Sector Focus

Blast freezing

	Sector	GWh/y
1	Retail display	9,233
2	Catering – kitchen refrigeration	4,380
3	Transport	4,822
4	Frozen storage – generic	900
5	Blast chilling – (hot) ready meals, pies	425
6	Blast freezing – (hot) potato products	316
7	Dairy processing – milk/cheese	250
8	Milk cooling – raw milk on farm	207
9	Potato storage – bulk raw potatoes	165
10	Primary chilling – meat carcasses	129

Mean estimated annual UK usage

Technology

The aim of a blast freezer is to freeze materials and food products that have normally already been chilled. Over 13.5 billion tonnes of frozen prepared food is produced in the EU each year. Much of this is chilled from 0 to 4°C to a final target temperature below -18°C. However some i.e. fried potato products may be frozen immediately after frying.

Energy used in sector

Blast freezing systems in the UK solely for potato products are estimated to consume between 218 and 415 GWh of energy per year.

Systems in use

The majority of freezing systems pass refrigerated air over the hot/chilled food to freeze it. Air based freezers range in complexity, size and cost depending on type of food to be cooled and throughput. Other types of food freezing systems are available including plate, immersion and cryogenics.

There is very little measured or published data on the energy efficiency of different freezing systems.

Simple cabinets/rooms

Simple blast freezer

Simple cabinets or rooms are suitable for small-scale operations. They are versatile, easy to load/unload and easy to clean.

Push through and conveyerised tunnels

For larger throughputs where floor space is available linear chilling tunnels can be used.

Many types are commercially available ranging from simple manual push through rack systems to automatic rack systems and conveyerised belt systems for individual food products.

Spiral chillers

For larger throughputs where floor space is at a premium then a range of spiral freezers are commercially available.

Some use a horizontal and others a vertical airflow but it is not known if this affects the energy efficiency.

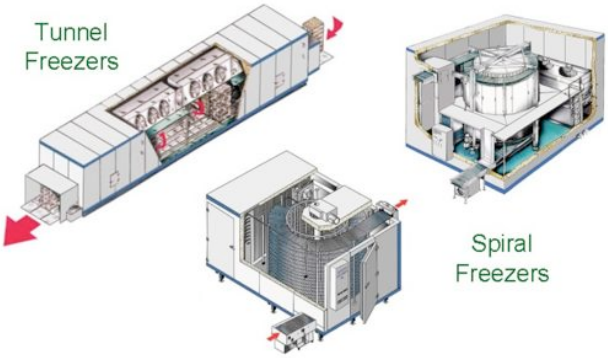


Plate freezers

Vertical plate freezers are commonly used for raw fish, raw material for pet food and meat offal.

Vertical plate freezer

Horizontal plate freezers have been used for cartoned meat and ready meal packs.

Plate freezers are more energy efficient than a blast air freezing system with the same throughput.

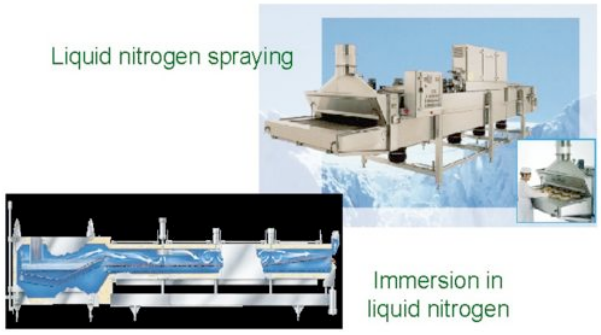
Cryogenic freezers

The capital cost of a cryogenic system is often less than a mechanical system of the same capacity however running costs tend to be higher.

Nitrogen tunnel freezer

Immersion freezing

Packaged products can be frozen by immersion in brine solutions or cryogenic liquids.



Simple low cost energy savings

Reducing Main heat inputs

- Minimise heat that has to be extracted from cooling food.
  - Use ambient cooling to remove heat from cooked products prior to cooling.
  - Minimise thermal load from packing and racking.
  - Cover unwrapped foods to reduce evaporation and subsequent condensation and freezing of moisture on evaporator coils.
- Minimise heat generated.
  - Fit energy efficient fans with drive motors outside freezer.

- Switch off fans when systems are empty.
- Reduce fan speed when surface temperature of food is within 2°C of air temperature.
- Minimise air movement when freezer used as a frozen storage system.

- Minimise heat infiltration.
  - Position freezer away from or shield from heat sources i.e. cookers, windows, south facing external walls, poorly insulated roofs, etc.
  - Fit effective door protection systems on all personnel and food entry and exit points.
  - Minimise surface area of chiller that is exposed to ambient temperatures.
  - Use maximum thickness of insulation and design structure without thermal bridges.

System loading

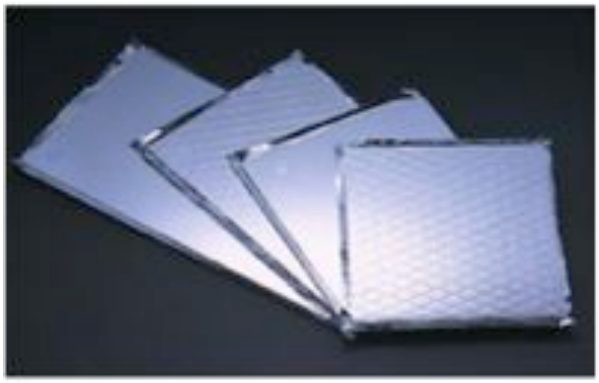
- The energy efficiency of a blast freezer operating without any food in it is zero.
- Ensure air passages are not blocked during loading.
- When the system is only partially loaded:
  - Make sure the loading pattern does not allow air to short circuit and return to the evaporator without extracting heat from the food.
  - Reduce depth of hot food by using more containers thus reducing freezing time and requirement for refrigeration system to be in use.
- Make sure that air cannot by-pass the evaporator by sealing ducts to force all air through the evaporator.

Maintenance

- Ensure that refrigeration systems are checked to ensure heat exchangers are free of dirt and that refrigerant is not leaking. Check operation of refrigeration components to ensure operating at installed capacity and efficiency.
- Replace and adjust worn or badly fitted door and food entry protection systems.
- Replace worn door seals.
- Check for any breakdown in insulation and replace.

Retrofit options

- Advanced insulation such as VIPs (Vacuum Insulated Panels) has the ability to reduce heat load across insulation. VIPs could replace current insulation and reduce energy consumption by 5-10%.



- Fit variable speed drives to fans controlled by feedback from IR surface temperature measurement of food being chilled.

Other options to consider

- High efficiency components such as compressors, heat exchangers, fans and lighting can reduce energy by up to 20%.
- Improving performance of the refrigeration system through liquid pressure amplification, suction pressure optimisation, evaporative condensers and checking to ensure no leakage of refrigerant can produce energy savings of up to 30%.
- Consider reclaiming heat from refrigeration plant for heating water or space heating.
- Consider reclaiming heat from refrigeration plant for low temperature thawing, tempering, drying or smoking processes.

Energy saving potential of future technologies

A number of technologies are under development for use in the near future. Some of the most promising include:

- Greater use of renewable energy sources such as solar electricity (PV), solar thermal, wind energy, biomass, geothermal heating and cooling.
- Greater system integration by use of heat pumps, Combined Heat and Power (CHP) and Trigeneration.

Fostering the Development of Technologies and Practices to Reduce the Energy Inputs into the Refrigeration of Food

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For further information on saving energy see: www.grimsby.ac.uk/What-We-Offer/DEFRA-Energy