# Energy use in the catering sector

# Case study – Refrigeration at the Langford canteen

# University of Bristol

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## Introduction

The catering sector is one of the major users of energy for refrigeration in the food industry. However, there are few data on the energy consumed by equipment in use in UK catering establishments.

The aim of this study was to collect data on the energy consumed by a range of commercial refrigeration equipment in real use and identify the savings that could be made by low cost energy saving measures. It was carried out in a central kitchen which serves the whole of the Langford site belonging to the University of Bristol, home to the School of Veterinary Science, typically providing 200 to 300 meals per day, with a capacity to serve 500.

The site was chosen as it has a range of commercial refrigeration equipment of different types, ages and condition found in many catering kitchens and is easily accessible.

## Method

**The Langford canteen kitchen has a range of refrigeration equipment using a nominal 230 Volt/50 Hz plug-in mains supply as listed in**

Table 1.

To provide data on the energy consumption of a range of catering refrigeration equipment operated under actual use conditions, the energy consumption of each individual item of refrigeration equipment listed in Table 1 was continuously monitored using a Plug-in Power and Energy Monitor (Model 2000MU, Prodigit Electronics, China) and recorded at 24 hourly intervals for a minimum of 7 days.

The ambient air temperature within the kitchen was recorded using a portable data logger (Comark, Model 2015, England) at 5 min intervals.

**Table 1. Refrigeration equipment monitored in Langford canteen kitchen**

| *Equipment* | *Description* |
|---|---|
| Gram freezer | Upright, 1 solid door, -21ºC |
| Polar fridge | Upright, 2 solid door, 3ºC |
| Polar fridge | Counter level, 4 solid door, 5ºC |
| True cold drink vending m/c (Coca Cola) | Refrigerated bottle vendor, ºC |
| Ice cream freezer cabinet (Mars) | Chest freezer, sliding glass doors, -20ºC |

Subsequently, the equipment considered to have the greatest potential for energy saving was selected and low cost energy saving measures were carried out. Following these changes, a further energy consumption trial was carried out to enable any improvements in energy efficiency to be quantified.

## Results and discussion

The mean and standard deviation of energy consumption (kWh/24 h) of each item of catering refrigeration equipment measured in the Langford canteen kitchen case study are provided in Table 2.

**Table 2. Energy consumption data for the Langford canteen kitchen. Standard deviation in parentheses)**

| *Equipment* | *Mean energy consumption (kWh/24 h)* | *Proportion of total energy used for refrigeration equipment (%)* |
|---|---|---|
| Gram upright freezer | 12.7 (0.72) | 40.4 |
| Polar 2 door upright fridge | 5.8 (0.57) | 18.5 |
| Polar 4 door counter fridge | 4.4 (0.20) | 13.9 |
| True cold drink vending m/c (Coca Cola) | 4.7 (0.28) | 14.9 |
| Ice cream freezer cabinet (Mars) | 3.9 (0.02) | 12.3 |
| Total consumption | 31.4 | |

The energy consumption varied from a minimum of 3.9 kWh/24 h for the ice cream freezer to a maximum of 12.7 kWh/24 h for the upright freezer (commercial service cabinet). This single door upright freezer (Figure 1) alone accounted for over 40% of the total energy consumed by all of the 240 V refrigeration equipment in the kitchen. It also appeared to be consuming more energy than expected relative to manufacturers' test data for similar sized freezers. Therefore, this unit was selected for further study to investigate if any low cost energy saving measures could be applied.

During the test period the mean kitchen temperature was 22.6ºC (Standard deviation 1.27ºC).

**Figure 1. Upright commercial service cabinet freezer in canteen**

**Effect of cleaning the condenser**

On further inspection it was noticed that the condenser unit mounted on the top of the freezer was extremely dirty and clogged with the accumulation of dust, grease etc. from continuous use in the kitchen environment (Figure 1).

**Figure 2. Top mounted condenser unit prior to cleaning**

Therefore, the unit was completely cleaned and allowed to equilibriate prior to starting a new energy consumption trial.

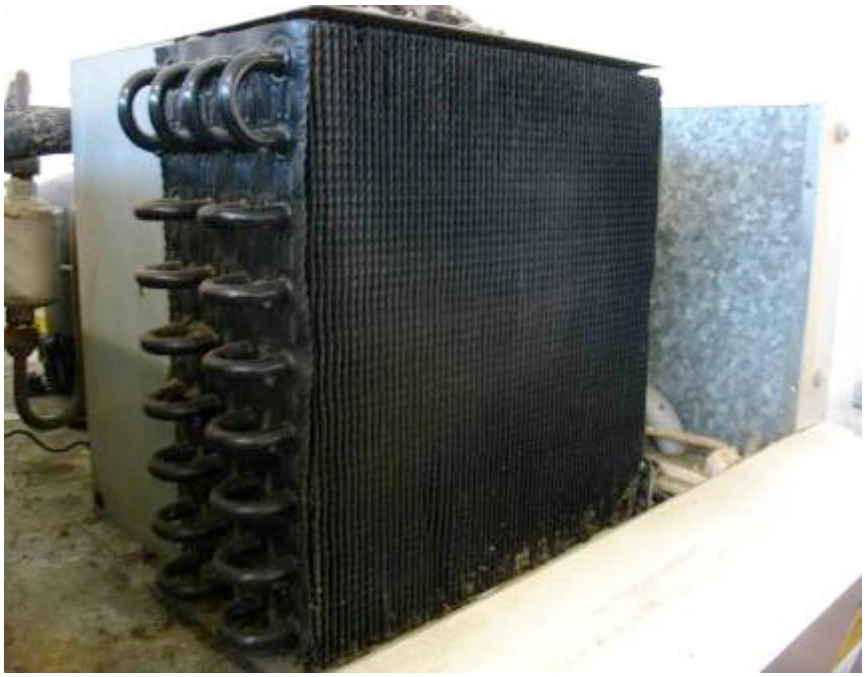

**Figure 3. Top mounted condenser unit after cleaning**

Table 3 illustrates the energy saving available due to the simple low cost measure employed (cleaning of the condenser unit) for the selected upright freezer. This alone reduced the energy consumption from 12.7 to 11.7 kWh/24 h, a saving of 8%.

**Table 3. Energy saving due to cleaning of freezer condenser unit**

| *Equipment* | *Mean energy consumption prior to cleaning* *(kWh/24 h)* | *Mean energy consumption after cleaning* *(kWh/24 h)* | *Percentage saving due to cleaning* *(%)* |
|---|---|---|---|
| Gram upright freezer | 12.7 | 11.7 | 8.0 |

**Effect of increasing the freezer set point temperature**

During normal running the freezer temperature control was set to -21ºC, however, after discussion with the kitchen manager it was evident that it would be quite acceptable to run at a higher temperature. Therefore, it was decided to quantify the effect on energy consumption of increasing the set point by 5ºC.

Table 4 illustrates the energy saving achieved by the simple low cost measure of increasing the set point temperature for the selected upright freezer. This alone reduced the energy consumption from 11.7 to 10.4 kWh/24 h, a saving of 11%.

**Table 4. Energy saving due to increasing the freezer set point temperature**

| *Equipment* | *Mean energy consumption prior to change (kWh/24 h)* | *Mean energy consumption after change (kWh/24 h)* | *Percentage saving due to increased set point temperature (%)* |
|---|---|---|---|
| Gram upright freezer | 11.7 | 10.4 | 11.0 |

## Conclusion

Mean daily energy consumption data for a range of five different refrigeration systems (240 V, 50 Hz) under “actual use” conditions in a working catering kitchen have been provided. Values of energy consumption varied from a minimum of 3.9 kWh/24 h for the ice cream freezer to a maximum of 12.7 kWh/24 h for the upright freezer (commercial service cabinet).

The trial also demonstrated that a two simple low cost measures (cleaning the condenser coil and resetting the thermostat) achieved energy savings of 8 and 11% respectively.