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The top 10 refrigeration energy using processes in the cold chain
Where is the greatest potential for energy saving?

Mapping of energy use

Objective

- Identify and rank 10 'operations' (process / food combinations) in order of their potential to reduce energy usage in food refrigeration by the use of improved technology and enhanced business practice

Mapping

- Aim to quantify where energy is used in cold chain
- At start not well documented and conflicting sources
- Initial indication that ~50% used in retail
- Lack of data on catering use and often not considered

Mapping – Initial estimate
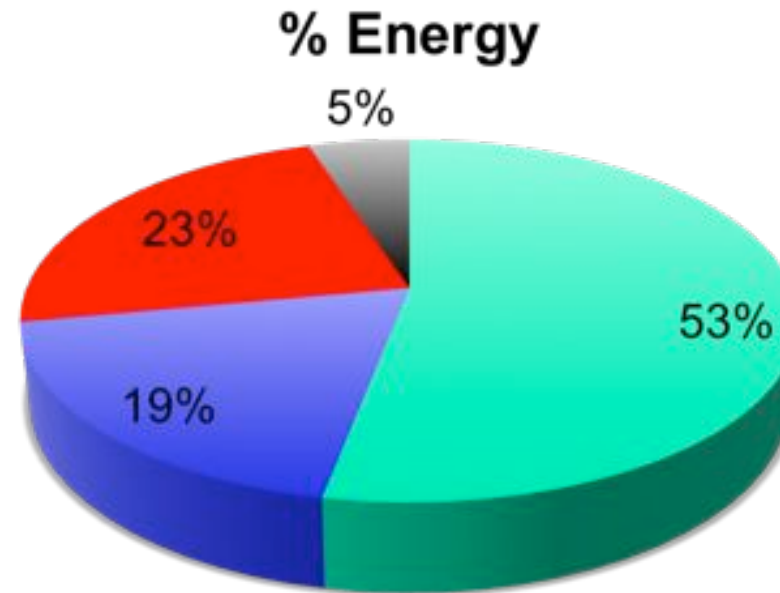
% Energy

- 53% Retail
- 19% Transport
- 23% Primary & Secondary chilling & Freezing
- 5% Chilled and frozen storage

Energy mapping - refrigeration
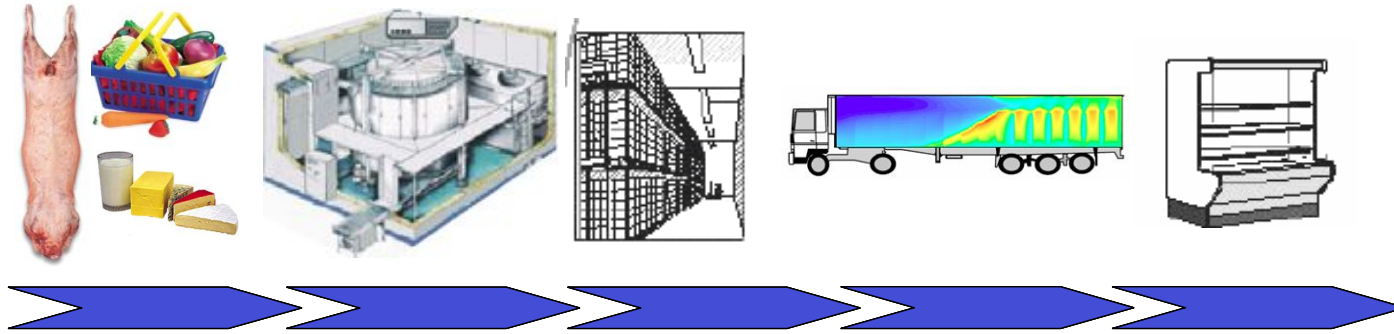
	Chilling	Freezing	Thawing Tempering	Secondary cooling	Chilled Storage	Frozen Storage	Transport	Retail	Catering
Energy used									
Throughput									
Energy change in food									
Efficiency									
Energy that could be saved									

Problem

- Little measured data on energy consumed in a food refrigeration process

- Common sources for much 'quoted' data and source usually an 'educated' estimate

- In the few cases where data had been measured there was no data on food i.e. throughput and temperatures

Energy mapping – top ten ranking

1	**Retail display**
2	**Catering – kitchen refrigeration**
3	**Refrigerated transport**
4	**Cold stores**
5	**Blast chilling – ready meals, pies, etc**
6	**Blast freezing – potato products, etc**
7	**Dairy processing – milk/cheese**
8	**Milk cooling – raw milk on farm**
9	**Potato storage – bulk raw potatoes**
10	**Primary chilling – meat carcasses**

1 - Retail display

- **5,800 to 12,700 GWh/year**

- **Data sources**
  - **Market Transformation Programme**
  - **FRPERC test data**

- **Estimate of cabinets in use - agreement**

- **Average energy consumption - variable**

2 - Catering – kitchen refrigeration

- **4,000 GWh/year**
- **Data sources**
  - Market Transformation Programme
  - FRPERC test data
- **Commercial service cabinets**
- **Walk-in cold rooms**

3 - Transport

- **4,820 GWh/year**
- **Data sources**
    - **Cold Storage & Distribution Federation**
    - **Brunel University - Savvas Tassou**
- **52,000 refrigerated vehicles in use**
- **Average 26 litres/day for refrigeration**

4 - Cold stores

- **900 GWh/y**
- **Data sources**
  - Cold Storage & Distribution Federation
  - Carbon Trust
- **Based on 2004 benchmarking exercise**
- **200 primary cold store sites**
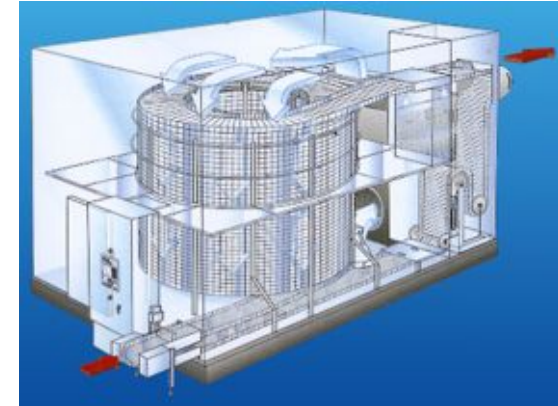- **9.65 million cubic metres capacity**
- **New study updating data**

5 - Blast chilling

- **310 to 610 GWh/year**

- **Data sources**
  - Market survey data 1.2m tonnes
  - Food & Drink Federation data

- **Cooling of (hot) products most energy**
  - Ready meals
  - Pies
  - Pizzas etc

- **Lack of process benchmarking data**

6 - Blast freezing

- **220 to 420 GWh/year**

- **Data sources**
  - Market survey data 3.2 m tonnes
  - British Frozen Food Federation

- **Blast freezing of products**
  - Processed potato - 1 m tonnes
  - Ice cream
  - Vegetables

- **Benchmark data 70 to 133 kWh/tonne**

7 - Milk cooling - raw milk on farm

- **100 to 320 GWh/year**
- **Data sources**
  - **Dairy UK**
  - **Milk Dev Council / Farm Energy Centre**
  - **US energy efficiency study**
- **14.6 m tonnes raw milk cooled 37 to 4ºC**
- **6.8 to 21.6 kWh/tonne measured**

8 - Dairy processing - milk/cheese

- **250 GWh/year**

- **Data sources**
  - **Dairy UK**
  - **Milk Development Council**

- **Dairy processing**
  - **Milk pasteurisation/cooling - 6.9 m tonnes**
  - **Cheese production - 0.39 m tonnes**

- **Milk published benchmark 20 kWh/tonne**

9 - Potato storage - bulk raw

- **140 to 190 GWh/year**
- **Data sources**
  - **British Potato Council**
  - **UK study – Devres & Bishop**
- **71.8 to 93.4 kWh/tonne cooling/storage**
- **6 m tonnes/y - estimated 2 m refrigerated**

10 - Primary chilling - meat carcasses

- ## 110 to 140 GWh/year

- ## Data sources
    - ### Production data / Defra, FAO
    - ### FRPERC measured data

- ## 3.39 m tonnes meat production

- ## Measured mean of 34 kWh/tonne beef

- ## Measured mean of 42.5 kWh/tonne pork

Energy mapping – top ten ranking

			Saving	
		GWh/y	%	GWh/y
1	Retail display	5800 - 12700	30-50	6300
2	Catering – kitchen refrigeration	4000	30-50	2000
3	Transport	4820	20-25	1200
4	Cold storage - generic	900	20-40	360
5	Blast chilling – (hot) ready meals, pies	310 - 610	20-30	180
6	Blast freezing – (hot) potato products	220 - 420	20-30	130
7	Milk cooling – raw milk on farm	100 - 320	20-30	100
8	Dairy processing – milk/cheese	250	20-30	80
9	Potato storage – bulk raw potatoes	140 - 190	~30	60
10	Primary chilling – meat carcasses	110 - 140	20-30	40

Thank you for listening

More information at:

http://www.grimsby.ac.uk/What-We-Offer/DEFRA-Energy/

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