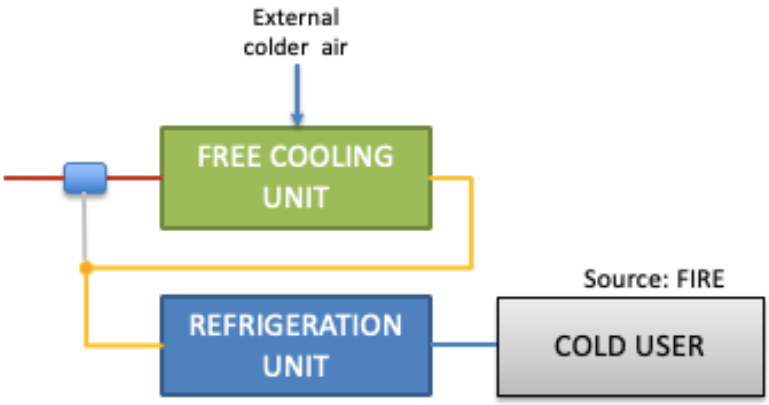
BEST PRACTICES – REFRIGERATION SYSTEM
FACTSHEET

ICCEE
Improving Cold Chain Energy Efficiency in food and beverage sector



Free Cooling

Free Cooling indicates the direct use of an external source, typically air, but can also be water, when its temperature (and humidity in case of direct external air use) allow its use directly (e.g. introduction of external air without any treatment) or indirectly (treating the air or exchanging heat with air or other heat carriers) with a lower energy consumption of the HVAC or cooling system. It is typically used in HVAC (Heating Ventilation and Air Conditioning) systems but can be also exploited to assist cooling for industrial applications. New HVAC systems usually are designed to allow free cooling, while other systems or older ones can often be modified to exploit free cooling.

The most suitable environment for Free Cooling is a combination of a cold or mild climate zone and the need of cooling energy for most of the year. This encompasses many manufacturing industries, such as food and beverage ones, but also other kind of facilities like data centres and spaces where constant temperature and humidity levels must be maintained (clean rooms, cold rooms, areas of hospitals, etc.)

"Free Cooling for sustainable refrigeration and air conditioning"

Food Industrial Plant

TRL 9

Investment
15.000 €

Savings
10.000 €/year
100.000 kWh/year

Main NEBs (other benefits)
Lower greenhouse gas emissions
Longer equipment life
Lower maintenance cost
Lower operational cost

Description of the technology

Traditionally HVAC and cooling systems utilises a chiller to generate the cooling required for processes or HVAC application.

Free Cooling systems, instead, aim to reduce or even bring to zero the energy required by chillers. These systems can be added to air-cooled or water-cooled electric chillers and activate when the temperature of the external source has an appropriate value.

The choice between exploiting air or water is determined by a number of factors, such as the availability of water and its cost, the available space for a chiller, the cost of electricity and the period of time in which free cooling can be used. In general, water-cooled chiller and free

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cooling compared to air-cooled ones and occupy less space.
Food & Beverage industries require several kinds of cooling, such as the temperature control to reduce the bacterial load and the quick freezing/cooling of pre-cooked of frozen foods.
The cooling systems could help to increase the productivity, without lowering the all-important organoleptic properties of the finished product such as taste, colour and smell.

What is the improvement focus?

Free cooling has the objective to reduce chiller energy consumption: it can be done via a (higher) direct intake of external air, via a chiller with a built-in free cooling coil or via a free cooler working in series with a chiller. The latter, usually, should be more efficient, due to the larger surface area provided by the air cooler.

Benefits

A Free Cooling system, together with the energy savings can offer different benefits, such as:

- Reduced water consumption
- Reduced operational costs
- Reduced carbon footprint
- Reduced maintenance costs

In particular, one of the most important voices can be seen in the reduction of maintenance costs. In fact, usually, Free Cooling chiller plants have a longer lifecycle compared to traditional chillers because of the reduced number of operation hours of the compressor during the year.

Opportunities and barriers to implementation

Opportunities	*Barriers*
Lower energy consumption and related cost	Possible major modifications of the distribution layout
Lower maintenance costs	Difficult to implement if external ambient temperatures are high
Higher equipment lifespan	

Calculations

The calculations below, for a system allowing a higher exploitation of external air, from the previous 10%-20% to around 50%, show a quick idea of the costs and returns of this practice, as well as the economic impact after the implementation of the new equipment. In order to be clear, the initial situation is directly compared with the final situation and a table of differences is shown broken down into the different key points of savings, using an average price of electricity taking into account their expected evolution. This example is taken by a real case study implemented in the Central Europe zone.

	Initial situation	Final situation
Inlet air flow [Nm^3/h]	60,000	60,000
Annual energy cooling consumption [kWh/year]	600,000	500,000
Annual economic energy expenditure for cooling [€/year]	60,000	50,000

Total investment (€)	15,000
Energy savings [kWh/year]	100,000
Average electricity price[€/kWh]	0.1
Energy economic saving (€)	10,000
Return period (years)	1.5

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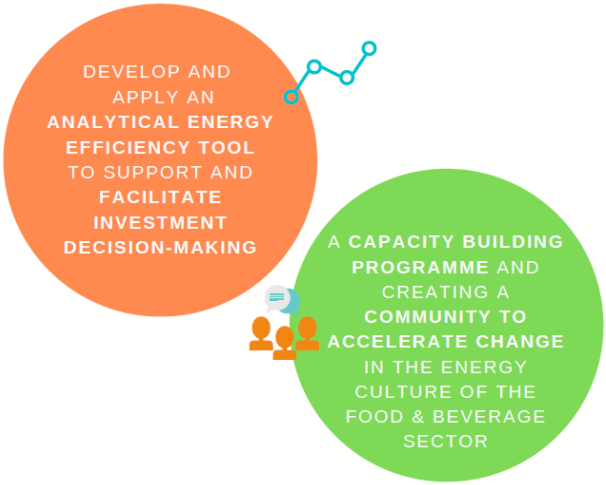
About ICCEE

The project ICCEE, www.iccee.eu, funded by the EU programme Horizon 2020, aims at improving energy efficiency in the cold chain of the food & beverage sector and making it easier for the sector to:

- undertake energy efficiency measures across the entire supply chain and
- accelerate the implementation of energy audit results.

ICCEE follows a holistic approach that moves from a single company perspective to the assessment of the entire cold supply chain. Existing financing schemes for SMEs will be assessed: the optimal ones will support the implementation of energy efficiency measures. ICCEE objectives build on 2 pillars:



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