Renewable Energy for Process Heat

Feasibility Report - Case Study

McCain Foods

This feasibility study was conducted as part of our Renewable Energy for Process Heat Opportunity Study – Phase 1. This project was undertaken in partnership with Climate-KIC Australia and in collaboration with Sustainability Victoria and the Department of Planning, Industry and Environment (NSW). The project was part-funded by the Australian Renewable Energy Agency (ARENA), more information here. A second phase of the project was commenced in early 2020, more information here.

The purpose of the feasibility study was to determine the technical and commercial feasibility of replacing some or all of the current fossil fuel process heating on the site with renewably powered alternatives, and to detail a pathway to implementation including technical and financial specifications and a business case for investment.

This case study summarises the findings of the study and is published with permission of the proponent. For more information about A2EP and the project, go to a2ep.org.au.

SITE DETAILS

Company:	McCain Foods
Site:	Ballarat, Victoria
Application sector:	Food processing
Technologies featured:	Heat pump
Consultant engaged for this study:	DETA Consulting | deta.global

Australian Alliance for Energy Productivity (A2EP)

A2EP is an independent, non-partisan, not-for-profit coalition of business, government and research leaders promoting a more energy productive economy. We advocate for the smarter use of energy for improved economic outcomes.

Australian Alliance for Energy Productivity (A2EP)
Level 10, UTS Building 10, 235 Jones Street, Ultimo NSW 2007, Australia
email: a2ep@a2ep.org.au, web: a2ep.org.au, phone: +61 2 9514 4948

McCain Ballarat, High Temperature Heat Pump (HTHP) Feasibility – Case Study

Site Details

McCain Foods operates a manufacturing plant in Ballarat, Victoria. The plant is split into two sites - Potato Plant and Prepared Foods Plant. The Potato Plant prepares potato products such as French-fries, wedges, roast potatoes and hash browns. The Prepared Foods Plant prepares meal products including prepared frozen meals, pizzas and lasagne. McCain has operated at the site since 1974.

The Plant is committed to reducing its carbon footprint and improving its operational resource efficiency as part of its overall strategic "*Be Good Do Good*" initiative and McCain's Global response to climate change.

Heat, in the form of high, medium, and low-pressure steam is used for a variety of food preparation purposes including:

- Washing
- Peeling
- Blanching
- Fryer oil heating
- Drying

Steam is generated at a single natural gas-fired boiler. As much of the steam is used in direct steam injection (DSI) application, it is currently not amenable to reuse as a heat-containing condensate. This represents both a water use reduction and heat capture opportunity.

Refrigeration services represent a significant electricity use for the Plant with a combined 3 MW of installed compressors consuming approximately 10% of the Plant's electricity. The majority of heat rejection is via evaporative condensers, with some heat recovered elsewhere (to underfloor heating in freezers).

Proposal

An opportunity was identified to recover heat from the large refrigeration system, rather than rejecting it at the evaporative condensers, by installing a high-temperature heat pump (HTHP) to take available heat from the refrigeration compression-cycle and upgrade it, through further compression to a higher temperature, where it's heat could be given up to process water at up to 85°C.

The heat sink proposed for the resulting HTHP heat was the preheating of make-up water to the boiler-house feed-tank, with the aim of reducing steam requirement for this service to practically nil. Heat available over and above that required at the feed-tank further holds the potential to pre-heat potable water for process and cleaning services.

The steam boiler was to remain in service, continuing to supply the main site steam requirements, and as a back-up supply for feed-tank heating when required.

Cost

The total project cost was estimated at approximately $1.5 million, with around $900,000 of this being for the supply and electrical/mechanical installation of the heat pump itself. The HTHP would produce a hot-water discharge temperature of up to 85°C.

Simple payback was projected to be approximately 7 years. This was calculated on the basis of a potential future solar plant (under feasibility) generating the required electricity for the HTHP.

Project Benefits

A key factor in the consideration of this proposal was the potential for significant reductions to the site's energy related carbon emissions. Two particular elements combined to create this potential; are:

- Solar electricity generation – the site is undertaking a feasibility study regarding the installation of a solar plant. Solar power has effectively zero carbon emissions, compared to grid electricity in Victoria which has emissions of 1.02 kgCO2e/kWh (2019 figures).
- HTHP Efficiency – the HTHP would offer a coefficient of performance (CoP) of up to 5 (effectively an efficiency of 500% on an electricity -in to heat-output basis), as compared to the existing boiler efficiency of 82%. So even on grid electricity, the net carbon emissions per kWh of heat delivered to site would be lower (0.204 kgCO2e) for the HTHP compared to the existing boiler set-up (0.226 kgCO2e).

Assuming the project could be delivered in a manner where electricity is sourced from an on-site solar plant, the overall CO2 emissions from the Plant could reduce the Plants CO2 emissions and energy usage by approximately 2% and 4%, respectively.

At this stage the proposal requires further development to fully integrate with other energy efficiency projects under consideration. Given the anticipated benefits, McCain intend to develop the HTHP feasibility further once all feasibilities are completed.