South African
Industrial Energy Efficiency Project

Case Study

Company name	ZZ2 Tomatoes, Limpopo					
Size of company (Based on energy bill)	**SMME** (R250k –R750k)		**Medium** (R750k –R24mil)	X	**Large** (Above 24mil)	
Sector	Agriculture					
Location	Esme4 nearby Musina, Limpopo					
Company Contact	Name: Ian van Brouwerhaven			Position: Engineer		
	Email: ian@zz2.co.za			Telephone: +27 15 395 2040		
Year joined Project	2016					
Date of Implementation	2016	**Duration**		1 month		
Utility Intervention	Refrigeration					
Case Study Author	Kevin Schlemmer					
Project Manager	Adrian Rudolph					

1. BACKGROUND

1.1 Company profile

ZZ2 was established in 1966 as a private owned company in Mooketsi in the Limpopo province. Today ZZ2 is a well-known icon in South Africa and operates in Limpopo province, Western Cape, Eastern Cape, Gauteng, North-West and Namibia.

ZZ2 is the largest grower and distributor of tomatoes in Southern Africa and retains about 40% of the market sector. They supply approximately 190 000 tonnes of tomatoes annually and employ between 8000 and 9000 people, spread over nine farms in South Africa.

The company is also involved with other perishable items like stone-fruit, avocadoes, dates, mangoes as well as live stock. ZZ2 is a multi-million rand farming corporation that has made its mark in the agricultural level.

http://zz2.biz/

1.2 Plant profile

The plant in question is located on the farm, Esme4 near Musina in the Limpopo Province. Chilled water is supplied to the process by two, standard imported Daikin chillers with fibre-glass cooling towers.

Chilled water evaporators are being used to remove field-heat from the product, as well as force cooling it in blast chiller rooms. The packing facility, where the product is sorted, packed and palletized is also cooled down by same chilled water system with.

1.3 Nature of the challenges

The facility at the Esme4 site experienced problems with the chilled water system. Mr. Ian van Brouwerhaven, the plant engineer and the contacted maintenance company were assigned to the IEE project.

The main issue identified was that the chillers' compressors were tripping off on their high-pressure safety device, which is disruptive to the production and compromises the cold chain integrity of the product. The immediate prognosis was that the cooling towers were not selected with sufficient capacity and were under-sized during peak load periods. The engineering team was proposing to replace the open-circuit cooling towers with a closed-circuit cooling tower system that would be sufficiently sized for peak load periods. A measure and verification process on the equipment was performed to prove whether the existing cooling towers are adequately sized before replacing it with new equipment.

The focus of this project was to install a temporary refrigeration performance analyser for three to five days on the system, to evaluate the performance of the refrigeration-vapor cycle and the sub-efficiencies, like condenser efficiency, of the refrigeration components to verify the performance of the cooling tower. As part of this process an energy meter was connected to measure the input energy to the compressor.

1.4 IEE capacity building programme

No official Energy Management System Training was given to the members of the IEE program delegates. ZZ2 would have benefit if they had attended the NCPC's 1-day Introductory Training course as well as the 1-day Introductory Refrigeration course.

It is recommended that the energy management team of ZZ2 attend the 2-day Energy Management Training course.

2. KEY ACHIEVEMENTS

Key findings table

Implementation Period (yyyy-yyyy)	2016-2017
Total Number of project	1: Re-adjust the flow/pressure regulating valve 2: Open and clean shell and tube condensers
Monetary savings in ZAR	43 389 (@R1.56 / kWh)
Energy savings in kWh	27 814
Total investment made ZAR	18 200
Overall % of total consumption saved	± 5%
Total Savings from no cost interventions	43 389
Payback time period in years	0.42 years
GHG Emission Reduction (ton CO2)	28.65 tons
Number of females employed prior to implementation	-
Number of females employed after implementation	No change

The savings summarised above refers to electrical energy.

After the recorded data was process, the thermal heat rejection of the compressors was compared to the cooling tower manufacturer's published data. The data was indictive that under full load conditions, the cooling tower's duty was adequate. This revealed that the cooling towers selection was correct. However, the manufacturer was specific about the supply pressure to the nozzles. It was found that the condenser pumps were over-pressurizing the nozzles in the cooling towers. This meant that water was running along the insides of the towers, rather than passing through the fill. This meant that heat could not be removed from the condenser water. This was the main cause of the high operating discharge pressure. The problem was rectified by adjusting the existing pressure/flow regulating valve.

Furthermore, the data revealed that the condenser efficiency was poor during full load conditions. Further investigation proofed that the condenser approach is outside acceptable limits, which meant that the condenser is fouled. To overcome this problem the shell and tube condenser had to be open and cleaned.

This solution to the problem meant that no CAPEX was required to replace the existing cooling towers with new expensive closed-circuit cooling towers.

3. IMPLEMENTATION OF AN ENERGY MANAGEMENT SYSTEM

System operators has received basic training on energy saving methods, but no formal Energy Management system has been put in place for the packing facility.

The company complies with other program or standards in the food industry, which is non- related to energy conservation. It would be recommended that the engineering team of ZZ2 follows an EnMS program.

4. IMPLEMENTATION CHALLENGES

The main challenge that was experience in the implementation of this project was to collect enough meaningful data in order to create a benchmark for the existing cooling towers. The involvement of Coolcheck was only at a much later stage, just before the process of ordering the new closed-circuit cooling towers. The requisition for the new equipment was put on hold for a short while so that this measure and verification process could happen.

The implementation of the solution was done in a short period and the result was almost immediate.

In the near future, Mr. Ian van Brouwerhaven is expected to join the next EnMS training programme.

5. HIGHLIGHTS OF OPERATIONAL/ESO INTERVENTIONS

5.1 Summary of all interventions

Energy uses/users	energy sources	Intervention	Utility saving Period	Investment (ZAR)	Savings (ZAR/year)	Payback (Yrs)	Utility saving (Units) kWh	GHG Emission Reduction (tonnes CO2/year)
Chillers	Electricity	Adjust the flow/pressure regulating valve	2016	3200	43 389	0.42	27 814	28.65
Chillers	Electricity	Clean shell & tube condensers	2016	15 000				
TOTAL				**18 200**	**43 389**	**0.42**	**27 814**	**28.65**

5.2 Details of highlights

The intervention identified with the lowest cost and the biggest impact, was to re-adjust the flow/pressure regulating valve which resulted in the following:

- The reduction of high discharge pressure on the chiller-compressors which eliminated the high-pressure safety trips.
- Reduction of water wastage – with the over-pressurized nozzles water leaked through the tower joints.
- Restore productivity in the production area.

Cleaning the fouled condensers resulted in lower condensing temperature operation, which contributes to energy savings. In long term this intervention can extent the life expectancy of the chilled water system.

6. BENEFITS AND LESSONS LEARNED

1.1. Benefits

- There was no change in the number of jobs on this site because of the implementation of the interventions. However, energy savings may have an impact in future years, given the difficult agriculture market conditions in South Africa.
- By introducing these interventions to this facility, the immediate socio-economic impact was the reduction of the cooling tower's water consumption – less water is being consumed when the plant operates more efficient.
- The non-immediate socio–economic impact is the reduction in the emission of carbon dioxide into the atmosphere.
- Intendedly the risk of product loss was mitigated when the system operated within its operating limits.
- Unintendedly the staff morale and productivity increased due to the fact that the packing area was a comfortable work environment.

1.2. Lessons

- By measuring and understanding the performance of the chilled water system, as well as the sub-component efficiencies, ZZ2 was able to save on a capital expenditure. The company became aware that investing in training is essential for there business.
- Going forward it makes sense for ZZ2 to develop a program where the system performance and efficiencies get benchmarked before any capital investments are made to replace or upgrade equipment. This becomes part of their maintenance routine and can be rolled out to all the other facilities the own.
- Electricity is one of the biggest cost-contributors in agriculture sector in South Africa – by reducing the cost of electricity the company increase their profitability.

7. FUTURE PLANS

Going forward, a need for EnMS training was identified for the engineering team at ZZ2. The plant engineer, Mr. Ian Van Brouwerhoven was enthusiastic about measuring the performance and efficiency of the refrigeration systems.

An increase in performance and efficiency of the systems will not only increase electrical savings, but also savings for capital expenditure. This means that a better forecast for equipment replacement or upgrade can be made for financial budget periods.