Sector Focus

Frozen Storage

	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) prepared 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 energy usage

Technology

A typical UK cold store will have 75,000 m^3 of storage space and be fitted with 10 to 14 m long mobile racks. A typical; European system will be almost 3 times as large (200,000 m^3) and have 32 to 38 m long automated racks.

The size of a cold store has an effect on the overall heat load through the insulation. A 2,830 m^3 cold store uses 124 kWh per m^3 per year whereas a 85,000 m^3 store uses 99 kWh/ m^3.

Energy used in sector

Refrigerated systems in frozen storage establishments in the UK are estimated to use 900 GWh of energy per year.

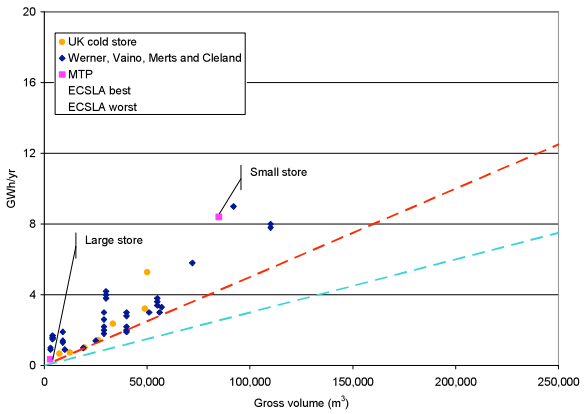
UK Market

Frozen meat in store

- 200 Primary Cold Storage Sites in UK (stores over 1,000 pallet spaces)
- Approx 9.65m cubic metres of capacity
- Estimated at 2 million pallet spaces
- 76% third party logistic providers
- 14% retailers
- 10% manufacturers
- 50% third party space owned by top 7 companies

Energy consumption

There is very little measured or published data on the energy efficiency of different commercial cold stores. The data shown below comes from worldwide publications and a small UK survey.

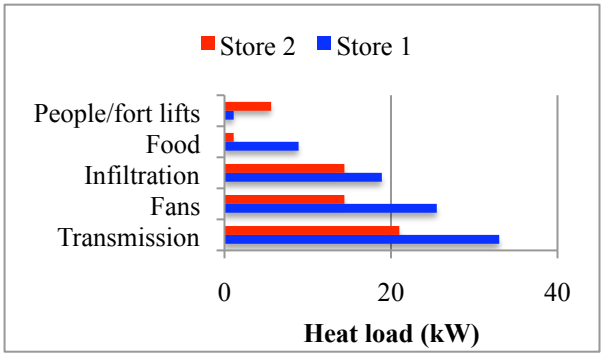


Energy consumption in frozen cold stores

The worst cold store consumed over 8 times the most efficient store.

Heat loads

The main heat loads two cold stores surveyed were transmission, fans, infiltration, from the food and people/fork lift trucks.

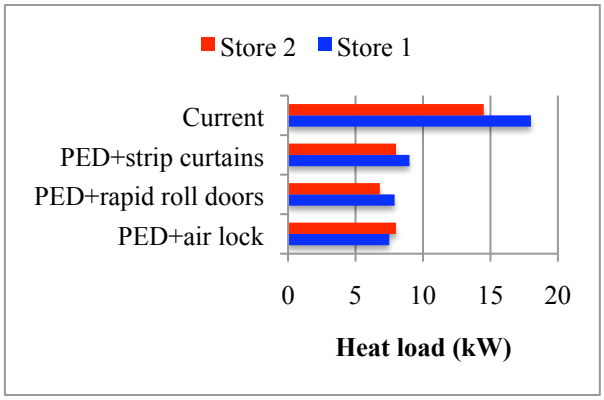


Heat loads (kW) in two frozen stores

Simple low cost energy savings

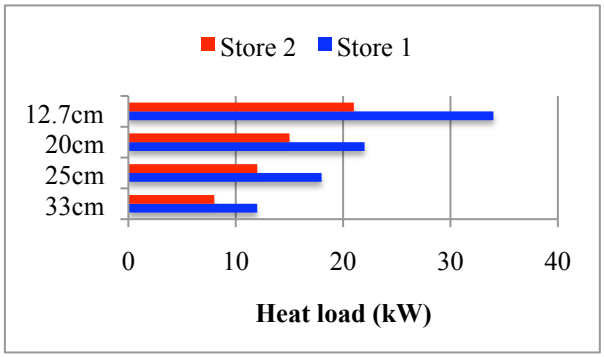
Reducing Main heat inputs

- Minimise heat generated.
  - Fit energy efficient fans with drive motors outside store.
  - Switch off fans when systems are empty.
  - Minimise air movement since this is a frozen storage system.
- Minimise heat infiltration.
  - Fit effective door protection systems on all personnel and food entry and exit points.



Heat load (kW) with different door protection in two frozen stores

  - Position store away from or shield from heat sources i.e. south facing external walls, poorly insulated roofs, etc.
  - Use maximum thickness of insulation and design structure without thermal bridges.



Heat load (kW) for different thicknesses of insulation in two frozen stores

System loading

- The energy efficiency of a storage room without any food in it is zero.
- Ensure air passages are not blocked during loading.
- When the system is only partially loaded:
  - Make sure that air cannot by-pass the evaporator by sealing

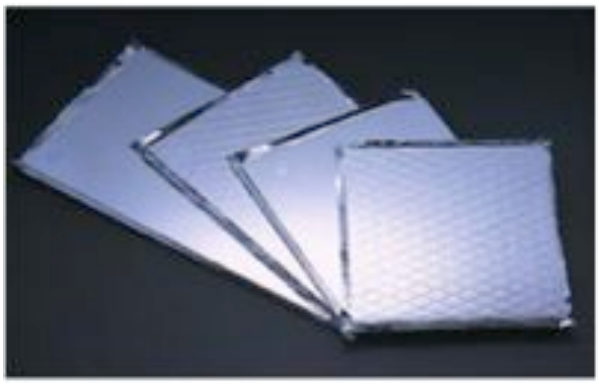
ducts to force all air through the evaporator.

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%.



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 or tempering 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.

In the two stores surveyed the current energy consumption was 59 and 91 kWh/m^3/yr. By implementing the energy saving measures shown in the following table savings of between 10 and 14% could be achieved by simple modifications and up to 38% by applying the best technologies.

	Store 1	Store 2
Current Energy consumption kWh/m^3/yr	**59**	**91**
Pedestrian doors	**53**	**85**
Rapid rolls doors/improved strip curtains	**52**	**82**
Defrost optimisation	**58**	**91**
Separate entrance to store	**51**	
Automatic closing door	**57**	
Preventing door being jammed open		**88**
Suction liquid heat exchangers	**56**	
Liquid pressure amplification	**49**	
Evaporative condensers	**58**	**56**
Low pressure receiver (lpr)	**40**	
Improve insulation on walls to 10"	**51**	**86**
Potential saving from introducing best technologies	**>32%**	**>38%**
Potential by updating current system	**>14%**	**>10%**

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

This project was funded by defra Department for Environment Food and Rural Affairs

Project coordinator: FRPERC Food Refrigeration and Process Engineering Research Centre; THE GRIMSBY INSTITUTE of Further & Higher Education; University of BRISTOL

Project partners: Brunel UNIVERSITY WEST LONDON; LONDON SOUTH BANK UNIVERSITY; University of Sunderland

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