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.

Lotus Garments Co. Case Study

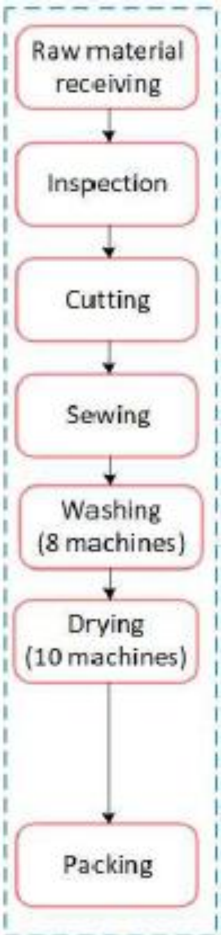
Port Said Public Investment Free Zone

Textile Sector **Garments**

4,281,467 Piece/year

27,759,070 kWh/year energy consumed

Production Processes Flow Diagram



Lotus Group is part of textile sector for manufacturing supportive consultation and production services from raw fiber to finished garments through about 8000 employees, operating since 1994.

New Jeans factories 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 **18.21%** from the total energy consumption while **natural gas consumption** represents **81.79%**.

Thermal energy system is supplied through **2 steam boilers**, one boiler with 4 Ton/hr capacity and the other boiler with 3 Ton/hr. capacity. Thus, the total capacity of the system is **7 Ton/hr.** and supply steam at **5-7 bar**. However, the **production processes needs** are between **3 - 3.75 Ton/hr.** which can be covered with one boiler to supply the system. If the suggested optimization measures were applied, unnecessary losses will be eliminated, and one boiler only can operate efficiently to supply the system at much lower cost.

- Optimization Opportunities -

Thermal Insulation

Boiler Optimization

Waste Heat Utilization

Solar Water Heating

Thermal Insulation

Insulation of pipes, tanks, fittings, and machines is a general principle that should be applied in all steam consuming processes in the factories. Insulation needs to be fixed at multiple parts of the steam system. The collective saving from proper insulation is usually enormous. Insulating steam pipes will help **to reduce energy consumption**, **CO_2 emission**, and **operation costs**. **safety will be enhanced** after **reducing** surface temperature from **170 °C to 34 °C**.

Capex: 19 **USD/meter**
Energy Savings: 152,962 **kWh/year.meter**
Payback: 1 **years**
CO_2 Reduction: 31 **tCO_2/year.meter**

Recover Heat from Exhaust Gases

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 158 °C therefore heat can be recovered. One of the **proposed solutions** under this measure is to **Preheat the inlet feed water** for the steam boiler **to 63 °C**. besides the savings showed below, **Savings** can reach **USD 70,500** over the **lifetime** of the solution.

Capex: 8,490 **USD**
Energy Savings: 275,480 **kWh/year**
Payback: 1.8 **years**
CO_2 Reduction: 56 **tCO_2/year**

Optimizing boiler blowdown flowrate

Using a fixed rate of blowdown does not take into account variation of the steam load. an automatic blowdown-control system optimizes blowdown rates by regulating the volume of water discharged from the boiler. Automatic blowdown control systems maintain water chemistry within the acceptable limits, while minimizing blowdown and reducing energy losses. This **solution** results in huge **CO_2 reduction** that are equivalent to **225 tCO_2/year.**

Capex: 7,000 **USD**
Energy Savings: 1,112,035 **kWh/year**
Payback: 0.19 **years**
CO_2 Reduction: 337 **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 (<80 °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 boiler feed water** which will decrease the energy consumed by the boiler. The system will be **installed on the roof** occupying **24m²** of area. The system is designed to **heat 22 m³/day to 95 °C**. The **system cost** is around **USD 21,929** and the **annual savings** will be **USD 8,760**. With lifetime of **20 years**, the **total savings is USD 175,200**. Other parameters are shown below.

System Design Area: 24 m² using FPC
Energy Savings: 513,428 kWh/year
Capex: 21,929 USD
Annual Savings: USD 8,759
Payback: 2.5 years
CO_2 Reduction: 104 tCO_2/year
Water Flow Rate: 22 m³/day
Design Temperature: 95 °C
Lifetime: 20 Years

Lessons Learnt

- **Thermal insulation is a quick win. It saves energy with very low upfront costs and have high impact a low payback**
- **Optimizing boiler blowdown requires low efforts but have high impact on CO_2 reduction**
- **Waste gas 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 **4,344,955 kWh/year**, representing about **19%** savings of the total thermal consumption (where **2.3%** is due to the integration of SWH systems),
- **Financial Savings:** 74,735 **USD/year,**
- **Capital Cost:** 40,410 **USD**,
- **Overall Payback Period:** 0.54 **years**,
- **CO_2 Emissions Reduction:** 878 **tCO_2eq/year**.

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SOLAR Heating for Industrial Process
Together Toward Efficient Production