with each other, 2016 only.

Production and Emissions



Showing the total monthly emissions compared to the monthly production, to clarify trends, 2015 only.



Showing the total monthly emissions compared to the monthly production, to clarify trends, 2016 only.

GHG Emissions report 2016

GHG Emissions for period of 1 January 2016 to 21 December 2016			
	Global KGC02		
	2015	**2016**	**Baseline (2015)**
Scope 1	14,027,576.19	15,503,096.73	14,027,576.19
Scope 2	824,032.13	1,530,516.67	824,032.13
Scope 3	74,366,492.57	77,094,814.89	74,366,492.57
Total Gross Emissions KGC02	**89,218,100.89**	**94,128,428.30**	**89,218,100.89**
Total Gross Emissions Tonnes of C02	**89,218.10**	**94,128.43**	**89,218.10**
Production : Emissions Ratio	1.19	1.19	1.19

Key

Scope	Activity
Scope 1	Gas consumed in the generator to produce onsite electricity
	Oil consumed in the generator to produce onsite electricity
	Gas consumed in the oven / boiler
Scope 2	Electricity consumed from the Bangladesh National Grid
Scope 3	Input of flour
	Input of sugar
	Input of palm oil
	Input of palm kernel oil
	Input of wrapping for packaging
	Input of high impact polystyrene (HIPS) tray
	Input of cardboard cartons for packaging

PART TWO

RECOMMENDATIONS AND TARGETS

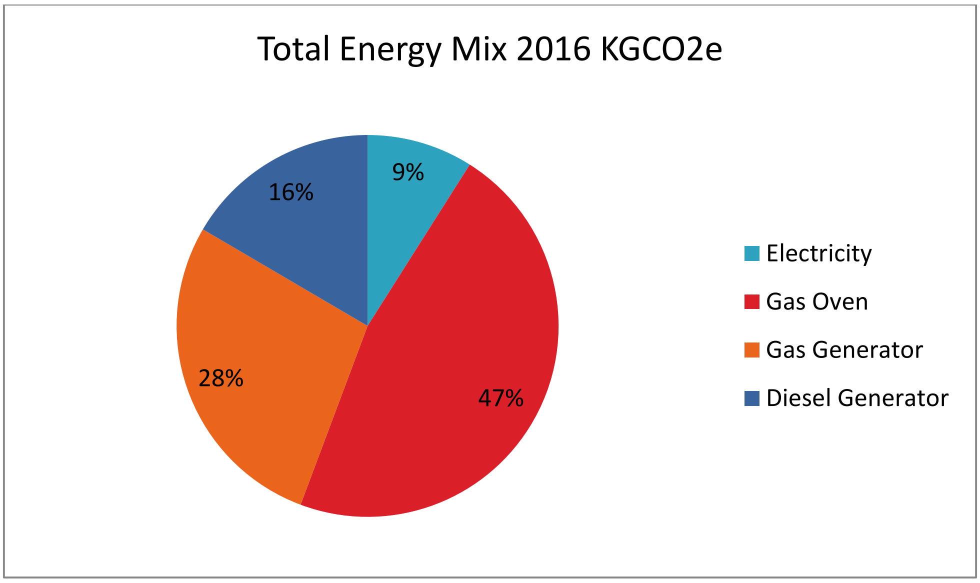
Introduction

The objective of this section of the report is using the data collected and discussions with Olympic staff, to set-out a series of goals or scenarios in which Olympic can reduce its carbon emissions. Each recommendation has been tailored to the Olympic scenario, and is defined by this. Only realistic, practical and attainable factors have been highlighted, keeping in mind the wider Bangladesh uptake in new technologies and resource availability. Where possible there will be provided a palpable, numerical figure in KGCO2e with which to give the recommendations clear perspective.

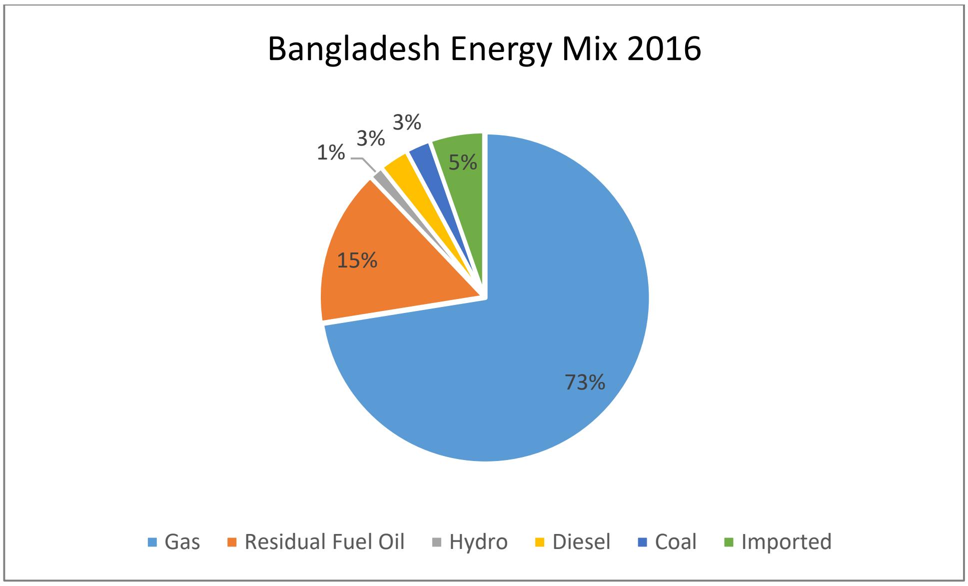
These have been divided into 5 sections; reduce emissions, offset emissions, efficiency, water and waste. The 5 sections are defined by the following section where attainable targets are outlined.

Reduce C02 Emissions

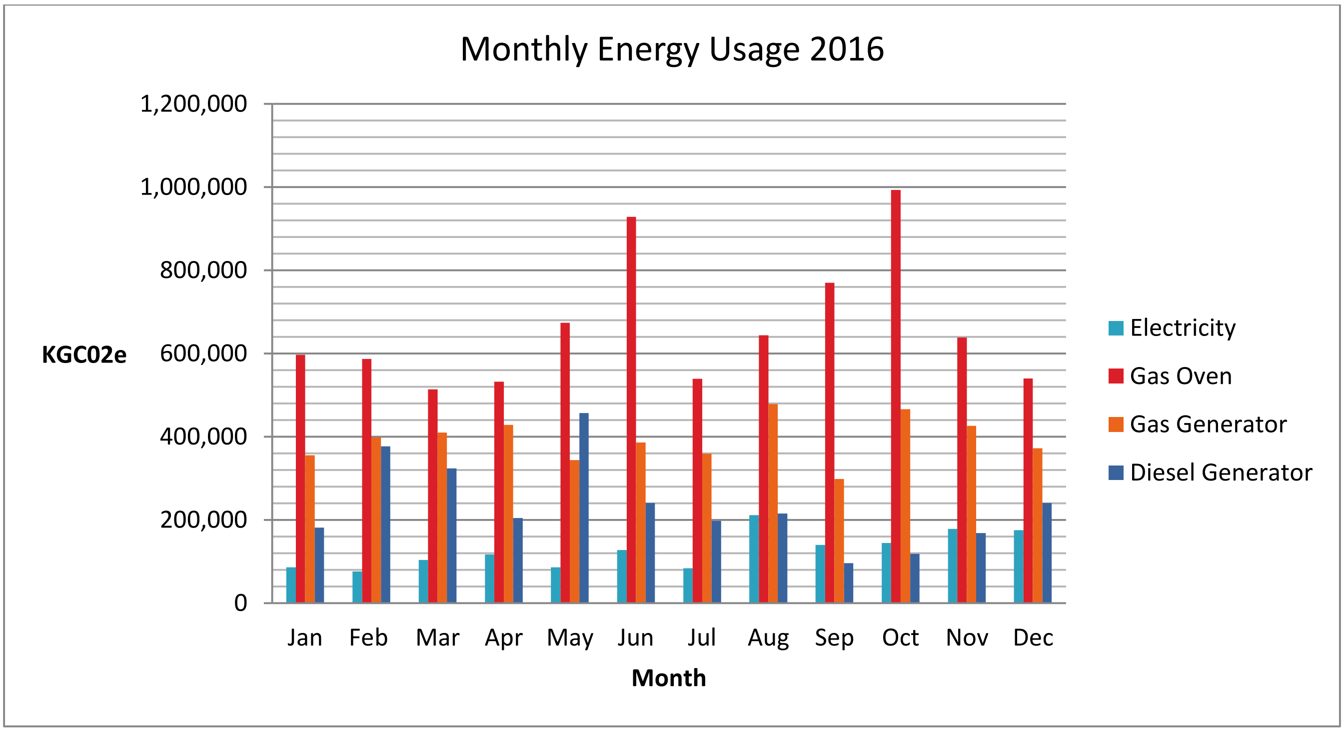
The organisation consumes a large amount of non-renewable energy sources to produce vast amounts of electricity and heat on a daily basis. Below is a chart detailing the yearly production of KGCO2e from non-renewable energy sources broken down into its constituent parts.



The largest contributor is Gas, and if the two sources are added together it makes up 75% of the total emissions from energy consumption. This loosely matches with the countrywide energy usage pattern as shown in the below pie chart.



This can be further broken down over the space of a year, in this case 2016.



As you can see there is little definitive correlation between energy uses, this is probably due to the factors which define the use of a certain source; namely market cost and availability.

This is useful to explore because it is important to highlight that it cannot realistically be recommended to use a certain type of fuel. By the Kilowatt on average, gas can be seen as being the least damaging fuel to consume. There is much discussion currently on Bangladesh's reliance on gas as a fuel and the fact that the in country supply is being quickly used up. Fuel oil is not an alternative to be recommended with the idea of reducing emissions, and the electricity grid is not yet stable enough to be relied upon.

All of these sources are non-renewable, with only the electricity grid being debateable. Currently it has at peak around 1% renewable input, the huge majority of this coming from Solar. This means that the electricity coming from the grid can be defined as non-renewable. So to reduce C02 emissions in regards to energy consumption, the use of renewables needs to be explored.

Solar

In rural Bangladesh today you would struggle not to notice tiny solar panels embedded in even the most humble thatch-roofed hut. This mostly due to effort of the infrastructure Development Company Limited (IDCOL) is seen as being one of the globes most significant solar revolutions. Since 2003 IDCOL has installed solar systems in 3.95 Million off-grid homes, reaching around 18 million people. Looked at in the terms of installed numbers rather that total wattage, this puts Bangladesh amongst the top few solar countries in the world. Compare this to nearby India where SELCO a leading solar company has installed 350,000 Solar systems since 1995, this makes the success even more stark especially as the country has a population of more than 1.2 billion.

Bangladesh is located between $20^{0}30'$ and $26^{0}45'$ north latitude. This gives it an average of 5KWH/m^2 of solar radiation over 300 days per year. There is a daily sunlight rage of 7 to 10 hours. This gives the country a great potential for solar power generation, and not only with the already popular small systems, there is great scope for larger systems to contribute to power needs.

There are already solar systems in built into the Olympic lighting circuit, sat on the factory roofs. There is significant space to expand these, and due to the large amount of electricity used by the organisation, virtually all of the energy produced will be always be used. Importantly there is large areas of unused plots which are ideally suited for solar installations.

As an example when we have looked at the factory sites, there is enough roof space to fit an additional 40 250W solar panels mounted on both of the roofs. Making a total array size of 20KW (peak). We have got a quote dated March 2017 from one of Bangladeshi's largest and most renowned solar installers and the total cost for both 40 panel systems is 1,500,000BDT.

An array with the combined size of 20KW in this geographical location should produce on average 30,040KWH of electricity per year. This calculation was generated using PVSOL by Valentin Software, which is the world's leading solar generation database. Using the figures from 2016, the cost of each unit (KWH) of electricity was 7.57 Taka.

The below table shows the financial scenario of the arrays.

Array Age	Year	Predicted Yearly Production (KWH)	Efficiency (%)	Yearly Saving (BDT)	Array Cost (BDT)
0	2017	30,040	100	227,403	1,500,000
1	2018	29,740	99	225,129	1,272,597
2	2019	29,439	98	222,855	1,047,468
3	2020	29,139	97	220,581	824,614
4	2021	28,838	96	218,307	604,033
5	2022	28,538	95	216,033	385,726
6	2023	28,238	94	213,759	169,694
7	2024	27,937	93	211,485	-44,065
8	2025	27,637	92	209,211	-255,550

9	2026	27,336	91	206,937	-464,760
10	2027	27,036	90	204,663	-671,697
11	2028	26,736	89	202,388	-876,359
12	2029	26,435	88	200,114	-1,078,748
13	2030	26,135	87	197,840	-1,278,862
14	2031	25,834	86	195,566	-1,476,703
15	2032	25,534	85	193,292	-1,672,269
16	2033	25,234	84	191,018	-1,865,561
17	2034	24,933	83	188,744	-2,056,580
18	2035	24,633	82	186,470	-2,245,324
19	2036	24,332	81	184,196	-2,431,794
20	2037	24,032	80	181,922	-2,615,991

As shown in the last quarter of year 7, in this case the year 2024, the system will have effectively paid itself off in savings from purchasing electricity from the grid.

Below is the emissions reduction for the electricity purchased from the grid if it were to follow 2016 amounts. The arrays would replace just over 1% of the electricity used every year.

Array Age	Year	Predicted Yearly Production (KWH)	Efficiency (%)	Yearly KGCO2 Reduced	Total KGCO2 Reduced
0	2017	30,040	100	19,226	19,226
1	2018	29,740	99	19,033	38,259
2	2019	29,439	98	18,841	57,100
3	2020	29,139	97	18,649	75,749
4	2021	28,838	96	18,457	94,205
5	2022	28,538	95	18,264	112,470
6	2023	28,238	94	18,072	130,542
7	2024	27,937	93	17,880	148,422
8	2025	27,637	92	17,688	166,109
9	2026	27,336	91	17,495	183,604
10	2027	27,036	90	17,303	200,908
11	2028	26,736	89	17,111	218,018
12	2029	26,435	88	16,919	234,937
13	2030	26,135	87	16,726	251,663
14	2031	25,834	86	16,534	268,197
15	2032	25,534	85	16,342	284,539
16	2033	25,234	84	16,150	300,688
17	2034	24,933	83	15,957	316,646
18	2035	24,633	82	15,765	332,411
19	2036	24,332	81	15,573	347,983
20	2037	24,032	80	15,380	363,364

Biogas

Another energy factor to look into is biogas. The current market in Bangladesh is in its infancy, and although all predictions point to it becoming a much larger player in the field of gas consumption in the country, at present there are very few large scale plants and none known that could supply the Olympic factory site to an acceptable level. With this in mind it will not be feasible to suggest the large scale usage of biogas within factories internal electricity generation, and gas ovens but there is a smaller scale model that fits the organisation and will be an ideal starting point from which to develop.

The kitchens in the factory use natural gas to cook upon, they also produce food waste, which in turn is a suitable source with which to produce bio gas. A small dome or digester for the production of gas could be installed, from which it can be siphoned off and used in the kitchen.

The below table outlines the emissions reduced for the replacement of 4KG of natural gas used in the cooking

1KG of gas = 0.53m3 So 4 KG of gas = 2.16m3 x 365days = 788.4m3 x1.88 (conversion) = 1,482 KGC02 per year saving. (using the concept of Biogas being more or less carbon neutral)

Offset Emissions

The production and purchase of carbon credits is a growing market globally, and with a small amount of careful selection is proving to be an excellent solution for reducing an organisations environmental impact.

Within Bangladesh there are a growing number of organisations who are registered to produce carbon credits for sale or exchange. A lot of these are connected to the wildly successful renewable energy industry that has developed in the country; this is not just solar but clean cook stoves, biogas and waste disposal. Biogas in particular would be a tactically shrewd place for which Olympic to invest in offsetting, as the development of that market would pave the way for its commercial viability in the future, which would ultimately financially and environmentally benefit the organisation.

Clean Cookstoves

The organisation employs approximately 3000 non-executive workers over its two sites. There is a large opportunity for it to offset some of its emissions by investing into clean cook stoves for a proportion of these workers. If the current set-up for cooking is a traditional stove which burns material to produce a flame which to cook over, then the emissions reductions and health benefits are significant. There are a variety of readily available cookstove types in Bangladesh the decision of which to use is defined by the target destination. If 12.5% of the approximate 3000 staff were selected to receive an improved cookstove this cook be implemented over a 5 year period.

The below table outlines the effect that the installation of the improved cookstoves would have on emissions:

Year	Number of Improved Cookstoves Installed	Yearly Emissions Saved (KGCO2e)
1	75	225,000

2	150	450,000
3	225	675,000
4	300	900,000
5	375	1,125,000

Factory and Energy Efficiency

The very nature of the Olympic factory is based around efficiency. Producing the various products at the lowest cost is the very nature of the core business. Efficiency in many cases goes hand in hand with environmentalism as for example the less electricity used reduces the emissions produced but also reduces the overheads in the form of electricity bills. So our investigation into the organisation found that in nearly all cases there could only be incremental improvements implemented.

In a previously commissioned report, it states that the Olympic factories are running at 95% efficiency. The factory itself is almost fully lit by energy efficient lighting. The air is kept to the same temperature as the outside air, as otherwise the cooking process can generate complications. There are no heavy using air conditioning units, just extractor fans. The machinery used in the processes internally is by design energy efficient, or was designed for a specific job so irreplaceable.

One area identified where some further efficiency could be achieved is with the use of heat exchangers or heat recovery technologies to utilise the 'waste energy' produced by the organisations processes. The most commonly used place for this is on the boiler and generator flues, although heat exchanges can be fitted to many suitable un-insulated heat emitting surfaces.

When we undertook the factory surveys, on all occasions the existing solar arrays were found to be in a state where significant amounts of large dust particles were present on the panels. In the dry winter months in Bangladesh airborne dust is a familiar factor. For a solar cell to operate at its peak capacity there is a requirement for there to be nothing that can impede the solar energy interacting with the panels, and a film of dust does exactly this.

If a panel is kept in a dirty state there can be a 30% efficiency loss for the array which is defined in the below table.

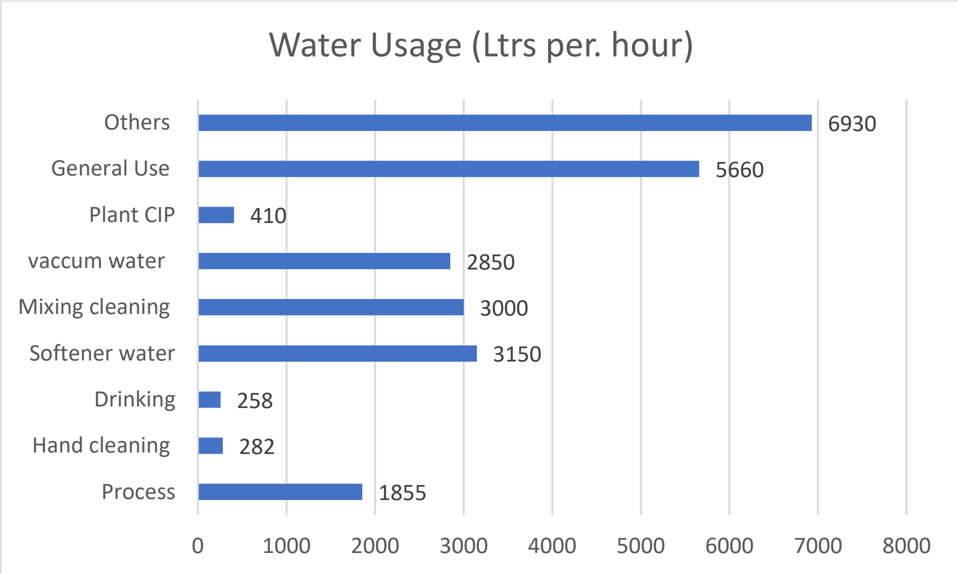
Array Type	Yearly Production (KWH)	Emissions Reduction Yearly (KGC02)	Emissions Reduction Lifetime (KGC02)	Energy Value Yearly (BDT)	Energy Value Lifetime (BDT)
Maintained	6,005	3,843	76,864	45,458	909,157
Unmaintained	4,204	2,690	53,805	31,820	636,410

Water

Groundwater is an important resource for livelihoods and the food security of billions of people, and especially in Asia. Increased groundwater accessibility in Bangladesh has led to deterioration in ground water quality and quantity. It is important for industries and those associated with agriculture to either find ways to curb the vast consumption or recharge groundwater.

Shown in the annex is a full chart showing the water usage in both the factory complexes. The amount of water used is significant. The water is drawn from the ground and processed for use in different areas of the factory. The actual effect on the environment is unknown, as an independent study of the local groundwater would be required to ascertain the effect Olympic is having. However it would be feasible to reduce the amount of water used by the organisation.

The amounts currently used are shown on the below table:



At present it is not possible to analyse the usage further as a system of metering or usage monitoring is currently not in place. The above data was collected by calculations generated by factory experts. The implementation of a regime of monitoring, and analysis will provide a critical insight into the areas which a reduction in water usage would be possible. This would also provide areas where savings can be made, there is strong evidence to show that this step would provide an insight into areas where the use of water could be reduced. A figure of 10% has been generated from secondary research on similar projects. The amount of energy saved would be significant and would certainly help reduce the organisations emissions, this is due to the pumping mechanism using the energy produced by the onsite generator to bring water onto the factory sites.

Waste

According to data gathered, the output of waste compared to the input of raw materials at the factory is very small. The reuse of any suitable materials into the previously outline biogas idea is a positive emissions reducing concept, but depends on identifying suitable material. The scope of this study did not include the full analysis of the organisations waste, and recycling. This is the required next step, and although the recycling of materials in Bangladesh is at present limited to specific types of plastic, glass and precious minerals there will be future development in this area. Any reduction in waste being sent to landfill can be defined as emissions reducing as 1KG of waste will release 1.2KGC02e if put into landfill mostly in the form of methane [13]. This is also defined as un-regulated release, as if processed (carbon capture) that figure would be much less.

Therefore we cannot recommend any sort of recycling, or reduction of produced waste as the data on current usage is not complete.

[13] http://www.lms.com.au/assets/Media-Resources/Fact-Sheet-on-Emissions.pdf

Scenarios

Below is a synthesis of the recommendations gathered by our team following on from the site visits, analysis of data and defined results from the production of the carbon footprint.

Reduce
• Replace 30,000KWH of electricity drawn from the national grid with energy generated by the installation of additional solar power arrays on the factory sites. - This requires the installation of 80 roof mounted solar panels in 2 arrays one on each of the factory sites. - The cost of each system would be 750,000BDT, equalling a total of 1,500,000BDT. - It is estimated that the systems would become profit making, in terms of un-purchased grid electricity in the 4^{th} quarter of year 7 after installation. - By the end of year 20 it is estimated that the array would have saved Olympic 2,615,991BDT in un-purchased electricity. - By the end of year 20 they would have reduced the organizations emissions by 363,364KGC02e, at a rate of 19,226 per year[14] - The lifespan of the system is guaranteed for 20 years; however, the actual lifespan is likely to far exceed that.
• Install a small scale biogas digester with the target to produce gas to replace the natural gas currently used in the kitchens. - This requires the installation of a 4.8m^3 digester that will produce 4.8KG of Biogas every day. - The system cost would be 52,000BDT. - The source of 'fuel' for the digester would be food waste from the kitchen and suitable waste from other sources within the organisation. - The emissions reduction would be 1,482KGCO2 per year.
• Reduce the gas usage by the gas ovens by 5% by the installation of heat exchangers and/or heat recovery mechanisms. - The existing system would not be effected in anyway other than experiencing a reduction in the amount of gas required - There would be an estimated efficiency improvement of 5% - The combined reduction of gas used would be an estimated 212,000 units per year. - This would produce savings in the region of 1,426,607BDT per year. - The estimated emissions reduction would be 397,926KGCO2e per year.

[14] Year 1 efficiency rating, estimated to reduce by no more than 1% per year subsequently.

Offset

- Replace 12.5% of Olympic staff's current cookstoves with improved clean cookstoves.
  - To be completed over the period of 5 years, for an estimated 75 per year.
  - The total cost of upgrading would be 140,000BDT[15]
  - The emissions reduction would be 225,000KGC02 for the first year, and by year 5 1,125,000KGCO2e per year.
  - The benefits of the stoves would extend to into the health of the staff member and their families.

- Invest into a suitable carbon credits scheme.
  - The focus of the investment to be on biogas development or production, or other Bangladesh produced or benefitting carbon credit frameworks.
  - The amount of credits bought can be defined by the remaining budget set aside for emission reducing activities
  - The current market rate is 730BDT per credit, or 1000KGCO2e[16]
  - As an example if there was 100,000BDT left over in the ring fenced budget, that would afford 136 credits, or 136,000KGC02 offset.

Optimize

- Establish a regular solar panel maintenance program.
  - Ensure that the existing two arrays on the factory sites are running at their expected peak capacity.
  - The main factor identified during site visits was cell cleanliness
  - The maintenance regime should be daily during the dry season twice weekly during the wet season
  - The regime will enable the staff to not only fully utilise the full potential of existing arrays, but also future expansions where the negative effect will be compounded.
  - The current generation loss Is estimated to be at an estimated 30%
  - The amount of loss generation is estimated at 1,801KWH or 1,153KGC02e per year.
  - The yearly loss in generation has a value of 13,638BDT

- Reduce Water usage by 10%
  - This will follow the implementation of an accurate, planned record keeping regime.
  - Ensure the record keeping regime takes into account all aspects where ground water is used.
  - Over the space of 1 quarter establish areas where water savings can be made
  - At the end of this time undertake an analysis and define the areas where savings can be made, which do not affect the efficiency of the operation. If the data is unclear extend the initial data collection to two quarters.

[15] Based upon the use of the Shakti Chula type stove
[16] http://www.goldstandard.org/blog-item/carbon-pricing-what-carbon-credit-worth

- Implement the water reduction strategy and ensure that it is followed through staff training.
- The estimated effect on the water table would be a reduction in pumped water by 2000 litres.
- The energy cost of this would require 50,000KWH less of electricity per year, at a saving cost of 378,500BDT.
- The emissions reduction would be an estimated 34,000KGC02e per year.

- Establish a regime of regular, planned, detailed record keeping to allow the further development of emission control.

- Using the produced training manual as a starting point ensure that a systematic regime is setup to monitor the following areas:
  - Water, detailed monitoring of all water usage related to the water pumped from groundwater.
  - Waste, detailed weight defined breakdown of all waste produced.
  - Inputs, further detail the weight of monthly inputs into the factory, and then follow with an origin analysis.
  - Electricity, ensure that existing solar array and potential extension is connected to a source where it will be fully utilised, and that the panels are producing what they are expected to.
  - Material inputs, defining what is recycled.

Summary of Recommendations

Over the course of gathering and analysing the data and discussions with the staff on the two Olympic sites, we have obtained a clear insight into the workings of the organisation. We have found the current efficiency to be impressive, which being on the one hand environmentally pleasing made the task of defining areas of significant improvement all the more complex. The key to the emissions at the factory is energy, its generation and use. The existing efficiency means that within the processes at least, the development of processes to reduce energy inputs are limited, however the source of energy used is a factor that needs to be further analysed and scrutinized.

For the organisation a lot depends on the growth of renewable, and low emission technologies in Bangladesh. Currently there are areas where the country is on par with much of the world, and areas which are falling far behind. It was not just the emissions reduction that we were concerned with in our recommendations, financial implications, availability of technology, and regional development all factored. Throughout we have highlighted the need for proper mechanisms for monitoring usage, in regards to all inputs. This will not only highlight further areas that can reduce emissions, but also is integral for achieving ISO 14001 or similar certifications. We believe it is the key to continued and improved environmental impact mechanism.

Our team is made up of people who have worked on similar projects globally, and one thing that Olympic should be proud of is the fact they are pursuing such a commendable goal, notably in a country where it is far from the norm. The development of a regime of emissions monitoring and reduction puts Olympic in the top 1% nationwide. It is also an area that will doubtless become more prominent over the coming years, and Olympics focus now puts them in an enviable position.

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