CASE STUDY | Ashburton, New Zealand

ANZCO Foods Canterbury

The ANZCO Foods Canterbury meat processing facility mainly processes beef and sheep. Coal is being used onsite to generate steam and hot water for rendering, cleaning and sterilising. The use of coal for process heat is emissions-intensive, with the majority of the site carbon emissions coming from the coal boilers.

To reduce both energy costs and carbon emissions, ANZCO invested in a high temperature heat pump (HTHP) to provide hot water while reducing demand on the coal boilers.

MEAT PROCESSING **HEAT PUMPS**

Project summary

Location: Ashburton, Canterbury, New Zealand
Facility type: Meat processing
Consultant: Deta Consulting
Heat pump supplier: Mayekawa
Installer: Active Refrigeration

Water temperature set point: 60 °C
HTHP target output temperature: 83 °C
Equipment in use: 2 x 6 MW coal boilers
New equipment: 1 MW ammonia heat pump
Annual reduction in coal: 6,356 MWh or 1,064 tonnes of coal
Total (net) annual energy savings: 2,356 MWh

Existing system

The site boiler system features a pair of coal-fired boilers (total output 12 MW) for steam production. These boilers work in tandem to supply process heat. However, the use of coal for process heat generation is poor in terms of relative efficiency. The generated steam functions as the primary heating medium within the rendering plant, catering to the needs of driers and evaporators. Additionally, this steam is used to provide hot water for the meat processing areas, via heat exchangers.

The system is equipped with a heat recovery mechanism designed to capture thermal energy from the rendering plant's evaporation process. It also incorporates both a flash steam heat recovery system and a condensate recovery system to further enhance energy efficiency.

The site employs a hot water ring main to distribute hot water to three distinct processing areas: lamb slaughter, lamb further processing and the beef plant. At each of these three areas, a hot water storage tank is attached to an electric hot water boiler to supplement the hot water supply, ensuring that the water temperature coming from the tank is suitable for the end-use.

The hot water and steam system was in relatively good condition with a good operation profile. However, the system also had potential for improvement and was compatible with top-up heating from the introduction of a heat pump system.

Additionally, the site had an objective to upgrade and centralise some of the refrigeration systems while simultaneously eliminating Freon refrigerants from the facility. With the refrigeration upgrade completed, a waste heat stream was available to be harnessed to complement the heat pump operation, thus contributing to the site's pursuit of energy efficient heating solutions.

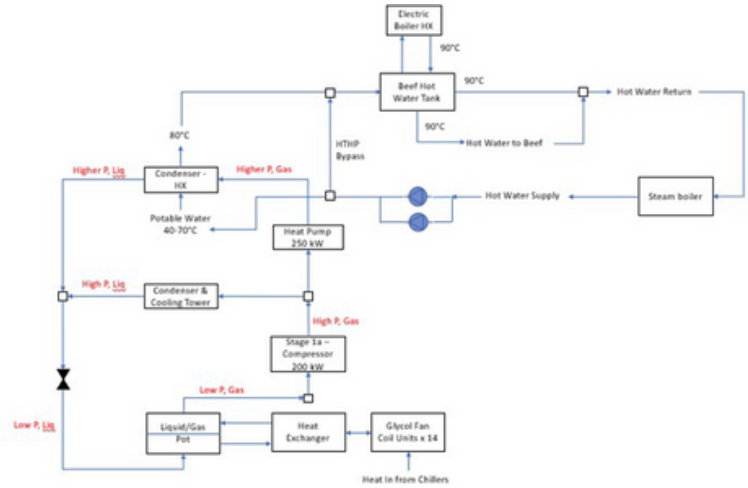

Diagram showing how the new HTHP integration was planned.

Heat pump solution

DETA had been collaborating with ANZCO Canterbury for more than a decade, focusing on energy efficiency improvements. While much work had been done on the demand side, this project marked a significant milestone as the first supply side initiative aimed at enhancing energy efficiency and curbing carbon emissions.

The primary process changes introduced with the high-temperature heat pump (HTHP) installation revolved around seamlessly integrating the HTHP unit into the new refrigeration system. Additionally, it entailed effectively incorporating the hot water generated by the HTHP into the closed-loop ring main system.

The installation of the HTHP allowed for a reduction in the required output temperature from the steam system (as the difference in heat was supplied by the heat pump), lowering both the energy demand from coal and the associated emissions. Additionally, this choice aligned favourably with the thermodynamic properties of ammonia, prompting its selection as the refrigerant over alternatives, such as CO2.

The use of ammonia as a refrigerant came with potential risks due to its flammable properties (classified as B2) and its potential as an asphyxiant. To mitigate these risks, strict adherence to the AS/NZS 5149 standard was maintained, ensuring the correct and appropriate system components were installed. This included the implementation of safety measures such as alarms, ventilation, and building requirements.

The system selected was a 1 MW (1 megawatt thermal/250 kW electrical) Mayekawa heat pump. The promise of substantial carbon and energy savings, identified through the heat pump system, played a pivotal role in securing the initial funding for the project. A NZ$400,000 contribution from New Zealand's Energy Efficiency and Conservation Authority (EECA) fund enabled this project to overcome ANZCO's internal capital project hurdles.

The DETA project delivery team collaborated closely with ANZCO's project sponsor, John Corcoran, Group Infrastructure and Asset Manager, in addition to various other essential stakeholders within the ANZCO organisation.

DETA fostered robust relationships with a diverse mix of contractors, all of whom played an integral role in the project's success. Notable contributors included Active Refrigeration, Bradfords, SWARM Intelligence and the valuable support extended by the teams at Electricity Ashburton and Ashburton District Council.

Project outcomes

From the time of recommendation to the installation of the HTHP, DETA worked with ANZCO Foods to prepare the business case, facilitate installation and most importantly conduct monitoring and verification post-installation and commissioning. The following summarises some key performance indicators of the heat pump project:

- The system was able to achieve an average coefficient of performance (COP) of 4.1
- Coal consumption reduction: 6,356 MWh or 1,064 tonnes of coal
- Onsite electricity use increase: 4000 MWh
- 8% reduction (1,750 t CO2-e) in site annual carbon emissions

Other project benefits

Some of the following benefits realised as a part of this project:

- Improved social licence to operate
- Improved marketability of products
- Reduced carbon emissions
- Reduced cost of operations

Project observations, findings and challenges

Due to the complicated nature of the hot water ring main (closed loop) and various distributed heating systems, the integration and commissioning was more complicated than originally anticipated.

Further, the integration of the heat pump into the refrigeration system due to the periodic operating nature of this system was challenging to fine tune to ensure maximum heat pump utility.

The project delivery phase ran through the 2021 COVID outbreak and also experienced some quite inclement local weather conditions during the construction phase. Additionally, installing a system on an operational/brownfield site means that commissioning had its fair share of surprises and nuances, but the collaboration and communication between all parties allowed the project to successfully overcome these.