Renewable Energy for Process Heat

Feasibility Report - Case Study

Simplot Australia

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:	Simplot Australia
Site:	Quoiba Plant, Devonport, Tasmania
Application sector:	Food processing
Technologies featured:	Heat pump and biomass boiler
Consultant engaged for this study:	pitt & sherry | pittsh.com.au

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Simplot Australia, Quoiba Plant

Context

Simplot's Devonport factory processes a large variety of vegetables and this makes it quite unique. The plant produces for the Birds Eye and Edgell frozen vegetable brands. The main activities on site are categorised as cleaning, peeling, cutting, blanching, cooling after blanch, freezing, and cold storage.

Heating is used for blanching and peeling and for hot water. Hot water is used widely around the plant for cleaning and for defrosting freezer tunnels. This heat is provided by a natural gas fired 5MW boiler. The boiler produces steam at high pressure (1500kPa) and is reduced immediately above the boiler to 500kPa. Steam is delivered around the plant using well insulated piping. In all cases steam is used only after a final pressure reduction to 20kPa.

The natural gas boiler is nearing the end of its life and is likely to be replaced in the next 3-5 years. The boiler is a rebuild of what was once a briquette fuelled boiler, and then for a period a coal fired boiler, before being converted to natural gas. The boiler has a bespoke economiser.

There are advantages for the plant production processes if more hot water can be made available. Cleaning would be quicker with warmer water. Most importantly the defrosting of the freezer tunnels will be faster. Freezer tunnels run for a considerable time before ice builds up on the internal surfaces, and this eventually needs to be removed. Warm water is used to melt and wash away the ice during a freezer tunnel shut down. At the moment the supply of warm water is limiting and the shutdown time of the freezer tunnels is longer than it needs to be.

Simplot can produce more warm water very simply by increasing the use of natural gas at the boiler. However, the heat required for warm water does not need to be produced at the high pressures and temperatures of the steam boiler. There are other more efficient sources of this lower grade heat on site.

The project proposes two stages of development:

1. 0-2 years - Create extra hot water on site by capturing rejected heat from the very significant refrigeration system. This is waste heat and using it elsewhere increases plant efficiency and does so with no additional carbon footprint.

2. 3-5 years - Remove the carbon footprint of the remaining boiler operations by replacing natural gas with locally available bio fuel such as wood waste or woodchips.

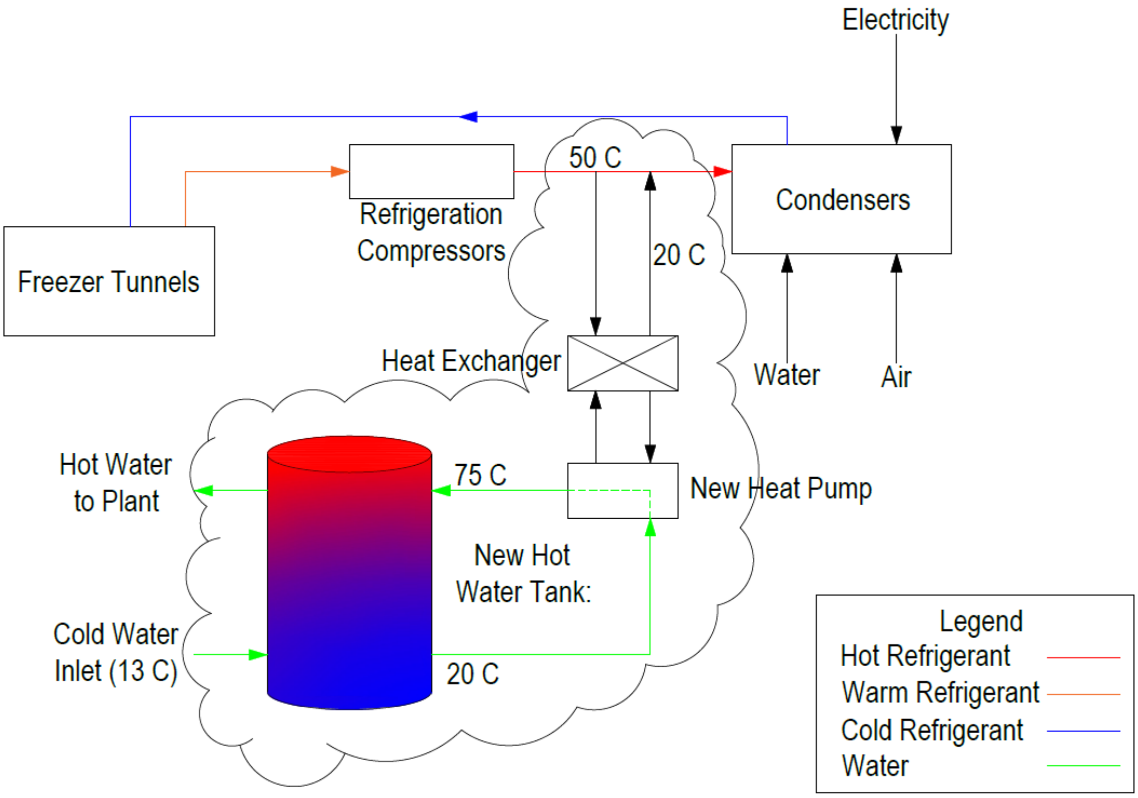
Proposal 1

Refrigeration on site is significant with 4 blast freezing tunnels in relatively continuous operation. The site runs an ammonia refrigeration system with typical water-cooled condensers on the roof. These condensers reject the heat that is extracted from the vegetables. This rejected heat can be captured by extracting it from the condenser circulation line (ammonia gas) prior to the existing condensers. This will be achieved with a new high temperature heat pump that can upgrade the heat from the condenser ammonia line from 50C to produce hot water at 70C. The heat pumps to be used have a conventional refrigerant and are very efficient having a high coefficient or performance (COP). There are two possible manufacturers and models in mind at this time, either would use a single ~1600kW unit producing heating for hot water uses.

This replaces the hot water that is currently produced by the boiler. This system also provides the desired new hot water to the factory. The additional hot water has several benefits around the plant in reducing time to defrost tunnels and reducing time for cleaning. It will also reduce the amount of water used for cleaning, the amount of water used by the boiler and water use at the condensers. The energy benefits include the reduction in boiler gas usage, a reduction in electricity used at the condensers and a reduction in chemical usage at the boiler.

An additional benefit of the increased freezer tunnel running time is greater opportunity to process local vegetables during peak season. This better use of local vegetables is a significant saving in transport and logistics costs, and the reduction in transport is another greenhouse gas improvement.

The project effectively takes what is a waste heat stream - one that currently demands electricity and water use in the condensers - and upgrades it to a useful heat stream that significantly reduces the load on the condensers and boiler. The drawing shows the new equipment in the clouded area.



The nett cost of the installation is $1.3m (or $1.8m if site solar PV is installed to provide electricity to run the heat pumps). Annual benefits total around $0.2m for a relatively long payback period.

The reduction in fossil fuel use is 790tCO_2e, or around 13% of the site footprint.

Proposal 2

The second phase of the project involves replacing the existing natural gas boiler with a biomass boiler at the time of replacement of the boiler.

The biomass boiler would be 5MW at an installed capital cost of $5.2m (current prices). The boiler would use a dedicated woodchip supply at fuel quality (not export quality). This biomass boiler option results in the provision of all steam to the remaining processes on site and has an annual benefit of $300k.

The business as usual replacement of the natural gas boiler with another new natural gas boiler is $4.8m. Thus, the difference between the two – new biomass boiler versus a new natural gas boiler – is $400k. So, there is a benefit of $300k per annum for this additional small extra cost. The reduction in fossil fuel use is 2500tCO_2e, or around 46% of the site footprint.