Energy and carbon performance analysis for supermarket refrigeration

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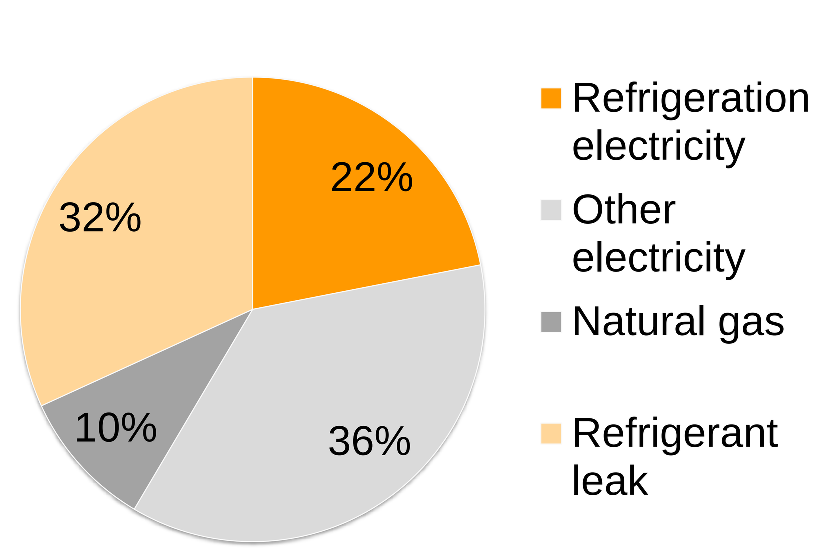
INTRODUCTION & AIM

Figure 1



Supermarkets in the UK are responsible for 3% of the total energy consumption and more than half of their GHG emissions lie in refrigeration (figure 1) . This comes from two aspects: indirect emissions from electricity consumption and direct emissions from refrigerant leakage (figure 2). This work examines the energy and carbon performance of supermarket refrigeration and proposes recommendations. The result of this project comes under the Imperial-Sainsbury's partnership to reduce their carbon footprint.

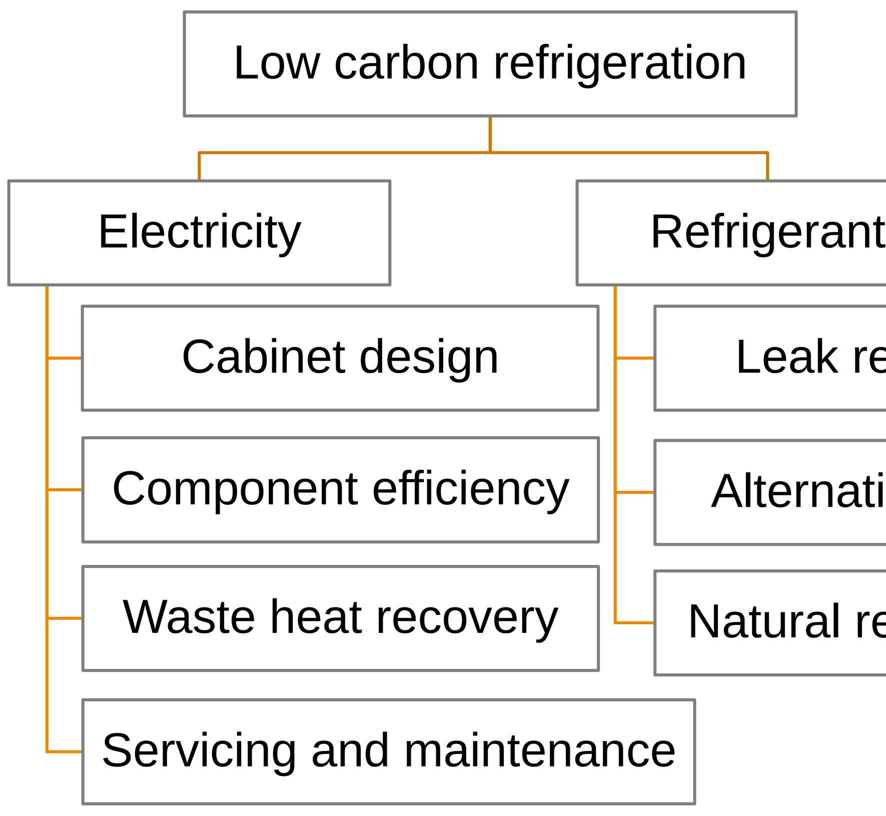
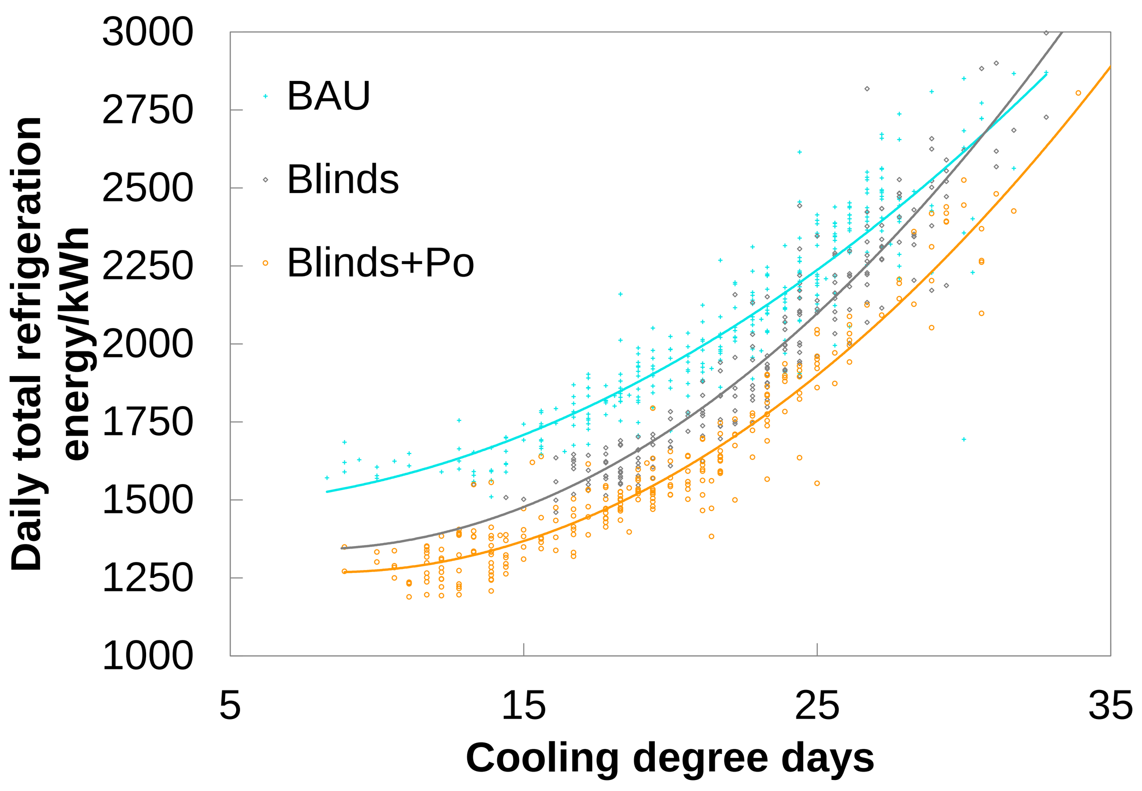


Figure 2

RESULTS

Figure 3



1. Energy saving initiatives

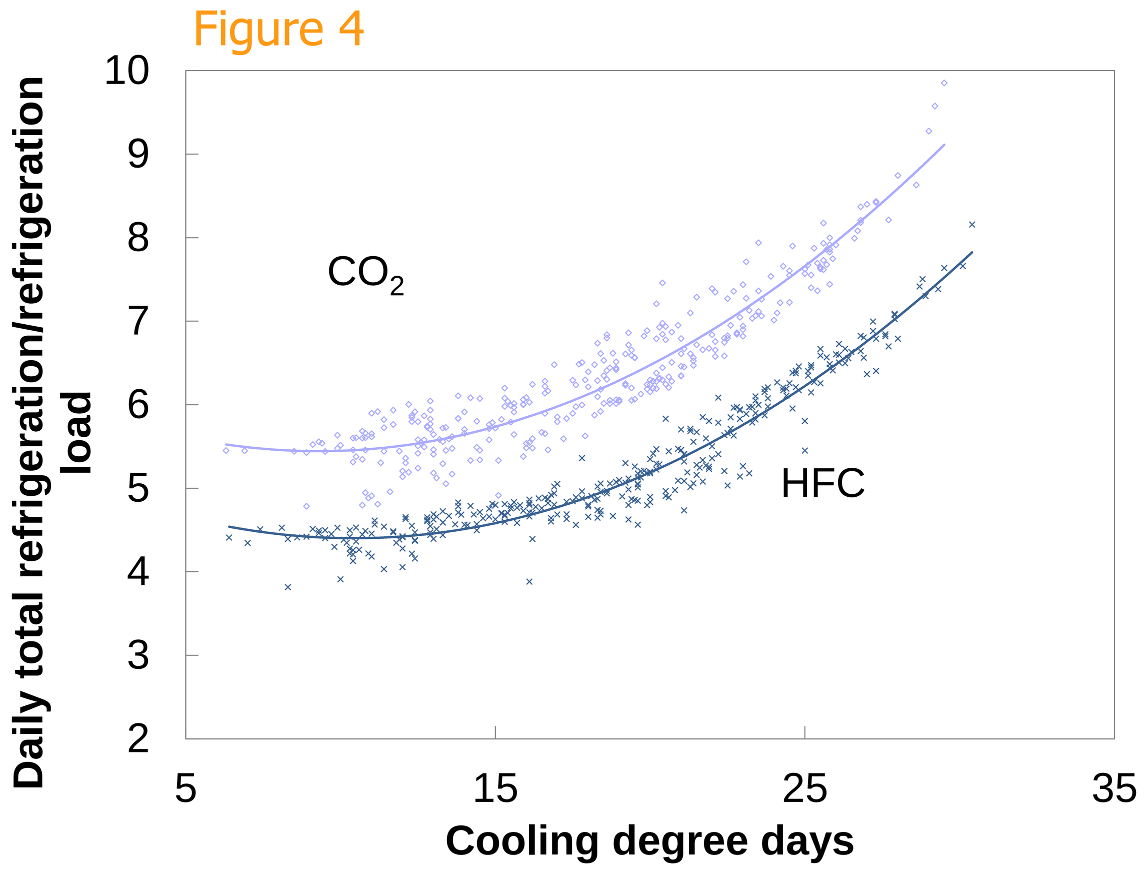
Night blinds on cabinets have much smaller impacts on shoppers and staff compared to glass doors. This was trialled in store and its results are shown in figure 3. It can be seen refrigeration energy consumption is closely linked to external temperature, this allows energy prediction. Night blinds (grey) save 9.8% energy on refrigeration compared to BAU (blue), representing 36.5 tonnes CO_2e. Noting savings are largely dependent on colleague engagement.

Packs optimisation (Po) saves energy by reducing the pressure lift for compressors. Figure 3 shows energy is again reduced after Po was implemented (orange). On average, Po achieves 8.4% energy savings, which means 30 tonnes CO_2e. The payback period is less than 3 months.

2. Low carbon refrigerant system

HFC refrigerants are very strong GHGs. Energy usage for HFC systems is compared with those run on CO_2 refrigerants. It was found that CO_2 system uses more energy but saves more than 50% emissions (figure 4). In addition, further analysis shows CO_2 systems perform poor in hotter climates. They start to consume more energy when average external temperature goes above 12ºC.

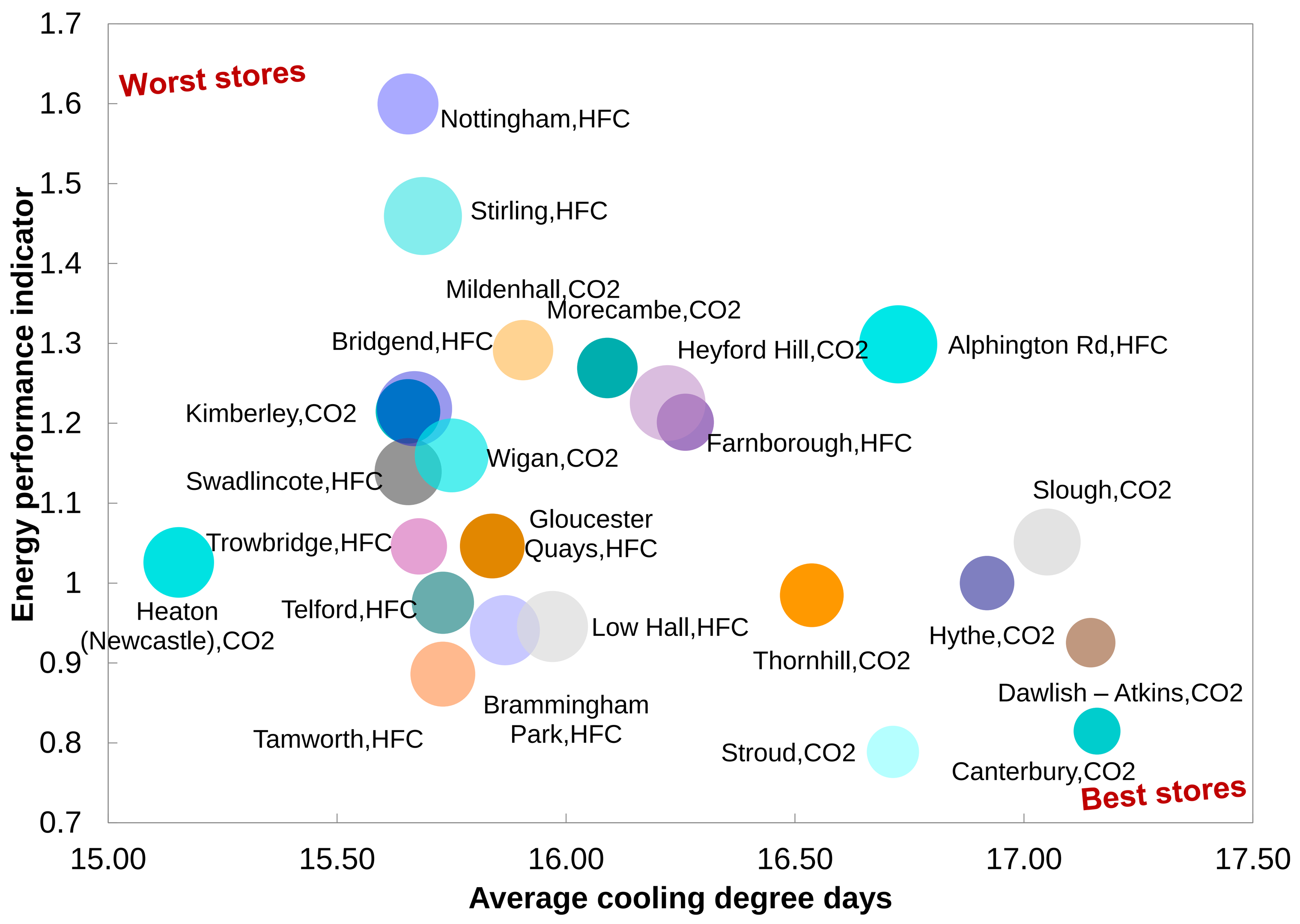
Figure 4



3. Energy performance indicator

Energy comparison across different stores is difficult since each store is unique. An energy performance indicator which incorporates opening hours, ambient temperature and refrigeration load is developed, shown in figure 5. Stores locating at the top left corner are the worst performing stores therefore should be addressed first. Size of the bubbles represents actual yearly energy consumption. This is also be conducted with bubble sizes representing actual CO_2e.

Figure 5



CONCLUSIONS

Refrigeration is responsible for a significant amount of energy usage and GHG emissions in supermarkets. Many technologies are available to improve this at low to negative cost. Among them, night blinds, packs optimisation and CO_2 refrigerant systems were studied. They former two prove to have good energy savings with short paybacks. Despite CO_2 systems do not save energy, they have much smaller overall carbon footprints.

REFERENCES

The Carbon Trust, "Refrigeration Road Map," The Carbon Trust, 2010.
"Food & Drink Industry Refrigeration Efficiency Initiative," Food and Drink Federation, 2007.