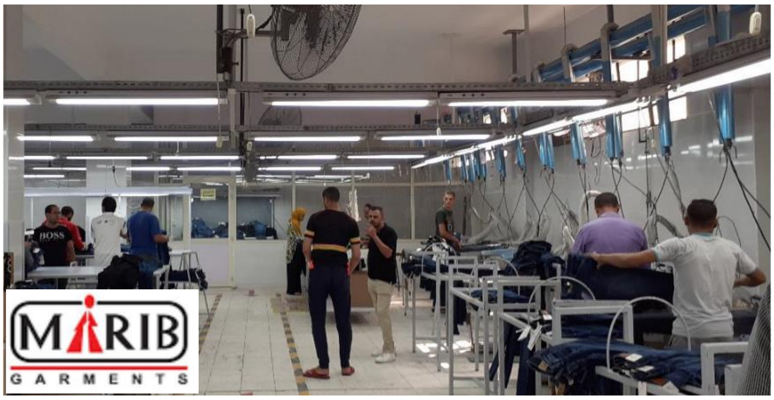
UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Solar Heating in Industrial Processes (SHIP) Project

The project "**Utilizing Solar Energy for Industrial Process Heat in Egyptian Industry**" is financed by the GEF and implemented by UNIDO in partnership with the Egypt National Cleaner Production Centre ENCPC. The objective of the project is to develop the market environment for the diffusion and local manufacturing of solar energy systems for industrial process heat. The project results will increase the knowledge and strengthen the awareness among the major stakeholders on the penetration potential of solar technologies in the food, chemical and textiles sectors in the region. The project focuses on improving the energy efficiency of the industrial process heating systems and the introduction of solar thermal technologies mainly in industrial companies that have low and medium temperature heat demand in three industrial sectors, namely the food, chemical and textiles sectors.

Marib International Garments Case Study



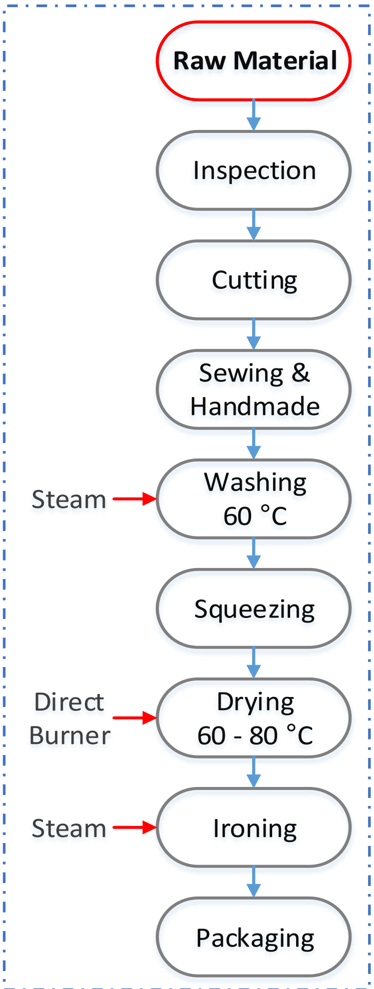
Obour City, Egypt

Textile Sector **Garments**

760 Tons/year

4,916,400 kWh/year energy consumed

Production Processes Flow Diagram



Marib International Garments company is operating since 2004to serve in the clothing industry and produces jeans trousers for international clients in Europe and the US. The total number of employees and workers in the factory is about 900 employees.

Marib factory processes flow diagram exhibits the main processes performed on the fabric raw material to produce the ready-to-wear garments. General analysis on the electrical and thermal energy consumption shows that **electrical consumption** represents **27%** while **natural gas consumption** represents **73%** from the total energy consumption.

Thermal energy system for the washing and ironing processes is supplied through **two steam boilers**, each one is 2 ton/hr capacity and supply steam at **7.5 bar**. Also, the thermal energy for the drying process is supplied through **direct burners**. Both of the boilers and burners are operating with natural gas as a source of fuel.

If the suggested optimization measures were applied, unnecessary losses will be eliminated, and the system can operate at much lower cost.

- Optimization Opportunities -

Waste Heat Utilization

Boiler Optimization

Solar Water Heating

Recover Heat from Exhaust Gases Using An Economizer

There is high potential to utilize the waste heat from chimney of the steam boiler. The temperature of the flue gases in the chimney is as high as 170 °C therefore heat can be recovered. The **proposed solution** is to **install an economizer** to **preheat the inlet feed water**. This solution will help to preheat the feed water from **29 to 45 °C**. hence, reducing boiler's **energy consumption**, **CO_2 emissions** and **operating costs**.

Capex: 2,500 USD
Energy Savings: 69,665 kWh/year
Payback: 2.1 years
CO_2 Reduction: 14 tCO_2/year

Heat and Mass Recovery From Blowdown and Relief Streams

Currently, flash steam and pressure relief streams associated with blowdown and overpressure operation, respectively are being wasted. The **proposed solution** is to **install a small flash tank** to recover heat and mass from these streams. This solution will help to recover about **2-3%** of the wasted steam hence, **reduce energy consumption, CO_2 emissions** and **costs** of feed water treatment and heating.

Capex: 1,250 USD
Energy Savings: 52,850 kWh/year
Payback: 1.4 years
CO_2 Reduction: 11 tCO_2/year

Heat Recovery From The Exhaust From Drying Process

The average air temperature from dryers exhaust ducts is **64 °C**. Therefore, The heat content in exhaust gases can be recovered. The **proposed solution** is to **install a heat exchanger** to **preheat the combustion air**. This solution will help to preheat the inlet air from **28 to 40 °C**. hence, reducing **natural gas consumption**, **CO_2 emissions** and burner's **operating costs**.

Capex: 2,625 USD
Energy Savings: 25,920 kWh/year
Payback: 5.8 years
CO_2 Reduction: 5 tCO_2/year

Integration of Solar Thermal Heating System

Solar heating technologies collect thermal energy from the sun and this heat can be used for heating purposes. Solar collectors are selected based on the range of the operating temperature range and the type of the industrial sector. Heat in the lower temperature range (<100 °C) can easily be provided with systems commercially available, such as flat plate collectors (FPC) and evacuated tube collectors (ETC). The **scenario envisioned** for the factory is to **preheat water that is required for the washing machines** which will decrease the energy consumed by the boiler. The system will be **installed on the roof** occupying **480 m^2** of area. The system is designed to **heat 40 m^3/day to 75 °C**. The **system cost** is around **USD 109,500** and the **annual savings** will be **USD 6,400**. Other parameters are shown below.

System Design Area: 480 m^2 using FPC

Energy Savings: 451,765 kWh/year

Capex: 109,500 USD

Annual Savings: USD 6,400

Payback: 17 years

CO_2 Reduction: 91 tCO_2/year

Water Flow Rate: 40 m^3/day

Design Temperature: 75 °C

Lifetime: 20 Years

Lessons Learnt

- **Boiler optimization requires low efforts but have high impact on energy consumption and CO_2 emissions reduction.**
- **Waste heat utilization is not a common measure, however highest energy saving can be achieved by this measure.**
- **Solar thermal integration combines renewable energy resources utilization and energy savings measures.**

The **total proposed solutions** summary:

- **Thermal Energy Savings:** up to **600,200 kWh/year**, representing about **12.2%** savings of the total energy consumption (where **9.2%** is due to the integration of SWH systems),
- **Financial Savings: 8,930 USD/year,**
- **Capital Cost:** **~115,880 USD**,
- **Overall Payback Period: 13 years**,
- **CO_2 Emissions Reduction: 121 tCO_2eq/year**.

For more information:

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SOLAR Heating for Industrial Process
Together Toward Efficient Production