

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 ENPC. 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.

Together Toward Efficient Production

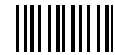
Lotus Garments Co. (old factory) Case Study



Port Said Public Investment Free Zone



Textile Sector



Garments

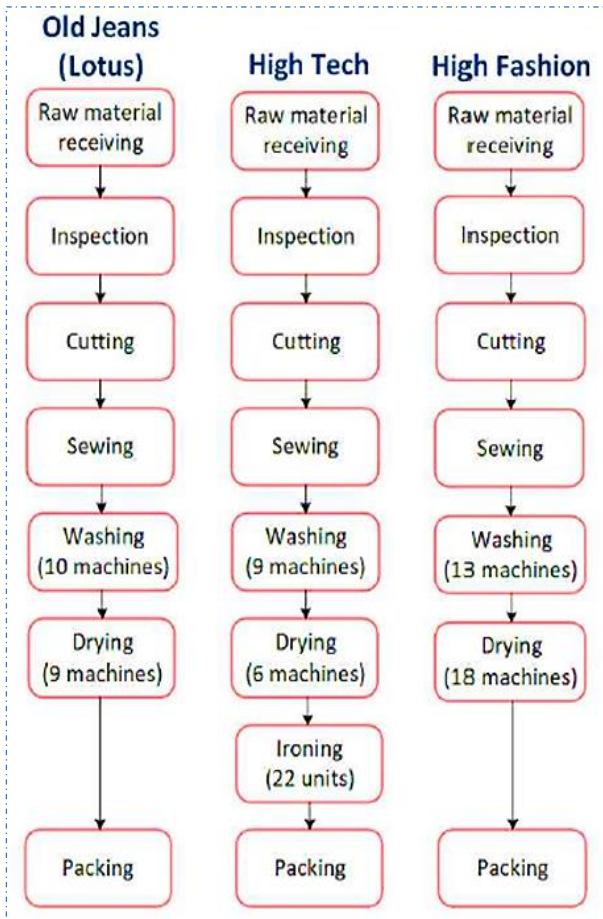


15,222,994 Piece/year



96,830,835 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.

Old Jeans factories processes flow diagram exhibits the main processes performed on the fabric raw material to produce the ready-to-wear garments. Old Jeans factory consists of three plants: Old Jeans (Lotus), High Fashion and High Tech. General analysis on the electrical and thermal energy consumption shows that **electrical consumption** represents **19%** from the total energy consumption while **natural gas consumption** represents **81%**.

Thermal energy system is supplied through **3 steam boilers**, 2 boilers with 4 Ton/hr capacity and one boiler with 6 Ton/hr. capacity. Thus, the total capacity of the system is **16 Ton/hr.** and supply steam at **5-7 bar.** However, the **production processes needs** are between **3.5-4.5 Ton/hr.** and two boilers are operating at part load 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, CO₂ emission, and operation costs. safety will be enhanced** after reducing surface temperature from **165 °C to 34 °C**.

Capex: **19 USD/meter**

Energy Savings: **5,275 kWh/year.meter**

Payback: **0.2 years**

CO₂ Reduction: **1.08 tCO₂/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. The **proposed solution** will **Preheat the inlet feed water** for the steam boiler **from 25 to 42 °C**. besides the savings showed below, **Savings** can reach **USD 40,000** over the **lifetime** of the solution.

Capex: **8,040 USD**

Energy Savings: **248,445 kWh/year**

Payback: **1.45 years**

CO₂ Reduction: **50 tCO₂/year**

Improvement in Burner Efficiency with an Oxygen Analyzer

The excess air is not automatically controlled in the boiler, thus the air to fuel ratio is not optimal and leads to an increased gas bill. It is recommended to install an online combustion gas analyzer and manual adjustment of the air damper to improve burner efficiency. This **proposed solution** requires **low capital cost** and results in huge **CO₂ emission reduction** that are equivalent to **89 ton of CO₂**.

Capex: **1,750 USD**

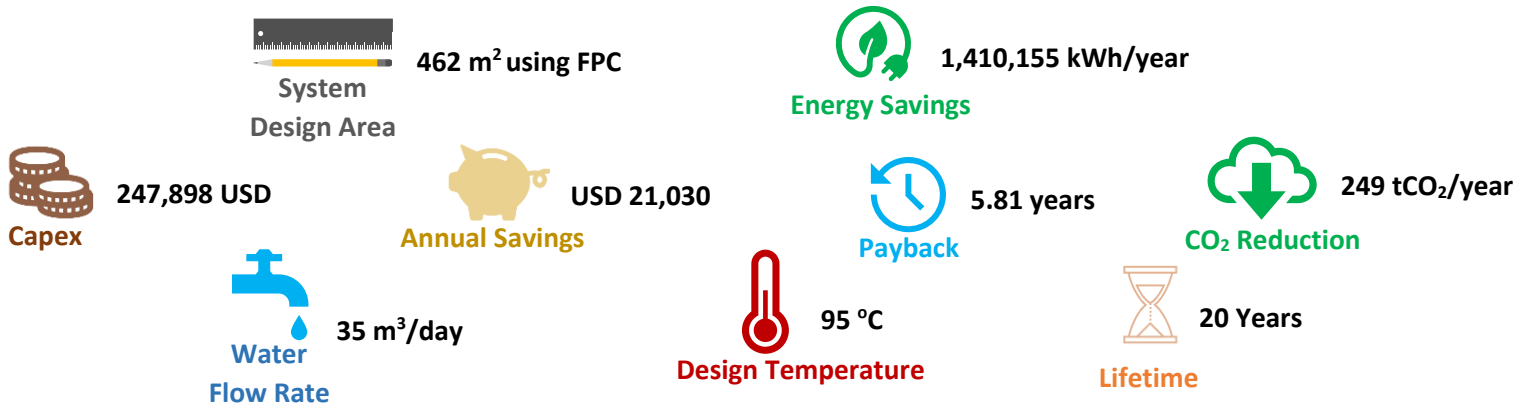
Energy Savings: **442,462 kWh/year**

Payback: **0.23 years**

CO₂ Reduction: **89 tCO₂/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 **462m²** of area. The system is designed to **heat 35 m³/day to 95 °C**. The **system cost** is around **USD 247,898** and the **annual savings** will be **USD 21,030**. With lifetime of **20 years**, the **total savings** is **USD 420,600**. Other parameters are shown below.



Lessons Learnt

- Thermal insulation is a quick win. It saves energy with very low upfront costs and have high impact a low payback
- Boiler optimization requires low efforts but have high impact on CO₂ reduction
- Waste gas utilization is not a common measure, however large 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 **6,491,980 kWh/year**, representing about **8%** savings of the total consumption (where **1.6%** is due to the integration of SWH systems),
- **Financial Savings:** **111,280 USD/year**,
- **Capital Cost:** **266,380 USD**,
- **Overall Payback Period:** **2.39 years**,
- **CO₂ Emissions Reduction:** **1,309 tCO₂eq/year**.

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