
Technical notes

Improving refrigeration efficiency and reducing electricity use

The price of electricity has risen more quickly than the cost of most other winemaking inputs in recent years, and refrigeration is by far the largest user of electricity in the majority of wineries. Consequently, improving refrigeration efficiency will result in an immediate improvement to the financial bottom line. In response to this opportunity, a practical spreadsheet-based software tool, the AWRI Refrigeration Demand Calculator, has been developed, and is available to all Australian wine producers from the AWRI website. The purpose of the calculator is to allow wine producers to model, analyse, understand, and better manage their refrigeration demand with a view to reducing the amount of electricity used, and thus the amount of money spent on electricity.

Resources and expertise are readily available to wine producers to manage efficient refrigeration supply and plant capacity. However, working with collaborators through its Riverina and Hunter Valley regional nodes, the AWRI identified that efficient management of winery refrigeration demand and associated heat transfer efficiency was an area where further understanding was required to achieve reliable efficiency gains.

The AWRI Refrigeration Demand Calculator was developed by Dr Richard Muhlack at the AWRI Riverina node and was built primarily using data from the 2013 vintage. The data were accessed by working closely with three large wineries in the Riverina, and three medium-sized wineries in the Hunter Valley via the AWRI Hunter Valley node. Interestingly and perhaps surprisingly, only one of the wineries involved had a dedicated power meter on their

The AWRI Refrigeration Demand Calculator at a glance

What is it?

The AWRI Refrigeration Demand Calculator is a spreadsheet-based tool for analysing and managing winery refrigeration demand.

How does it work?

The calculator allows producers to enter grape intake and production data to simulate refrigeration demand across their entire annual production cycle. Users can assess the impact of factors such as cellar storage and cold stabilisation temperatures, fermentation conditions, climate, brine temperature, tank size and insulation on refrigeration demand and energy costs.

How much does it cost?

The AWRI Refrigeration Demand Calculator is free to download for Australian wine producers.

How do I use it?

An example spreadsheet and a user guide with detailed instructions are available to help you get started.

What if I need help or have feedback?

Please contact Peter Godden on 08 8313 6600 or peter.godden@awri.com.au with any queries, comments, or suggestions regarding the calculator.

refrigeration plant. This meant that the other wineries had no way to measure how much money they were spending on refrigeration or to assess the impact of any changes to their plant or practices. It is suspected that this is the case for the majority of wineries in Australia.

Data supplied by the company with the dedicated power meter allowed a more detailed and accurate model to be built. Validation of the model was carried out after the 2014 vintage with collaborating wineries supplying crush figures for red and white grapes and data on electricity use. For the winery with the dedicated power meter, the calculator was able to predict the amount of electricity used up to the post-vintage period when the validation was performed, to within 5% of the actual usage.

Refrigeration is shared between many operations in wineries, and until the availability of this tool it was difficult for wine producers to know the relative importance of different aspects of their winery systems. With the calculator, producers enter grape intake and production data to simulate refrigeration demand across the entire annual production cycle, and can include data to customise the modelling for their own winery set-up and winemaking techniques. Factors taken into account when calculating refrigeration demand, energy use and energy cost include:

- cellar storage and cold stabilisation temperatures
- fermentation conditions
- fermenter and storage tank size and shape
- climate and solar loading
- brine temperature
- the presence or absence of insulation and insulation rating
- tank orientation and different types of heat exchangers.

The impact of wine-to-wine heat exchange for energy recovery during cold stabilisation can also be assessed.

In many wineries there is also the potential to save a substantial amount on the total electricity bill, by avoiding punitive tariffs which exist in many electricity supply contracts. Depending on the contract, such tariffs might commence as soon as an agreed threshold is exceeded, and remain in place for the remainder of the billing period. Audits conducted by the Riverina node identified one case where such tariffs accounted for approximately 15% of the total annual electricity charge. In such a case, improving scheduling of refrigeration to avoid exceeding such thresholds has obvious financial benefits.

Another tool developed at the Riverina node is the AWRI Ferment Simulator. The Simulator incorporates a function where wine producers can model their refrigeration usage against

forecast temperatures for all active fermentations, allowing total refrigeration demand to be accurately predicted, and compared against contracted supply for the same period. If, for instance, a heatwave is forecast which might lead to above-contracted electricity demand, a 'what-if' function in the Simulator allows users to assess the amount by which fermentations would need to be cooled before the heatwave, to avoid exceeding the threshold.

The AWRI Refrigeration Demand Calculator can be downloaded for free from the AWRI website at: http://www.awri.com.au/industry_support/winemaking_resources/refrigeration-demand-calculator/downloads/ The calculator is provided as an unlocked Excel file (compatible with Office 2007 onwards) and the source code is also unlocked, allowing wine producers to interface directly with internal systems for automatic data acquisition if desired.

A user guide and an example spreadsheet are available from the same page on the AWRI website. However, every winery is unique, and it should be noted that the information presented in these resources is intended as a guide only and should not be relied upon or extrapolated beyond its intended purpose, and that an experienced engineer or contractor should be engaged before major changes to winery infrastructure are made.

The current refrigeration project drew on the AWRI's existing capability in best practice refrigeration operation and engineering simulation. Additional refrigeration resources, including the reference guide *Improving Winery Refrigeration Efficiency* and associated case studies, can be found on the AWRI website (http://www.awri.com.au/commercial_services/process-optimisation/refrigeration). The AWRI's previous work in this field also led to the development of a *Research to Practice* training module, which has been presented in several wine regions around Australia. That module has now been expanded into a workshop based on the new calculator which was presented seven times in three states and via a webinar during the first six months of 2014. The webinar recording is available from the AWRI's webinar page.

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