

Thermal storage for cooling systems

Cold thermal storage systems are technically viable and can reduce reliance on grid electricity. They can utilise more on-site solar generation or help you consume electricity at lower tariffs, but they are also likely to reduce overall cooling efficiency and have relatively low return on investment.

Should thermal storage for cooling be employed on dairy farms?

Short answer: Probably not – unless it will solve other problems such as local grid constraints for farms that are wanting to expand.

Thermal storage systems utilise existing refrigeration systems to create chilled water at 1°C or a mixture of glycol and water at less than 0°C, which is stored in an insulated tank. The chilled water or glycol is then used to cool the milk using a plate heat exchanger, which is installed after the pre-cooler. Thermal storage allows the refrigeration system to be operated during periods with lower electricity tariffs or when excess solar PV is available.

Below is a brief explanation of the challenges and opportunities of utilising cold thermal systems.

There are four main methods for cold thermal storage: an ice bank, glycol storage tank, chilled water tank or phase change materials (PCM) in a storage tank. Each has their advantages and disadvantages, as summarised in the table here.

Advantages	Disadvantages
Ice bank system	
<ul style="list-style-type: none"> Compact. Proven. Relatively simple. 	<ul style="list-style-type: none"> High capital cost per kilowatt-hour of energy storage. Efficiency losses due to heat gain from surrounding air unless very well insulated.
Glycol storage tank	
<ul style="list-style-type: none"> Potentially low capital if current chiller uses glycol and if able to re-use existing cold storage vessels (e.g., old milk vat). 	<ul style="list-style-type: none"> High cost of glycol giving potentially high capital cost per kilowatt-hour. Efficiency loss due to heat gain from surrounding air unless very well insulated.
Chilled water tank	
<ul style="list-style-type: none"> Potentially low capital cost if able to re-use existing cold storage vessels (e.g., old milk vat). 	<ul style="list-style-type: none"> Potentially complex if retrofitting a glycol or DX chiller system and efficiency loss from additional heat exchange. Large second stage heat exchanger needed.
Phase change materials (PCM)	
<ul style="list-style-type: none"> Compact. Constant delivery temperature. 	<ul style="list-style-type: none"> Expensive per kilowatt-hour. Suited to lower temperature needs.

Recent energy efficiency projects run by the New South Wales Department of Primary Industries have tested chilled water retrofit for glycol chiller plants and have delivered low return on investments.

It was observed that thermal storage systems can reduce the performance of the chiller and increase overall energy consumption due to higher energy losses (i.e., more cold being lost to surrounding air) and lower coefficient of performance (COP) of the refrigeration system.

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