EFFICIENCY SOLUTIONS FOR INDUSTRIAL HEAT

CASE STUDY

IOI Group

Pasir Gudang, Johor, Malaysia

Sector
Oleochemical

Intervention
Steam systems optimization and solar thermal integration

EnMS and steams systems optimization implementation period
2014 to 2020

Investment $	$2,888,600[1]
Energy savings per annum	17,172,540 kWh
Annual financial savings	$539,095[2]
Annual CO_2 emissions reduction	10,989.14 tons CO_2e
Total payback time	5.5 years
Payback time	Six months

Company profile

IOI Group is one of the largest palm oil producers in the world. The Malaysian company's versatile products are used in a wide variety of industry applications and consumer goods, including detergents, surfactants, shampoos, soaps, cosmetics, pharmaceutical products and food. With manufacturing facilities in Malaysia and Germany, IOI Group's downstream products are exported to more than 85 countries worldwide.

Being a palm oil producer, IOI has faced intense international pressure to enhance its sustainability practices. In response, IOI has turned to energy system optimization and solar thermal energy as one of many efforts it hopes will improve the environmental credentials of its products, and enhance overall operational efficiency.

Energy consumption

From oil extraction, to sterilization and purification, the processing of palm oil from fruit to refined oil and other derivatives requires an array of specialised heat applications. To process just one fresh fruit bunch (FFB) into crude palm oil (CPO), the average amount of energy and steam (including hot water) required is 20 kWh and 600 kg respectively.[3] Considering the industry produced 72.27 million metric tons of palm oil just in 2019, and it requires around five FFBs to produce just one ton of CPO[4], evidently there is a lot of potential for energy system optimization.

The palm oil industry has invested significantly into technology designed to reuse by-products such as palm shell, fibre, empty fruit bunches and pome as fuel (biogas). However, while the use of biogas is a progressive step, it is not a panacea especially for downstream processing. Also, given the vast demand for energy in the palm oil industry, it is not viable to expect biogas to replace the industry's entire energy mix. So, in order to reduce its carbon footprint, it is important for the palm oil industry to invest in energy efficiency and source alternative renewable fuels.

The energy optimization solution and UNIDO's role

In 2014 IOI Group's Pan Century Oleo Chemicals (PCOC), located near Johor Bahru, joined forces with UNIDO to optimize its energy systems. Following a series of training workshops and supervised energy systems assessments, IOI successfully implemented and maintained a series of steam system optimization interventions which contributed to a reduction in the plant's gas bill by more than 10 per cent, and overall continues to save the company in excess of USD $500,000 in energy costs per annum.

In 2017 UNIDO-Malaysia presented IOI group with a new challenge: solar thermal integration. With partial financing and technical training from the Malaysia Energy Efficiency and Solar Thermal Application Project, (MAEESTA) — a national initiative supported by the Government of Malaysia in partnership with UNIDO and the Global Environment Facility — the IOI energy management team successfully installed a solar powered feed water system. Designed to preheat feedwater for steam generation, the solar powered soft water tank saves an estimated 127,000 KWh of gas per year, which is equivalent to a lifetime reduction of 1,600 tonnes of CO_2e.

1 Currency is reported in USD based on 2020 average MYR conversion rate
2 Currency is reported in USD based on 2020 average MYR conversion rate
3 Aziz, Oda & Kashiwagi (2015), 'Design and Analysis of Energy-Efficient Integrated Crude Palm Oil and Palm Kernel Oil Processes.'
4 DOING (2019), 'How to Extract Palm Oil From Palm Fruit'.

Solar thermal energy will heat up the soft water tank from 30°C to 50°C

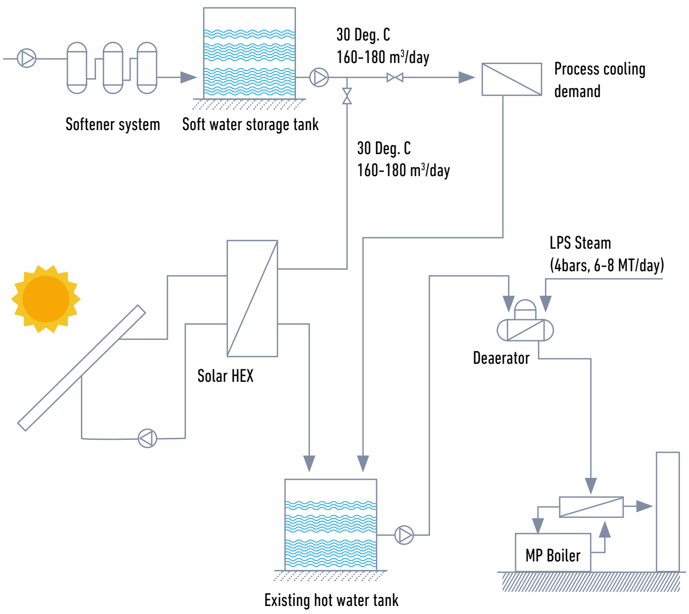

Figure 1. Solar thermal integration of boiler feed water system

Challenges and lessons learned

For many of the UNIDO-Malaysia staff, the completion of IOI's solar thermal integration project was the first of many large scale solar thermal pilots the team has in the pipeline. Given IOI was effectively a pioneer in UNIDO's solar thermal MAEESTA programme, the experience provided a number of rich insights and lessons for future projects.

1. It's critical to fully convince site owners and managers of the various benefits that solar thermal can provide with very minimal disturbance to productivity during the construction phase. Benefits include significant return on investment, rapid payback and an overall increase in staff awareness of the importance of efficiency.
2. The installation of solar thermal technologies needs to be considered as a 'final solution' in the journey of energy system optimization, which starts with an energy management system (EnMS) as a first step. For example there is no point investing in a solar hot water system if your piping is leaking or if overall energy use is not optimal. Even if your energy is generated with renewables, leaks are still leaks and contribute to wasted resources.
3. There is huge potential for solar thermal application in Malaysia. However, because the cost of energy is currently so cheap, it's critical for the market to be stimulated through policy incentives and also inspired by local case studies.
4. Local vendors, many of who may only have experience in the residential sector, need dedicated training for industrial contexts. One of the biggest misconceptions is that a solar system needs to be oversized (the bigger the better). However oversizing leads to unnecessary added costs and technical problems. This can lead to stagnation and other related issues, which can ultimately jeopardize the reputation of solar thermal technology.

Overall achievements

Measures Implemented	Investment [$]**	Financial savings [$]**	Payback [years]	Energy savings [kWh/year]	Emission Reduction [tCO2e/per year] ***
Solar thermal collector*	$28,200	$3,900	7	0.92 tons	80
Continuous Blowdown Heat Recovery System at Cogeneration Plant	$19,500	$570	34	795,940	509.40
Flash Steam Heat Recovery for Demin Water Heating at Splitter III	$12,100	$9,125	1.5	2,227,680	1,425.72
Thermal Oil Heater for Distillation I (completed)	$291,400	$63,600	4.5	2,290,000	1465.60
ICE Condensation Vacuum System for PC1 & PC2 at Edible Oil	$2,428,100	$335,000	7	9,808,320	6277.32
Recovery of Heat & Water Condensate from Heat Exchangers (Neat Soap Steam HE condensate & Flash Steam Condensate from Vapor liquid Separator HE at SNP Complex	$109,300	$126,900	0.85	1,923,600	1231.10

*Based on current available data & estimated annual savings

**Currency is reported in USD based on 2020 Malaysian ringgit (MYR) exchange rate

*** 0.64 kg CO2 eq/kWh . Calculated in line with the International Sustainability & Carbon Certification GHG Emissions Requirements

About the energy efficiency solutions series

Throughout 2020, the Accelerator is drawing on its collective wealth of experience and expertise to produce a series of knowledge kits on industrial energy efficiency. These cover five key energy efficiency solutions: Energy Management System; efficiency solutions for Motor-driven Systems; for Industrial Heat; for Industrial Cooling; as well as Energy Metrics and Performance Indicators. Find out more: www.industrialenergyaccelerator.org/efficiency-solutions/

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For more information about UNIDO's steam system optimization and solar thermal training contact regional programme manager Sanjaya Shrest: S.SHRESTHA@unido.org

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