

# RaaS

Refrigeration as a Service – Stage 1 on pathway to superior energy efficient refrigeration

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## 1.0 Project Description

The project aimed to demonstrate the viability and feasibility of Refrigeration as a Service (RaaS), as outsourcing alternative to conventional plant ownership on up to three (3) processor Sites. In this model, plant ownership as well as responsibility for maintenance, insurance and energy cost would reside with the RaaS service provider and not the processor.

Developing a RaaS proposal for a meat processor is unique per Site and somewhat complex due to the specific cooling and heating needs of each Site as all processor Sites vary substantially in production volume, species, and type of production processes, and in relation to Site service costs and availability. Developing a RaaS proposal is therefore not trivial, nor is the viability of RaaS a given for every Site.

Each participant Site would undergo detailed monitoring of energy and services use as well current plant load and performance to fully understand heating and cooling demands across a production cycle (typically at least 1 week)

Once monitoring data was available, a detailed engineering study to determine the optimum plant design of either a new, replacement refrigeration plant (or of an upgrade or retrofit for the existing plant) was conducted to achieve lowest total ownership costs.

Based on the observed operating data (= cooling and heating consumption) and the developed refrigeration plant design, energy use, capital costs and maintenance costs for the proposed plants were estimated, and a RaaS proposal prepared for consideration by each Site, detailing the fixed monthly costs (capital and maintenance) and expected variable costs (cooling and heating used).

## 2.0 Project Objectives

The project had two main objectives under Stage 1:

- A. Demonstrate the process Sites need, and undergo the initial process to successfully establish RaaS (i. e. monitoring, scoping, energy modelling, cost estimation, etc. )
- B. Demonstrate that the RaaS agreement is commercially attractive and more environmentally beneficial in comparison to conventional plant ownership.

## 3.0 Project Chronology and Overview

Expressions of interest and a RaaS Explainer document (attached) were prepared late in 2021 and circulated to members. Several Sites expressed interest and further discussions with the applicant Sites were then held. Two companies with in total three separate processing Sites were then selected for the project, as reported in Milestone Report #1 (28/02/2022) :

**Site #1** The study at Site #1 involved assessment of the existing Freon-based refrigeration systems at Site #1 with the view to full replacement with a central ammonia plant (brownfields replacement). Site #2, a sister company of Site #1, is in a similar situation and had been undergoing prior monitoring under a separate AMPC Services Insights project and provided a second fall-back RaaS assessment option if required.

**Site #3** The study at Site #3 was proposed to encompass both the existing ammonia plant (brownfields upgrade) to be retained and improved, and the new adjacent freezing, chilling and packaging facility (Greenfields). The monitoring would focus on the existing site.

Familiarization and scoping work was conducted on both sites during March 2022.

In both cases the familiarisation encompassed the following activities:

1. Take-up of all refrigeration systems (equipment models and system design, and note services provided as relevant (e.g., specific room duty, general low/high temperature, etc)
2. Take-up of hot water generation systems for handwash, wash down and sterilizer duty.
3. Understand power reticulation systems serving the refrigeration systems, in order to plan power metering.
4. Understand water and fuel reticulation, in order to plan water and fuel metering as applicable.
5. Understand internet connectivity constraints at the site and at the likely location of the metering devices and gateways.
6. Connect with respect Site and external personnel required to assist with subsequent planning of the monitoring scope.

A detailed description of the refrigeration and hot water services at each site was reported in Milestone Report #2 (30/3/2022).

Minus40 then prepared a detailed monitoring plant for each site, to include a detailed list of data points requiring measurement in both cases and developed hard- and software solutions to transmit the data points to a cloud server. The monitoring plan was reported in Milestone Report #3 (28/4/2022)

The solutions comprise a customized combination of

- 1) Power meters to monitor specific devices such as compressors and condensing units.
- 2) Software interface to existing HMI platforms, either local or internet based, as available.
- 3) Sensors and loggers coupled to gateway computers for direct data upload.

Metis Monitoring was then engaged by Minus40 to supply and install the monitoring equipment to the two Sites, which took place during April 2022. The scope of the installed monitoring systems was comprehensively reported in Milestone Report #4 (30/5/2022), including photographs of equipment as installed.

Cloud data for both Sites was available for Site #1 since June 2022 and for VV Walsh since July 2022.

Comprehensive analysis of the cloud data was conducted during August 2022, with results comprehensively reported in Milestone Report #5 (31/8/2022), including graphs showing weekly cooling and heating processes for both sites.

This was followed by the development of a specification for the upgraded refrigeration systems for both sites, as reported in Milestone Report #6 (31/8/2022).

Subsequently, the energy usage (electrical input, refrigeration and heating output) where modelled to determine the annual plant utilisation, and essential factor in the financial RaaS model, and the maintenance costs for the refrigeration plant in the respective location. Alongside the costs of capital, the cost of electrical energy use and maintenance are the key cost elements, whilst income from the sale of cooling and heating energies are used to balance the ledger. The results of the energy modelling and maintenance cost estimation were conducted during late 2022 and reported in Milestone Report #7 (23/1/2022).

At this point in the project, it became evident that the indicators for RaaS were NOT compelling for the Site #3 plant, as reported in Milestone Report #8, and it was decided to instead prepare a RaaS proposal for the Site #2 instead, for which equivalent data was already available under the Services Insights project.

The two proposals as presented to Site #1 and Site #2 during December 2022 were reported in detail in Milestone Report #8 (2/2/2023).

Site #1 and Site #2 have expressed interest in the proposals as submitted, but due to industry and market conditions, neither Site has progressed discussions:

- A. Site #1 have paused further decisions until October 2023, after which a resumption of RaaS project discussions on the basis of the scope as proposed is expected.
- B. Site #2 have decided NOT to proceed with plant expansion scope (which was included in the RaaS proposal development), but instead to revert to a services upgrade scope only. Site #2 is expected to request a revised RaaS proposal based on this much reduced project scope shortly.

Subsequent to the submission of the proposals, Minus40 then prepared a RaaS guideline document (in lieu of a webinar) in agreement with AMPC, in fulfillment of Milestone #9.

## 4.0 Site needs and RaaS establishment

The initial project stages as reported above addressed the steps required leading up to the development of a RaaS proposal, including:

- 1) Identifying target Sites (Milestone #1)
- 2) Scoping each Site to understand existing heating and cooling services (Milestone #2)
- 3) Preparation of a monitoring plan for each Site suitable to secure the required information (Milestone #3)
- 4) Installation and commissioning of cloud-based monitoring systems (Milestone #4)
- 5) Analysis of data gathered from monitoring systems (Milestone #5)
- 6) Development of specification for upgraded refrigeration systems (Milestone #6)
- 7) Energy modelling of each Site to understand savings achievable (Milestone #7)

The information gathered with these steps provided enough information to assess whether Refrigeration as a Service can provide benefit to both the business and the provider to ensure a productive long-term relationship.

## 5.0 Commercial viability and environmental benefit of RaaS

To be able to present a compelling business case to the business, the RaaS operator should ideally be in a position to achieve 1) significant energy savings that 2) would not have been achievable to the business otherwise. Then, the additional costs of monitoring and outsourcing are balanced by the achieved savings and both the business and the RaaS operator benefit from the arrangement. Both parties stand to benefit from the arrangement as the business has net savings due to lower energy and management costs, and the RaaS operator derives an income from providing a beneficial service. If this is achieved, the RaaS arrangement is visibly beneficial and is therefore a long-term viable business proposal. As RaaS contracts are typically based on a 15-year contract duration, it is

important for both parties that the conditions for such a long-term relationship are evident in order to justify the initial setup and costs.

In some circumstances the reduced burden, risk and cost of managing the services are a third significant driver in a RaaS relationship, so that even when the achievable energy cost savings alone do not make the business case attractive, the reduced burden of management can justify the added expense of a RaaS arrangement.

Initial analysis by Minus40 showed that whilst the first two criteria were well in place for Site #1, insufficient energy savings in proportion to capital investment required were achievable at Site #3. Minus40/AMPC therefore decided to switch to the fallback Site #2 for the next stage of RaaS proposal development, which was then conducted, and the results presented to Site #1 and Site #2, as reported in Milestone Report #8.

Subsequent to the completion of the RaaS proposals, and alternative opportunity to potentially improve the scope of the savings achievable at VV Walsh was identified by way of the Maestro technology recently developed by Beca. As a subsequent project, Minus40 will propose the implementation of Maestro at VV Walsh as an alternative pathway to a RaaS solution.

On every Site considered (Site #1, Site #2 and Site #3) energy savings both as electricity savings and fuel (LPG, Diesel or Natural Gas) were identified, providing substantial potential environmental benefits and decarbonisation potential to the respective Site.

## 6.0 Conclusions

The project has demonstrated a methodology that can be utilized to determine if Refrigeration as a Service is a viable option for a processing Site, whilst simultaneously providing insights on energy usage and energy savings opportunities for the Site. The stages in this process would include:

- 1) Scoping the Site to understand existing cooling and heating systems.
- 2) Develop and implement monitoring systems to provide accurate data (power, flow, temperature) of the heating/cooling systems.
- 3) Analysis of data to understand quantum and usage profile of energy use.
- 4) Develop upgrade plans and estimate the capital costs and savings potential, under a well-managed RaaS solution.
- 5) Conduct commercial modelling to develop a long-term RaaS proposal to achieve the energy savings (and additional Site management savings).
- 6) Present (and subsequently revise and fine-tune) the RaaS proposal to the Site.

On completion of the project, the three Sites that ultimately participated in this project were at various stages of consideration:

- 1) Site #1 are planning to re-open the project folder in October 2023 once other unrelated business decisions have been implemented.
- 2) Site #2 are planning to request a revised (reduced) RaaS project scope to now not include Site expansion, but also subject to other unrelated business decisions.
- 3) Site #3 remain keen to consider an alternative RaaS pathway with more flexibility regarding asset ownership and utilising Industry 4.0 IoT. . A Stage 2 project involving Maestro remote optimisation technology is

currently being prepared as the potential alternate pathway to superior energy efficient refrigeration for site #3.