# Bangladesh Garments Accessories and Packaging Manufacturers & Exporters Association (BGAPMEA)

## Final Report

## on

## "Study for R&D to prepare position paper on quality control, productivity level, use of renewable energy and energy efficiency"

**under Bangladesh INSPIRED Project Component 2b**

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## Garment Accessories & Packaging (INSPIRED Programme)

# POSITION PAPER ON ENERGY REQUIREMENT SOURCES OF ENERGY, QUALITY CONTROL AND ENERGY EFFICIENCY FOR ATTAINING OPTIMUM LEVEL OF PRODUCTIVITY IN THE GARMENT ASSESSORIES AND PACKAGING SECTOR IN BANGLADESH

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**Abstract:**

A study regarding quality control, productivity level, use of renewable energy and energy efficiency was carried out to determine the impact on any manufacturing unit in the sector. In the present day context it is imperative to have an in-depth overview on the current productivity level, how it can be sustainably increased, which factors are inhabiting the growth pattern, economic use and re-use of renewal energy saving cost of production and be energy efficient in the production process.

**Table of contents:**

# 1. Introduction

## 1.1 Situation in the Accessories Industry

Even for a local outfitter, making a dress is not just about taking measurements or cutting and stitching fabric. There are a lot of nitty-gritty elements that are needed to deliver a finished garment. Large-scale manufacturers spend 50 percent on fabric and 18 percent on accessories to make a finished garment. In the readymade garments sector, the items other than fabrics are called 'accessories'.

Accessories are as important as the fabric itself. The garment accessories trade, therefore, has flourished worldwide along with the RMG sector. In Bangladesh, the garments sector grew rapidly over the last several years for a lower cost of production, but growth of the accessories industry crystallized later. In the beginning, Bangladesh used to import almost all kinds of garment accessories. But as local companies thrived, dependency on imported accessories gradually subsided.

The country initially imported accessories from countries like China including Hong Kong, Singapore, Japan and India, spending hare a large portion of the profits. But now, the country is almost self-sufficient in garment accessory manufacturing, as the ancillary industries blossomed and flourished here, driven by high demand. Zippers, buttons, labels, hooks, hangers, elastic bands, thread, backboards, butterfly pins, clips, collar stays, collarbones and cartons are the major garment accessories produced in Bangladesh[1].

## 1.2 Challenges

The garment industry is the backbone of the economy of Bangladesh. About three million people are involved in garment and textile industries. In terms of working environment, Bangladeshi garment industries are facing great challenges at present. Fire accidents are common in garment factories. Recent building collapses pose a serious threat to its future. Besides these, increasing production costs due to increasing price of energy and materials, demand of increasing labor costs and unfavorable trade policies plays important role to push this large industries into a great challenge in the future. At this point it is necessary for SMEs to develop significant initiatives towards a better environment in general and sustainability in production in particular.

## 1.3 Energy supply scenario

Bangladesh is considered as one of the most energy-scare nations, with one of the lowest per capita electricity consumption rates in the world. More than a third of Bangladesh's 166 million people still have no access to electricity, while the country often is able to produce only some of its 11,500-megawatt generation capacity[2]. Commercial energy consumption is mostly natural gas (around 66%), followed by oil, hydropower and coal. As of 2011, 79 natural gas wells were present in the 23 operational gas fields producing over 2,000 million of cubic feet of gas per day (MMCFD). It is well short of over 2,500 MMCFD which are demanded, a number which is growing by around 7% each year. To overcome the increasing energy demand it is necessary to introduce more energy efficient technologies and to switch over to renewable energy sources. At the moment Bangladesh has 15 MW solar energy capacity through rural households and 1.9 MW wind power in Kutubdia and Feni[3].

### 1.4 Production

Bangladesh enjoys a good business of the textile sector with 1,232 small and big scale garment accessories manufacturing units[4]. The production of these units comprises buttons, zippers, and tags to final packaging such as carton.

The size of these units varies from small to medium and cottage-based independent packaging and accessories which are scattered all over the Bangladesh. Garment industry uses numerous accessories which are necessary for a complete apparel being manufactured. The 36 most commonly used accessories are described in the table 1.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Belts | 10 | Elastic tape (Woven) | 19 | Plastic Bags | 28 | Thread (Polyester) |
| 2 | Badges | 11 | Elastic tape (Knitting) | 20 | Plastic Bobbin | 29 | Thread (Rayon |
| 3 | Binding Tapes | 12 | Elastic tape (Jacquard) | 21 | Ribbons | 30 | Embroidery) |
| 4 | Buttons | 13 | Hook and Loop | 22 | Slider (Zipper) | 31 | Thread (Nylon) |
| 5 | Buttons (Plastics) | 14 | Laces | 23 | Sisal Rope | 32 | Thread (Elastic) |
| 6 | Buttons (Metal) | 15 | Label (Woven) | 24 | Sewing Machine | 33 | Yarn (Metallic) |
| 7 | Cartons | 16 | Label (Metal) | 25 | Needles | 34 | Yarn (Acrylic Knitting) |
| 8 | Collar material | 17 | Label (Leather) | 26 | Thread | 35 | Zipper |
| 9 | Elastics | 18 | Paper Ribbon | 27 | Thread (Cotton) | 36 | Carton |

***Table 1:*** ***Common Garment Accessories***

## 2. Industrial assessment

### 2.1 General structure

The power consumption of garment accessories industry is based on different sources like gas, coal, diesel and renewable energies (solar, wind, and biomass). However, the ratio of using renewable energies to conventional energy sources is very low. The Government is providing subsidies on renewable energy plant setup but there is low awareness and lack of services. During a visit of ttz to Bangladesh in November 2014 several representative companies of the garment accessories industrial sector were assessed concerning their production in general and the situation regarding energy consumption in particular. Most of the assessed companies are depending on diesel and gas energy due to the unavailability or unreliable supply from the main electricity grid stations. These problems not only increase the production costs but also affect the environment by producing a huge amount of air pollution and $CO_2$ emissions. An overview of the accessories industry production along with sources and costs for energy can be seen in table 2.

| No. | Production | Source of Energy | Approx. Cost of Energy (EUR/month)* |
|---|---|---|---|
| **1** | Buttons, woven label, printed label, multicolor PP/PE/OPP polybag, butterfly, collar insert, collar bones, backboard, neck board etc. | 80% gas<br>20% diesel | not available |
| **2** | Buttons, Woven Label, printed Label Multicolor PP/PE/OPP Polybag, Butterfly, Collar Insert, Collar bones, Backboard, Neck Board etc. | 100% diesel | 9,700 |
| **3** | Zipper Slider, thread conning, Hook | 70% grid station | 20,750 |

| | | | |
|---|---|---|---|
| | & Loop, sticker, Labels, Hang Tag | 30% Diesel | |
| **4** | Sewing thread , poly, offset printing, narrow fabric, heat transfer printing, screen printing, roto gravure printing, sublimation printing, thermal print, woven label, care label, carton, leather badge, stone & metal motive, gum tape, rubber patch, hanger, collar stand, stray & butterfly. | 90% gas<br>10% grid station | 7,250<br>3,200 |
| **5** | All kind of narrow fabrics (various kinds of Elastic, non-elastic, tape, belt, ribbon, label etc.) | 60% grid station<br>40% diesel | 5,500 |
| **6** | Carton, poly bag, sewing thread, back board, neck board, collar insert, butterfly, twill tape, tissue paper, gum tape etc. | 90% grid station<br>10% diesel | 2,575<br>270 |
| **7** | Carton, polybag, hanger, backboard, neck board, collar insert, butterfly, elastic, hang tag, sewing thread. | 70% grid station<br>30% diesel | 2,100<br>400 |
| **8** | Metal zipper, plastic zipper, nylon zipper, plastic button (16 categories), dying. | not available | not available |
| **9** | All kind of zippers | 60% grid station<br>25% gas<br>15% diesel | 4,800<br>1,200<br>800 |
| **10** | Carton, poly, gum tape, elastic, Plastic. | 100% gas | 2,000 |
| **11** | Cartons, hang tag, printing item, narrow fabric, buttons. | 75% gas<br>25% diesel | 7,000<br>1,000 |
| **12** | Poly bag, BOPP bag, sewing thread, elastic gum tape | 80% grid station<br>10% gas<br>10% diesel | 3,100<br>1,550<br>1,550 |
| **13** | Price tag, hang tag, all kinds of labels ,photo inlay, all kinds of stickers, collar insert, garments print, printed fabric labels, screen print, embroidery, twill tape, belt, elastic lace, draw string, draw cord , embroidery etc. | 60% grid station<br>40% diesel | 2,150<br>3,100 |
| **14** | Auto carton, manual carton, poly, offset printing, ball press, gum tape, backboard, zip lock, poly bag, plastic clip, collar insert. | 50% gas<br>35% REB[1]<br>15% diesel | 5,200<br>5,700<br>5,200 |

***Table 2: <u>Garment accessories industries production and sources and costs of energy</u>***

## 2.2 Energy sources

Mainly, fossil fuels are consumed to generate energy, mainly electricity. The combustion of fossil fuels such as gas, coal or oil, results in the release of carbon dioxide into the atmosphere posing a serious threat on the world's climate. Carbon dioxide is re-absorbed by plants and trees and converted into biomass as a natural carbon recycle. However, the balance of emission and reabsorption of the carbon dioxide is disturbed by consuming fossil fuels that can be understood as carbon removed from the cycle and stored underground million years ago. The consequence is a global warming leading to climate change due to bringing back this carbon into the atmosphere.

Reduction in the use of fossil fuels due to more efficient technologies as well as by replacement by renewable energy sources not only helps in the preservation of atmosphere but it can also help to reduce the cost of production. The following strategies to reduce carbon dioxide emission and reduction in production cost in the garment accessories industries can be implemented:

- Use of highly efficient electricity generators
- Use of highly efficient electrical appliances
- Ensure proper use of lights and electronics (turning off when not in use)
- Using fuels with lower carbon dioxide emission (e.g. natural gas instead of coal)
- Generation of energy from renewable sources
- Installation of carbon dioxide capture and sequestration to reduce the $CO_2$ emissions from new and existing gas-fired power plants, industrial processes and other stationary sources of $CO_2$.

Moreover, to enhance the export quality, it is necessary to adopt such processes which totally comply with the international market requirements. Use of international standards and certification like ISO, OEKO-TEX® (which limits the use of harmful substances/chemicals in the manufacturing process of apparel) cannot be overlooked.

## 2.3 Renewable energies

### 2.3.1 Solar energy

Solar panels on the roof or on the ground allow sustainable production of electricity from solar irradiation. On the border of Earth’s atmosphere the solar irradiation hits with an energy density of 1,367 kilowatts per square meter. Most of its energy is lost in the atmosphere on the way to the surface. It is reflected by suspended particles such as dust or ice crystals and converted into heat. Only ten percent of the irradiation reaching the ground, but could meet the energy needs of the people. This energy is an emission-free and free-of cost source to generate electricity and heat.

Solar irradiation is an inexhaustible source of energy. This is probably the biggest plus when considering advantages and disadvantages of solar energy. The conversion of solar irradiatio into electricity is achieved through photovoltaics (PV). Photovoltaic panels convert solar energy into direct current electricity using semiconducting materials. Photovoltaic systems employ solar panels composed of a number of solar cells to supply usable solar power. Although the investment in a photovoltaic system is not negligible, but is subsidized by the government based on the Renewable Energy Sources Act.

A photovoltaic system is an important contribution to climate and environmental protection. According to the information, 3.6 million tons carbon dioxide emission lowered in 2009 alone, because in the energy production process it creates neither dust nor greenhouse gases. It has numerous advantages like;

- The local power generation will provide you with more independence in energy supply.
- The PV industry creates many jobs in the region.
- Renewable energies ensure long-term low energy prices.

An important point from the disadvantages and advantages of solar energy is definitely the climate. Bangladesh has very good sun radiation characteristics. The average bright sunshine duration in Bangladesh in the dry season is about 7.6 hours a day, whereas in the monsoon season it is about 4.7 hours[5].

### 2.3.2 Potential of solar energy implementation in Bangladesh (environmental analysis)

Bangladesh is located between 20 ° 30' and 26° 45' Northern latitude and has a total area of 1.49E+ 11 m². An average of 5 kWh/m² solar radiation reached this land during more than 300 days per year. The maximum amount of irradiation is available during March and April whereas the minimum occurs in December and January. A 2012 study found the daily sunlight hours in Bangladesh to range from 7 to 10 hours; they further reduced this by 54% (to 4.6 hours) to account for rainfall, cloud, and fog. So this abundant solar energy has a large potential to be used in various sectors in Bangladesh reducing the traditional fossil fuel based power consumption and ensuring a green environment for the future generation[6].

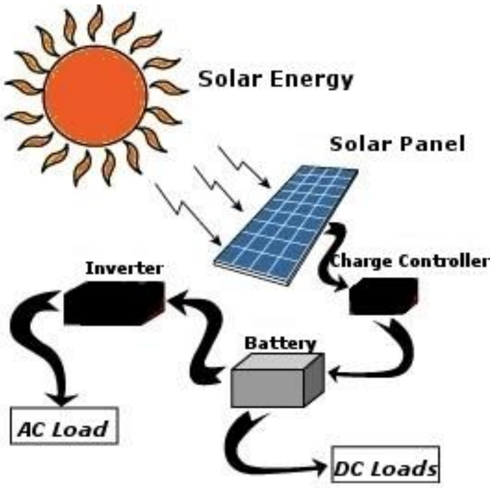


*Figure 1: Solar energy conversion into electricity*

Between 2007 and 2010 the frame of the EC funded project "Promotion of Renewable Energy in KHULNA Division", in which ttz Bremerhaven was involved, solar energy was introduced as an alternative, innovative and practice-oriented form of energy supply for SME's and private households in KHULNA division, Bangladesh. Small manufacturing enterprises, urban handcrafts and households are serious concerned by permanent shortages of the electrical power supply net. During the power cuts the hard or impossible to produce or sell their goods. At the moment the only possibility to overcome the power cuts is the operation of small fuel based power generators, come along with considerable exhaust and noise emissions and the problem of increasing fuel costs.


*Figure 2: Solar energy production & training center, Khulna*

This project has promoted the use of regenerative energy (RE) for the bridge over of the energy shortages. The usage of photovoltaic energy with a suitable storage technology can ensure a sufficient energy supply in case of electrical blackouts. Therefore technological know-how about photovoltaic was in Khulna Division by forming a cooperation network between local government, enterprises, industry bodies, academies, financing institutions and European partners. The main tool for the implementation of solar energy was a practice and product-orientated training program for the qualification of local solar trainers together with the representatives of at least 100 local SME's. Therefore a demonstration plant and a combined training workshop and information center were constructed locally in Khulna City with in this project. The proposed solar center and the demonstrations plant (planned is a 20 KWp photovoltaic system, divided into 3 different units) became a permanent setup which is still used for multiple purposes:

***Figure 3:** __Solar panels in the solare energy training and production center in Khulna__*

- demonstration of energy production from solar irradiation,
- teaching and training of different target groups,
- propagation of RE-related information beyond the end of the project.

To summarize, photovoltaics has been successfully introduced to the country and skilled operators as well as suppliers are locally available.

For a general overview and to further elucidate the solar energy potential for the garment accessories industry in Bangladesh, the solar energy production and consumption has been calculated. The calculations were done according to an average price rates of solar panels, inverters and batteries for the Bangladesh market. However service and maintenance charges are not included due to the differences of service providers. One can determine an average cost for installing the solar panels for the life span of 25 years to acquire electricity but it enormously depends on the market price rates and quality of the products i.e. life time. The calculations are attached as Excel file to this document and the values can be seen/changed in the Excel file according to the industry requirement. The results from an average use of 500 kWh per unit can be seen in the table 3.

| No | Source of energy | Power (kWh) | Total MWh (25 years) | Cost kWh (BDT) | Cost life-cycle of 25 years (BDT) |
|---|---|---|---|---|---|
| **1** | Grid station | 500 | 3,900 | 9 | 35,311,462 |
| **2** | Photovoltaics | 500 | 3,900 | 18 | 71,344,969 |
| **3** | Gas generator | 500 | 3,900 | 31 | 121,428,450 |
| **4** | Diesel generator | 500 | 3,900 | 35 | 135,059,345 |

***Table 3:** __Cost and consumption of different energy sources__*

The prices of energy are representing the current market index. The prices can vary according to the markets and manufacturer.

It can be seen that there is a significant reduction in the cost of electricity from PV compared to generators operated with fossil fuels. The energy supply from the local grid is proved to be cheapest option but due to load-shedding it is not a fully reliable source to depend on. Solar energy locally produced is very reliable and furthermore more economic than fossil fuel driven generators. Bangladesh has good geographical location with the daily 10 hours of sun.

Energy from the generators is also reliable but it is quite expensive as it can be seen in the table 3. The cost of producing the same amount of electricity is almost double compared to solar energy. The costs for the society resulting from emissions such as $CO_2$, $NO_x$ and particulate matter are not even considered. Fossil fuels are limited and the unsteady situation of oil and gas prices also influences the costs of producing electricity and directly affects the profit of the industries. As Bangladesh is going to run out of own gas in the next 25 years so the idea of relying on gas generators is also not very sustainable, unless biogas in sufficient quantities can be produced to supplement natural gas. However, the operating cost of the generators can be decreased by using modern generators with the heat recovery option which not only reduce the negative effects on the environment but also increase efficiency and less fuel consumption.

Energy from the biomass is not included in the calculations because it is not a feasible option for producing electricity for more than 1,000 industrial units in Bangladesh at the moment since momentarily no large industrial scale biogas plants are in operation in the country. Furthermore, biomass production and logistics are also challenges in this context and will be discussed in the following section in detail.

So depending on the calculations and the situation of the local supply of electricity from solar energy seems to be a very promising strategy that can be implemented in short time.

### 2.3.3 Biomass

A. Biomass from agricultural residues

Bangladesh is an agriculture-based country and the available biomass is mainly of agricultural residues like rice husk & rice straw from rice plants, bagasse from sugarcane, jute stick, residues from wheat, potato, oilseeds, spices etc. In addition to the agricultural waste the other sources are dry materials such as dry wood, dried leaf, charcoal, coconut shells and food waste from households. Over last 30 years, there has been an increasing trend of biomass fuel supply in Bangladesh. The total supply of biomass fuel was 236.08 PJ in 1980 and has increased over next 20 years to 356.66 PJ (1.73% growth). Traditional fuel supply usually comes from main three sources viz. crop residues, animal dung and trees. The percentages of different traditional energy were as follows: cow-dung 20.4%, jute stick 7.5%, rice straw 11.6%, rice husk 23.3%, bagasse 3.2%, fire wood 10.4%, twigs and leaves 12.5%

and other wastes 11.1%. Rice husk contributes biggest share of biomass energy and it was 83.04 PJ in 2003 - 2004. Energy production from rice husk is steadily increasing[9].

B. Biomass produced in plantations

Under the current circumstances with the scarcity of energy resources in Bangladesh, the need for biomass to fulfil everyday energy needs is regarded as substantial, and the potential establishment of plantations to produce biomass for technical purposes is considered beneficiary. Such plantations of fast growing crops are called Short Rotation Plantations (SRP). SRP ideally imply plantations cultivated with annual or perennial fast growing high biomass producing species that have coppice ability (re-grow after harvest) and which have high value, not only because of the obvious environmental benefits, but also to the farmer via the selling of the end products, e.g. wood biomass or others. The SRPs act as bio-filter for wastewater and the species selected (trees, shrubs, herbs etc.) produce biomass which will be enhanced due to the fertilization effect of the wastewater.

In 2004, ttz Bremerhaven coordinated a project (INAWAB – Integrated approach for sustainable wastewater management and biomass production in Bangladesh) under Asia Pro Eco Programme of EU with four other partners. The aim of the project was to propose a system to reuse the sewerage wastewater and propose the practice of Short-Rotation-Plantations (SRP) irrigated with wastewater, the same approaches are already used in developed western countries. The discharge of untreated wastewater into natural water bodies and the ongoing deforestation cause immense problems for Bangladesh's environment, population and socio-economy. The nutrients and pollutants existent in wastewater (N, P, BOD, COD, heavy metals etc.) pose serious threats on the quality of natural water resources and have significant impact on human health. To achieve the aims of sustainable development and poverty alleviation, it is necessary to develop and implement approaches that contribute to manage the remaining natural resources in a sustainable manner. For a South-Asian developing country like Bangladesh, such approaches need to be highly adapted to the specific local conditions, must be low-cost in establishment and operation and easy to adapt by the local beneficiaries to be successful. SRP has the potential to contribute in solving environmental and social problems arising from untreated wastewater and deforestation in Bangladesh.
An overview regarding the most relevant positive and negative impacts, which must be considered for the adaptation of the SRP concept, are named below.
Positive impacts:

- Increase of living standard and poverty alleviation
- Creation of new sources of income for farmers and other beneficiaries,
- Additional non-farm income (lower SRP maintenance effort enables farmers to go for alternative jobs),
- Improvement of safe drinking water supply from current receiving water bodies (due to quality improvement),
- Improved sanitation and lower risks for waterborne diseases,
- Better environment,
- Stabilization of local supply with fuel wood and market prices,
- Strengthening gender issues due to women involvement in SRP value chain (e.g. Processing of SRP biomass for increased value),

- Improved conditions for industries which rely on clean environment (e.g. fishery, Tourism, waterworks, etc.),
- Low investment costs for local de-centralized wastewater treatment solutions,
- Implementation of existing legislation, policies and international conventions,
- Raised awareness among farmers and local population about safe wastewater reuse.

Negative impacts and risks:

- Competition for wastewater as a cheap source for irrigation and fertilization (among SRP operators and with other land uses),
- Reduced level of living standard for the people living close to the SRP due to deterioration of local environmental and hygienic quality,
- Increasing dependence of farmers from other food sources due to lower subsistence production.

Under the current situation it is difficult to assess the socio-economic risks arising from SRP implementation especially because of the novelty of the Short-Rotation-Plantation approach with combined wastewater treatment in Bangladesh and even whole Asia. No practical experiences exist for such an approach in the country and further research activities need to be carried out to ensure that negative impacts can be avoided adequately.

C. Biomass from industrial residues and wastes

Chemical pulping of wood fibers results in a by-product which is used as an energy source for the pulping process. In integrated carton board mills, where pulp and carton board are both made at the same site, the wood by-products provide energy in the form of electricity and steam for the manufacturing process. This energy source is therefore renewable and sustainable. The European paper and board industry is the largest producer and consumer of biomass based energy – 20% of the EU total – thus avoiding the use of non-renewable resources such as oil, coal and gas. Of the European pulp, paper and board industry's total primary energy consumption in 2013, 56% was derived from biomass[8].

Carton board mills are contributing strongly to these improvements. Investments are being made to completely eliminate all fossil carbon emissions by switching the energy supply from fossil fuels such as natural gas to biogas. All production will then be biofuel driven and mills will be self-sufficient in electricity and thermal energy in the form of steam. Over 95% of European pulp, paper and board mills have installed combined heat and power (CHP) plants, mainly based on biomass and natural gas. Combining the production of electricity and heat provides savings in fuel consumption in the order of 30 -35% compared to separate production[8]. Burning wood to generate energy for a national grid is an easy solution to meet demand for renewable energy – but it is not efficient or sustainable as it would lead to pressure on forests and higher costs. Using wood as a raw material for the paper and industry is more resource efficient as it creates four times more value and retains six times more jobs than the energy sector would, by burning wood.

### 2.3.4 Biogas

One interesting option for energetic valorization is the anaerobic digestion of the liquid and/or solid organic residues. The high concentration of organic matter in the residues can be converted biologically in a methane rich biogas and a high quality soil conditioner and fertilizer (digestate). In “agricultural” biogas plants mostly animal excreta (slurry, solid manure), residues from harvests and energy crops are used as substrate. Also food and market waste or residues from abattoirs and food industry (dairies, food processing) can be suitable substrates for biogas generation at large scale. Main product is biogas consisting of about 50 – 65 % methane (the main component of natural gas) and 35 – 50 % carbon dioxide. In most biogas plants, the resulting gas on site in a plant is used to generate electricity and heat (combined heat and power production CHP). Alternatively, the biogas can be upgraded to bio-methane offering all utilization options of natural gas.

Biogas technology has been successfully implemented in Bangladesh at small scale in rural areas, e.g by organiszations like GIZ and others. At large technical/industrial scale (i.e. installed electrical power capacity of 500 kW up to some 10 MW) to the knwoledge of the authors no such system in in operation. Nevertheless, the technology is mature, robust, economically feasible and well approved under practical conditions (e.g. Germany, about 10,000 biogas plants in operation with a total of approx. 49 millions of MWh/a electricity production in 2014).

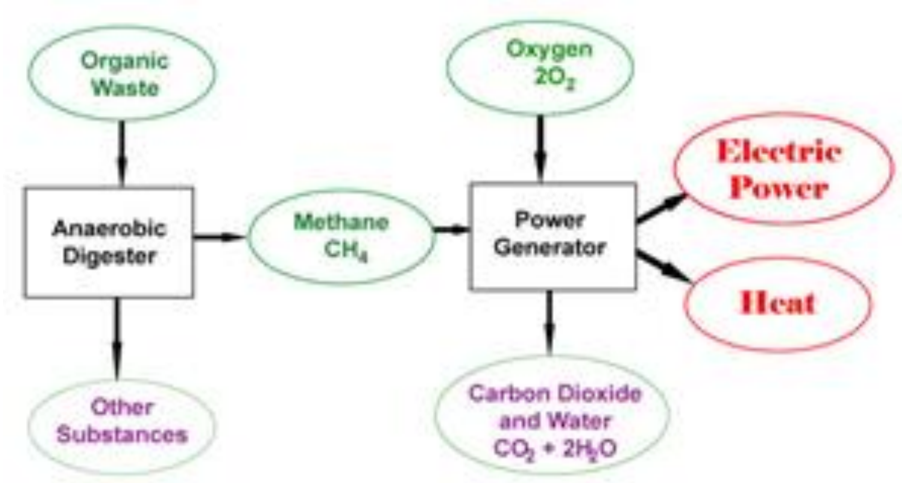


***Figure 4: <u>Electricity generation from biogas</u>***

### 2.3.5 Gasification

Another interesting option for energy generation from biomass and agricultural residues is gasification. In gasification processes organic matter is thermo-chemically converted into gaseous compounds such as hydrogen, carbon monoxide or methane. High process temperatures and operating pressures are typical for such processes. The syngas can be converted into electricity and heat by means of CHP processes using e.g. turbines. This technology

## 2.4 Energy efficiency

Energy efficiency plays a vital role in any production process. The efficiency can only be increased by decreasing energy consumption. It can be achieved by implementing highly efficient machinery, low energy consuming lighting, balanced air conditioning, etc. For an optimum production, it is necessary to implement energy efficient processes. As a first step a baseline survey is a good to tool to monitor and evaluate the process. It helps to identify which processes and machines are of low efficiency and need to be replaced by more efficient systems.

### 2.4.1 Processes with improved energy efficient

Optimisation of the energy use in industrial systems leads to significant cost savings and a positive environmental impact. The areas where energy efficiency can be implemented and significant cost reductions achieved are e.g.:

- process media pipelines, especially the high temperature ones,
- heat exchangers, pressure vessels,
- boilers,
- flue ducts and industrial chimneys,
- all kind of eletrical drives,
- cooling and deep freezing,
- illumination,
- ventilation and air conditioning ,
- walls and roofs of buildings.

A simple way of increasing the efficiency and performance of a process is to ensure that it is properly insulated; minimizing energy consumption and maximizing the effective lifetime of the plant are highly valuable benefits of a well-insulated process. Energy consumption can be reduced by simply keeping thermal losses in heat transfer small. Annual maintenance is a must for a well performing machinery system and air conditioning equipment's.

Providing fresh air flow into working place is a low-cost and potentially energy-efficient way to cool the place and maintain good indoor air quality. In good weather, natural ventilation (when air moves through windows or doors) can suffice for cooling. Natural fresh air ventilation can also be supplemented by a number of low-energy mechanical ventilation devices that can help.

Lighting in the clothing industry is of great importance not only because of its quality but also quantity due to the meticulous work and verification in the various activities, mainly in non-automated sub processes. The need to guarantee the amount of light is itself a clue to the demonstration of lighting as a critical point. Typically the clothing industry relies heavily on artificial lighting of the fluorescent type. A 100 W light bulb can be replaced by a 20 W LED bulb providing the same amount of light but at the same time consuming 80 % less electricity. However, all kind of over-consumption in this area should be avoided which includes:

- excess consumption through technical issues:
- reduced area for natural lighting;
- use of outdated and low efficiency lamp technology;
- use of ferromagnetic ballasts;
- inexistent reflectors on fixtures;
- over lightened area;
- use of general instead of located lighting.

**Excess consumption through behavioral issues:**

- dirty reflectors on fixtures;
- lighting turned on unnecessarily

Additionally to illumination in the following some more technical and behavioral points are listed leading also to increased energy efficiency in the production process.

**Excess consumption due to technical weak points:**

- using motors in fixed speed;
- use of low efficiency motors;
- use of rewinded motors;
- use of direct start in motors;
- use star/triangle starter in larger engines;
- uncompensated reactive energy;
- phase imbalance due to poor distribution of single-phase equipment

**Excess consumption due to inefficient behavioral/organisational issues:**

- machines turned on without being necessary
- low load regimen;
- high downtime between loads.

On the other hand it is also important to point out the losses encountered in the electric network from the transformer down to consumer.

**These losses are mainly due to:**

- oversized transformers and/or at end of life;
- undersized wiring;
- phase imbalance;
- overloaded switchboards

### 2.4.2 Heat recovery

Heat recovery is very useful and modern technique to utilize the waste heat to produce electricity. Waste heat is created as a by-product of industrial processes and combustion of fuel (CHP). In an industrial process that involves transforming raw materials into useful products, heat is wasted as a result. If not captured and used to generate emission-free renewable-equivalent power, waste heat is released to the atmosphere through stacks, vents, flares and mechanical equipment.

Heat recovery is the collection of waste heat and using it to fill a desired purpose elsewhere. With the waste heat temperature (< 100°-300°C) emission-free electricity can be generated, which allows the industrial user to put their wasted energy back into the process that created it. Recovery engine(s) on waste heat streams from industrial processes will have payback times as short as one year. Research indicates that recovery of the energy waste from industrial facilities could fulfill up to 20 percent of total domestic electricity demand and simultaneously effect a 20 percent reduction in greenhouse gas emissions.

One application being targeted for initial product deployment is waste heat recovery from the exhaust of diesel generators. The exhaust gas from these generators are typically 450°C to 600°C, which supports 250°C to 300°C fluid delivery temperatures to the heat recovery engines. Once the engine is producing electricity using the exhaust gas from the diesel generator, there are two basic options available for how to use the electrical energy: load reduction and battery charging.

This type of process will not only help to  reduce fuel costs but also decrease the GHG emissions and plays a vital role in the improvement of the reputation of the industry.

## 2.5 Waste and wastewater management

### 2.5.1 Recycling of waste and recovery of valuable components - waste as a resource

The waste management hierarchy is a key driver for resources efficiency and waste prevention is at the top of the hierarchy. A few years ago waste management was considered more to be a burden than a promising

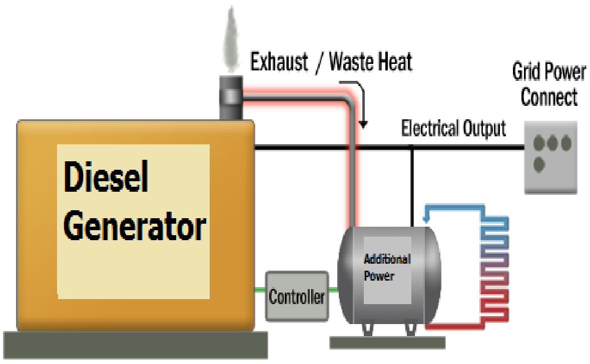


*Figure 5: Waste heat recovery to generate electricity*

ttz Bremerhaven initiated and coordinated in 2009 the ISSOWAMA project, funded by the European Commission under its FP7, aimed at raising awareness for the Integrated and Sustainable Waste Management (ISWM) approach. This approach focuses on all the *elements* in the waste management system from generation via reuse or energy generation to final disposal; on all the *aspects*, - social, institutional, legal, financial, economic environmental and technical; and on involving all the stakeholders at different levels; in order to ensure the effective implementation of a sustainable system. ISSOWAMA used the case study approach. Good practice examples were sought out and documented in all the project countries in South Asia (Bangladesh, India), the Greater Mekong Sub-region (Cambodia, Thailand, China) and South East Asia (Indonesia and Philippines). These case studies were used both to demonstrate the ISWM method, to showcase the wide variety of alternative approaches that have been adopted in the region and to draw out the lessons learned, in order  to help countries and cities select the appropriate next steps in developing their own integrated and sustainable solid waste management system. From Bangladesh Khulna University for Engineering and Technology (KUET) and Dhaka City Corporation participated. Detailed information and case study results can be found on the project website (http://www.issowama.net).

Example with relevance for the garment accessories and packaging sector - carton board recycling:

Reducing the quantity of waste generated in the production process of carton board packaging has been a central focus for the industry for many years, which has long recognized the economic and environmental benefits of waste reduction. The environmental benefits of recovering paper for example to be used as a secondary raw material are well appreciated and carton board manufacturers are working to optimize its use and thus reduce waste. Increasing efficiency of stock preparation through investment in modern technology has led to an increase in the recuperation of recovered fibers, by several thousand tons per year, and the reduction of rejects from the production process.

A second aspect is the prevention of the generation of waste through light-weighting materials and using the minimum amount of material necessary for the product to be fit for purpose. Carton board manufacturers have worked to light weight their products over many years. For example, a typical carton packaging a frozen fish pie is 20% lighter today than it was in the 1970s. (Source: INCPEN[10]). Good recyclability of used paper products such as carton, depends on good eco-design. The planning and design phases of carton solutions contribute significantly to waste prevention. Ideally, packaging design should be addressed at the same time as product design, so that the two work together.

Informed choices of auxiliary materials such as inks and coatings are also keys to good eco-design. For example, ink manufacturers are increasingly using renewable and recyclable resources such as soy, vegetable oil and starch and helping printers to recover and recycle inks and solvents. Sheet fed inks are also integrating up to 100% renewable vegetable oils, and deliver significant improvements, including the reduction of VOC emissions and energy consumption by rapid setting or reduced paper wastes, through quick start-up.

### 2.5.2 Industrial wastewater management

Industrial wastewater treatment in general is a wide field. Amounts of wastewater and composition can vary extremely requiring tailor made solutions for treatment and re-use or discharge. Depending on the goals of treatment there may be different technology options. The best choice may depend on boundary conditions but at the end total costs will be also one of the criteria for selection. To elucidate this here some examples for typical wastewater streams, treatment goals, boundary conditions and suitable technologies as well as resulting costs to be considered:

**Possible wastewater streams in a factory in the sector:**

- effluents from production processes (e.g. streams containing acids, caustic or other chemical substances (e.g. salts), solvents, hydrocarbons, fine solid particles, etc.),
- effluents from product handling processes (dyes, bleaching detergents, etc.),
- effluents from restrooms,
- effluents from kitchen and canteens,
- wastewater from cleaning,
- rainwater runoffs.

**Possible treatment goals:**

- protection of environment (surface water bodies, soil, etc.) – e.g. removal of COD, BOD, N, P, salts,
- removal of toxic or hazardous substances (e.g. halogenated organic compounds, radioactive substances), substances easily (sugars, Kjeldahl-Nitrogen containing compounds) or difficult ( cyclic or polycyclic, aromatic compounds) to degrade,
- recovery of water as resource (for the production process, for operation of steam boilers, cooling towers, etc.),
- recovery valuable substances from wastewater (raw materials for production, dyes, chemicals needed for the production process, etc.),
- disinfection (removal of pathogens),
- protection of workers and/or public health,
- potable water production.

**Possible boundary conditions:**

- space availability,
- indoor or outdoor installation,
- availability of waste heat (e.g. to run thermal processes or membrane distillation/membrane crystallization or to regenerate activated carbon adsorbers),
- availability of direct current (e.g. to run ED systems),
- availability of gas or diesel generators (makes sense in case anaerobic wastewater treatment is an option due to wastewater composition and quantities),
- availability or absence of skilled wastewater treatment operators (automated systems, systems which are remote controlled or operated on site).

**Possible wastewater treatment technologies**:

- biological processes (aerobic, anaerobic, anoxic, combinations),
- physical processes (filtration, pressure-, electrical-field- or temperature-driven membrane separation processes, thermal processes, flotation, sedimentation, extraction, adsorption on activated carbon, ultrasonic, etc.),
- chemical processes (precipitation, O3, H2O2-UV, Fenton's reagent, etc.),
- combinations (e.g. Membrane Bio Reactor – MBR).

**Costs and revenues to be considered:**

- investment cost for equipment and construction, annuity,
- costs for operation (electricity, chemicals, consumables),
- costs for spare parts and general maintenance,
- costs for discharging residues (e.g. sludge),
- labor costs,
- revenues and value of recovered resources (water, chemicals / valuable substances, biogas (anaerobic))
- .

Costs for wastewater treatment can range from a few Euro-cent/m³ up to some €/m³, depending on the individual scenario on site. In case the value of recovered substances is high enough, wastewater treatment can even generate a profit (e.g. in the case of recovery of dyes).

### 2.6 Quality Control

#### 2.6.1 Improvements in the productivity

Improvements in productivity can have a dramatic effect on growth and can often be achieved without substantial capital investment. Regardless of size or sector, there are a number of areas where productivity can be improved.

#### 2.6.2 Processes

Business processes such as customer relationship management and order management evolve over time but the tendency to do things the way they have always been done can create significant bottlenecks and inefficiencies.

Taking a step back to review your processes, with support, can reveal opportunities to rationalize the approach, increase capacity, improve processing time and cut costs. Investing in the further development or organization of individual employees and teams along the way can also generate additional benefits and provide quick-wins with minimal up-front costs.

For manufacturers, improving production processes by using systematic approaches such as Lean Manufacturing can help to reduce costs and optimize the location of equipment and deployment of labor. The choice of materials and assembly techniques can also have a significant impact on efficiency and can be reviewed to improve cost-effectiveness.

#### 2.6.3 Technology

Technology supports almost all business processes and investing wisely in new technology – whether it is web, software or equipment based – can be a key factor in keeping ahead of the competition and generating bottom-line savings. Rapidly evolving online opportunities can improve your relationships with both customers and suppliers, while investing in cutting-edge manufacturing techniques can streamline production and help to get your products to market before the competition.

#### 2.6.4 Resources

A key driver for cost savings and productivity improvements is the efficient and cost-effective management of key resources the business relies on, such as energy, materials and water.

Simple and often small changes in everyday behavior can have a significant impact on profitability by driving down the costs associated with the purchase of materials, the consumption of energy or utilities and waste collection and recycling.

By reviewing procurement practices and optimizing the throughput of resources to make individual processes more efficient, waste can be avoided at source, whilst reducing its carbon emissions and improving its environmental credentials.

## 3. Recommendations for sustainable production

For the more sustainable and resources efficient production in the garment accessories and packaging sector in Bangladesh the authors give the following recommendations:

- monitor and record each stage of the production’s energy consumption

- implementation of energy efficiency measures,
- decentralized electricity generation on site by means of renewable energies, in particular PV, to secure sustainable and affordable electricity supply at times of unstable grids in a short term
- promotion and implementation of resources efficient biomass based energy supply chains (especially biogas) in a medium and long term,
- reuse of resources, recycle and recover valuable substances,
- waste minimization and recycling can help to significantly decrease production costs and treatment operation costs as well as pollution of the environment,
- construction of effluent treatment plants (ETP) considering the specific situation on site
- adjacent small factories at the same industrial area can establish jointly operated ETPs to treat effluents and share costs.
- Introduce an industrial ecology and symbiosis approach within the same industrial zone that would certainly reduce the waste generation and will ensure the efficient resources use.

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