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Catering Sector Energy

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Summary

1. **Overview of Catering Service Cabinets (CSCs).**
2. **Mapping of energy use in CSCs**
3. **Energy effects of CSC design, features and use**
4. **Case studies**
5. **What can be done**
6. **Conclusions**

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Commercial Refrigeration Energy

Source: Market Transformation Programme MTP 2006

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Commercial Service Cabinets

- Virtually every catering outlet has CSCs.
- Over 500,000 units in the UK
  - More than 50,000 sold annually
- Mainly integral cabinets
  - Upright units 1 & 2 door
  - Under counter units of various designs
- Small bespoke market

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Top 10 in saving potential (GWh/y)

	Sector	Energy	Savings
1	Retail	12,700	6,300
2	Catering - kitchen refrigeration	4,000	2,000
3	Transport	4,800	1,200
4	Cold storage	900	360
5	Blast chilling-ready meals, etc	610	180
6	Blast freezing - potato products	420	130
7	Milk cooling - raw milk on farm	320	100
8	Dairy processing - milk/cheese	250	80
9	Potato cooling/storage	190	60
10	Chilling - meat carcasses	140	40

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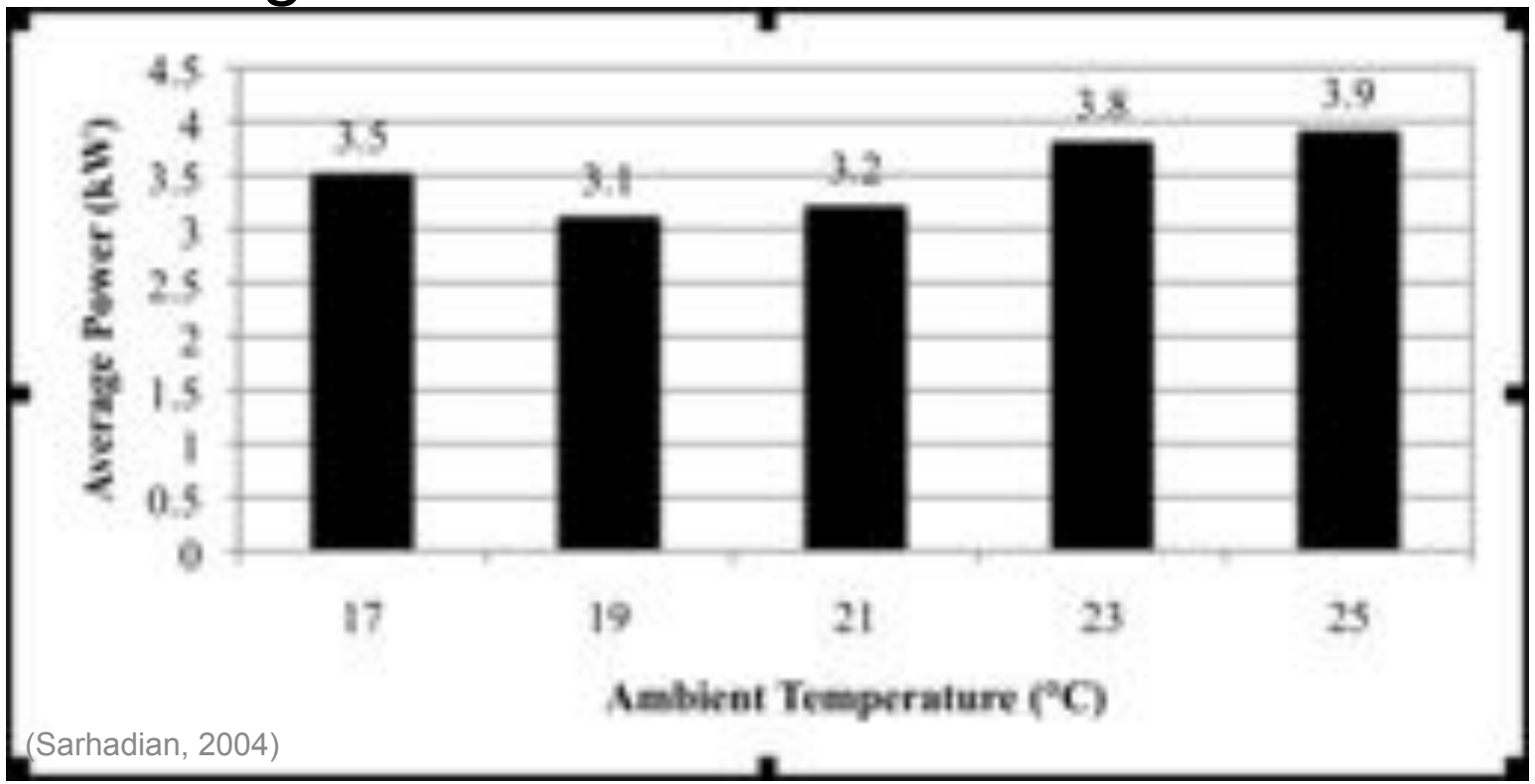
Ambient Temperature

- Catering establishment chillers and freezers



(Sarhadian, 2004)

- Refrigerated vending machines
- 8°C rise in ambient … 40% rise in energy use

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Commercial Service Cabinets

- Chilled units mean consumption 2,900 kWh per year.
- Frozen units mean consumption 5,500 kWh per year.
- Buying decision often based on capital, rather than running cost
- Energy saving features are not widespread.

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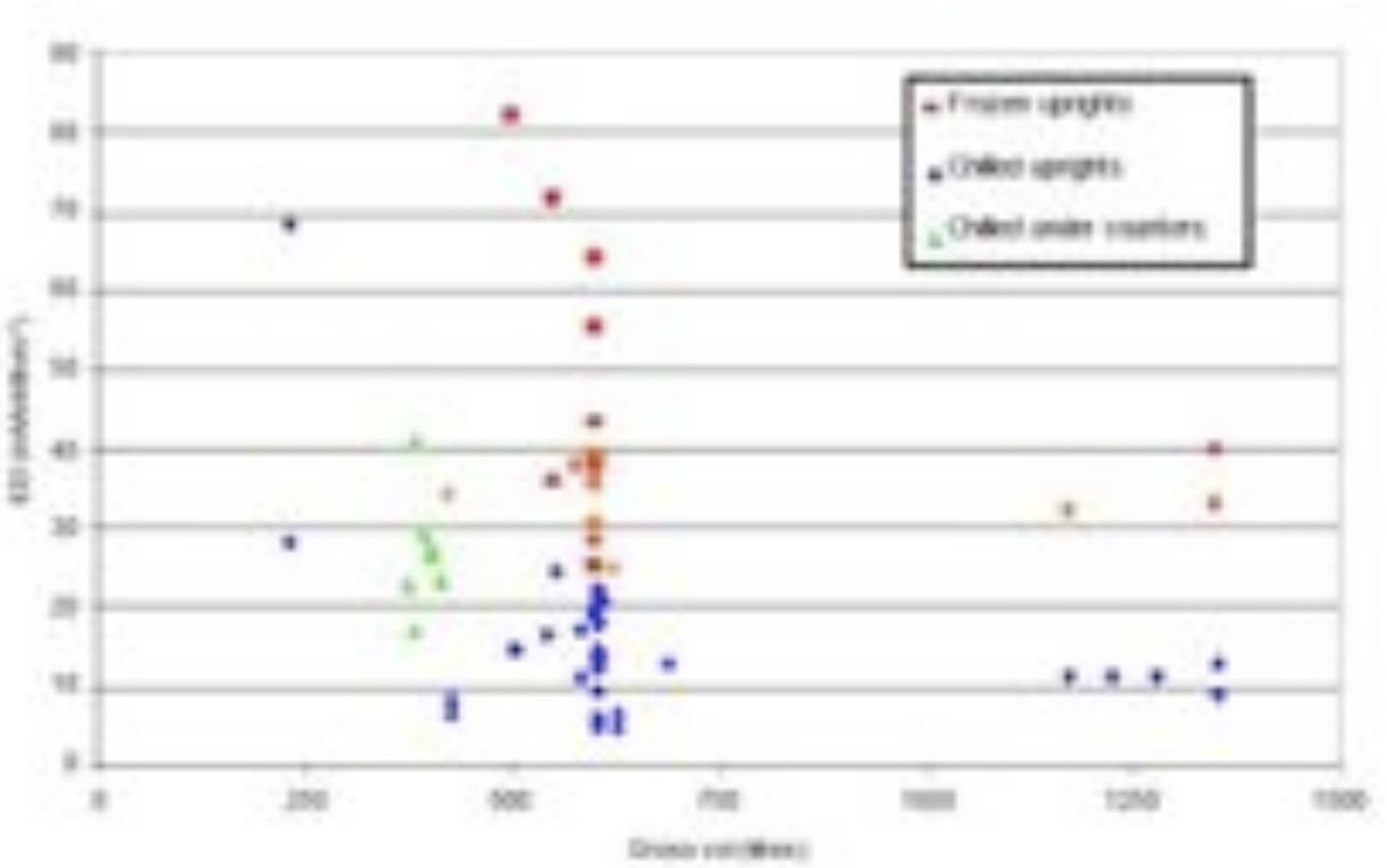
Efficiency Ranges (EN441)



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Design Effects (EN441)

	EEI (kWh/48h/m³)		
	Mean	Max	Min
Solid door (chilled)	**15.24**	**68.74**	**4.85**
Chest freezer	16.26	36.53	4.47
Glass door (chilled)	22.40	41.65	10.07
Multi-deck (chilled)	24.31	68.92	7.85
Glass door (frozen)	38.34	54.58	11.88
Solid door (frozen)	**39.28**	**82.04**	**24.75**
Well (frozen)	43.15	89.19	16.72

EN441 test environment at 30°C, 55% RH

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Commercial Service Cabinets

- Freezers less efficient than chillers
- Chest freezers more energy efficient but less convenient

- Large efficiency differences in all categories due to
  - Design
  - Operation
  - Use

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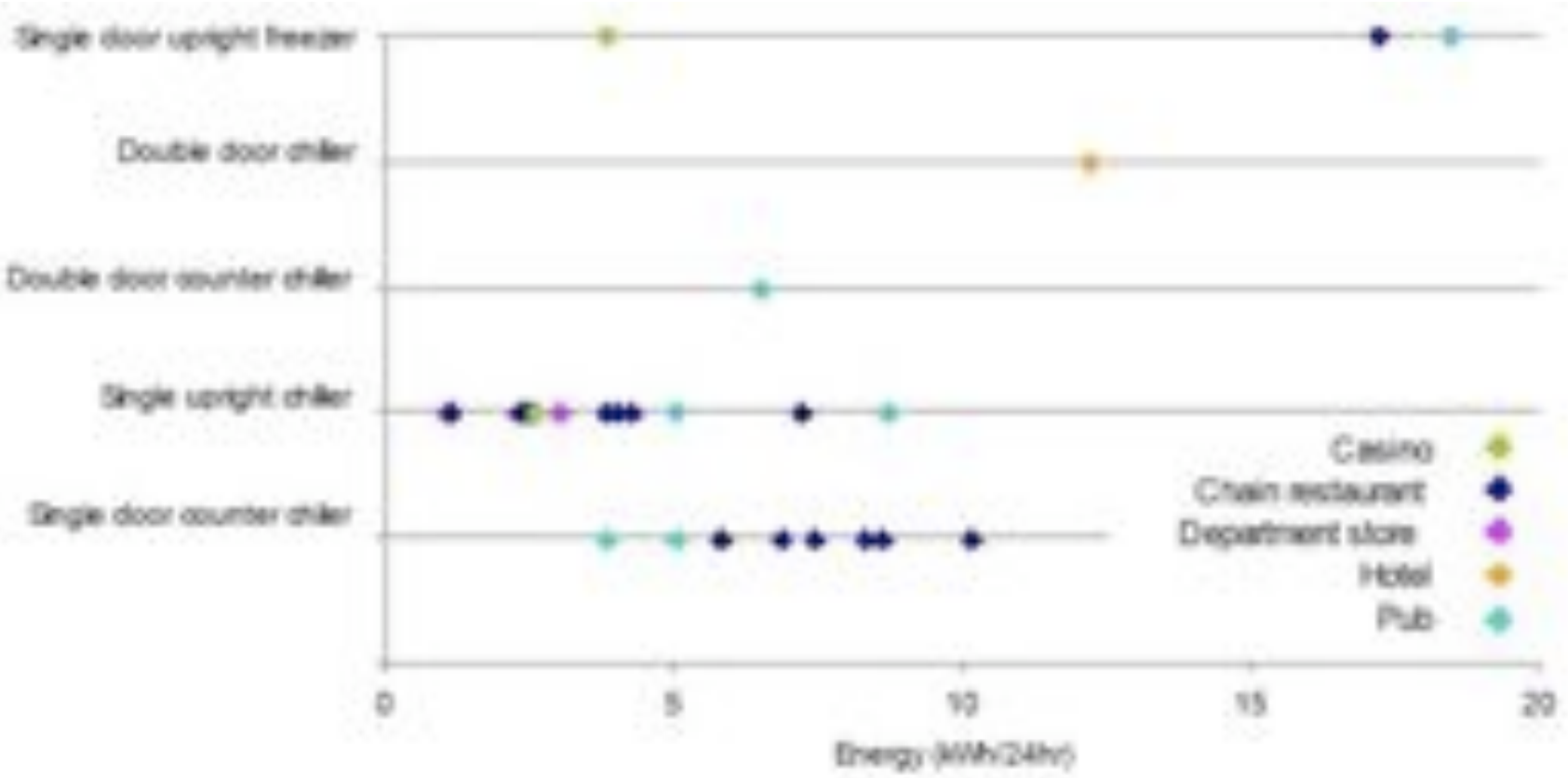
Real Situations



EN441 mean test data for single upright chiller

- 7.6 kWh/24hr (solid door)
- 11.2 kWh/24hr (glass door)

indicating EN441 test is more onerous than real situations

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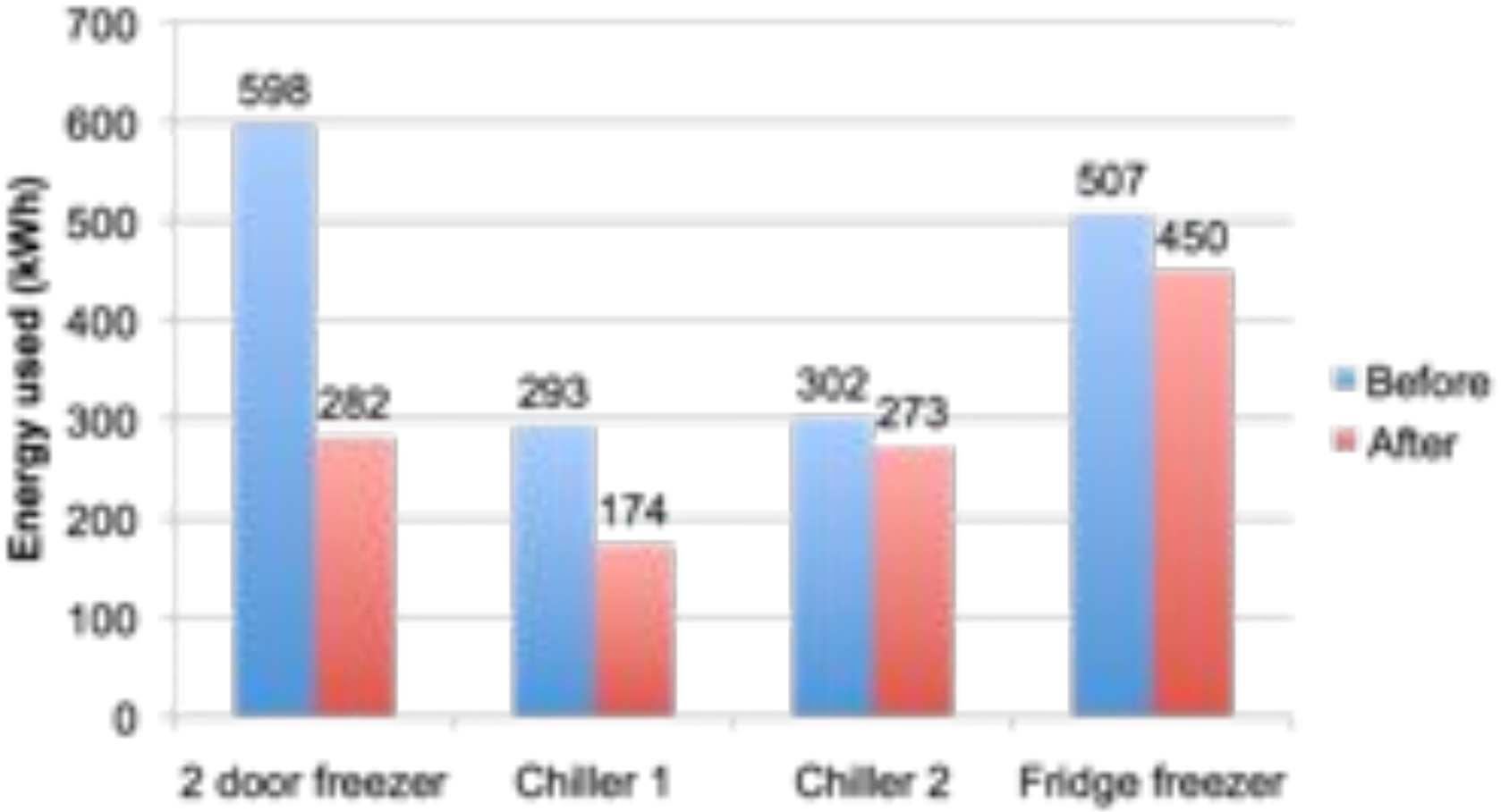
Design Improvements (1)

- Catering sector chillers and freezers
- Greatest individual gains from
  - Optimising door seals
  - DC fans
  - Re-use of waste heat
- Mean energy improvements
  - Chillers: 6.26 to 1.62 kWh/day (74%)
  - Freezers: 8.53 to 4.54 kWh/day (47%)

Pedersen et al, 2004

Design Improvements (2)



Pedersen et al, 2004

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Energy Saving Measures for Designers (1)

- Good insulation
- Avoid thermal bridges in structure
- Reduce fan speed when food close to air temperature
- High air flows for temperature changing (improved heat transfer)
- Low air flows for storage (avoid unnecessary heating)
- High efficiency components

Energy Saving Measures for Designers (2)

Technology	Rationale	Commonly used in CSC's	Estimated energy saving potential
Suction-liquid heat exchange	Sub cool liquid	Yes	10%
Liquid line solenoid	Removed 'off-cycle' losses	Not standard	10% (dependent on off cycle time)
Control systems - fan pulsing, compressor start up control	Reduce unnecessary loads	Not standard	Up to 30%
Inverter driven compressors	Reduction in start up losses, off cycle losses	No	20%
Off-cycle defrost	For chilled cabinets only	Yes	5%
Discharge gas defrost water evaporators	Removed need for electrical heaters	Yes	2%
DC fans	Lower energy usage	Not standard, becoming more widely used	1%
Gasket heaters	Removing/reducing gasket heaters. Lower energy usage	Not standard	1%
Improved insulation	Reduced heat load	No	20%

NB. Energy savings potential is not necessarily cumulative

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Case Study: Catering Refrigeration Energy Reduction

- Small catering kitchen
  - Serving 200-300 meals/day
  - Capacity for 500 meals/day
- All refrigeration equipment monitored with plug type energy meters
- Equipment with greatest potential for energy saving selected.
- Low-cost energy saving measures carried out
- Retest

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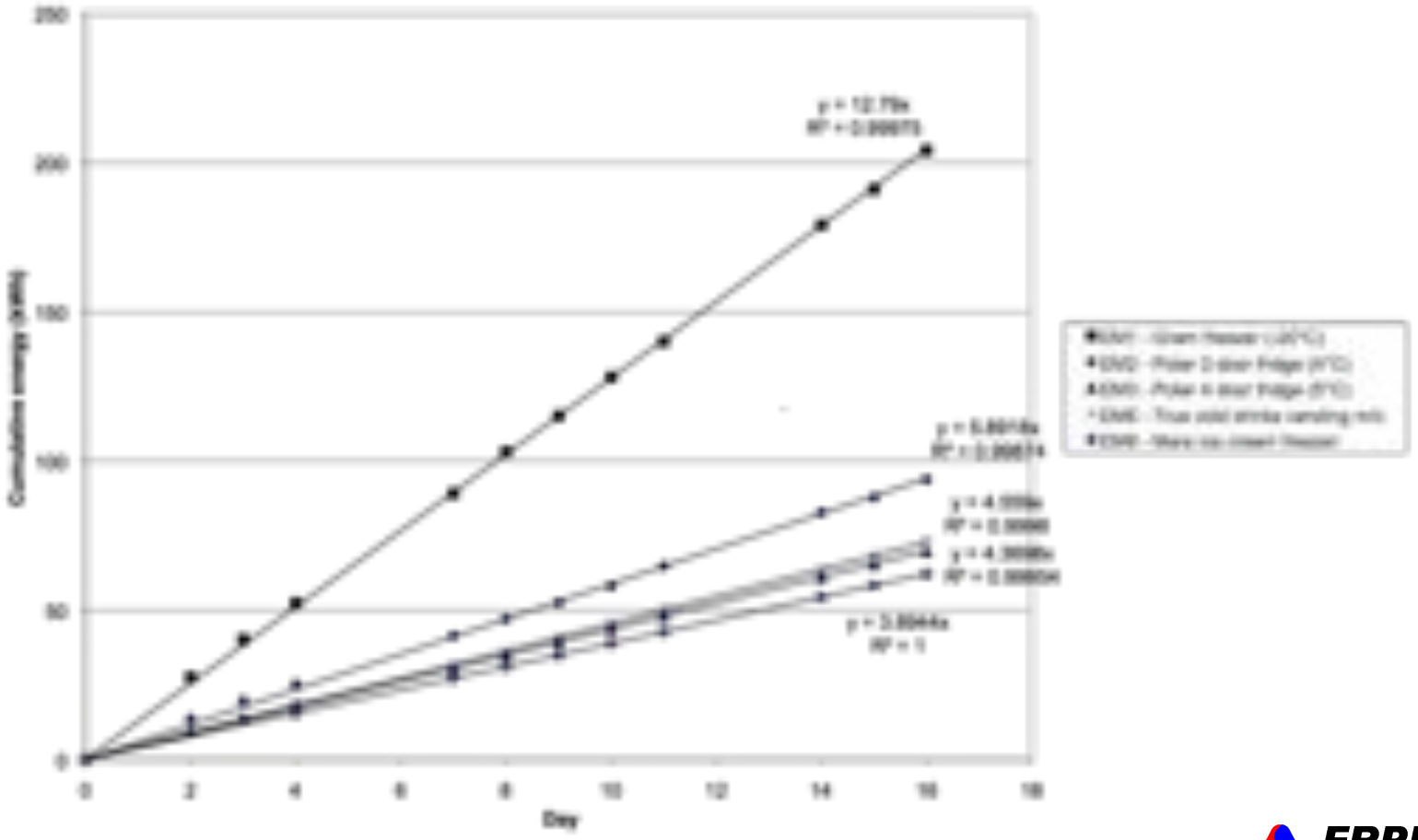
Case study: Overall Kitchen Refrigeration Energy Use



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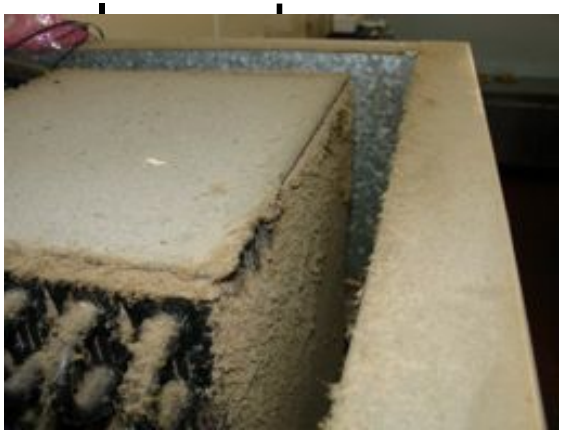
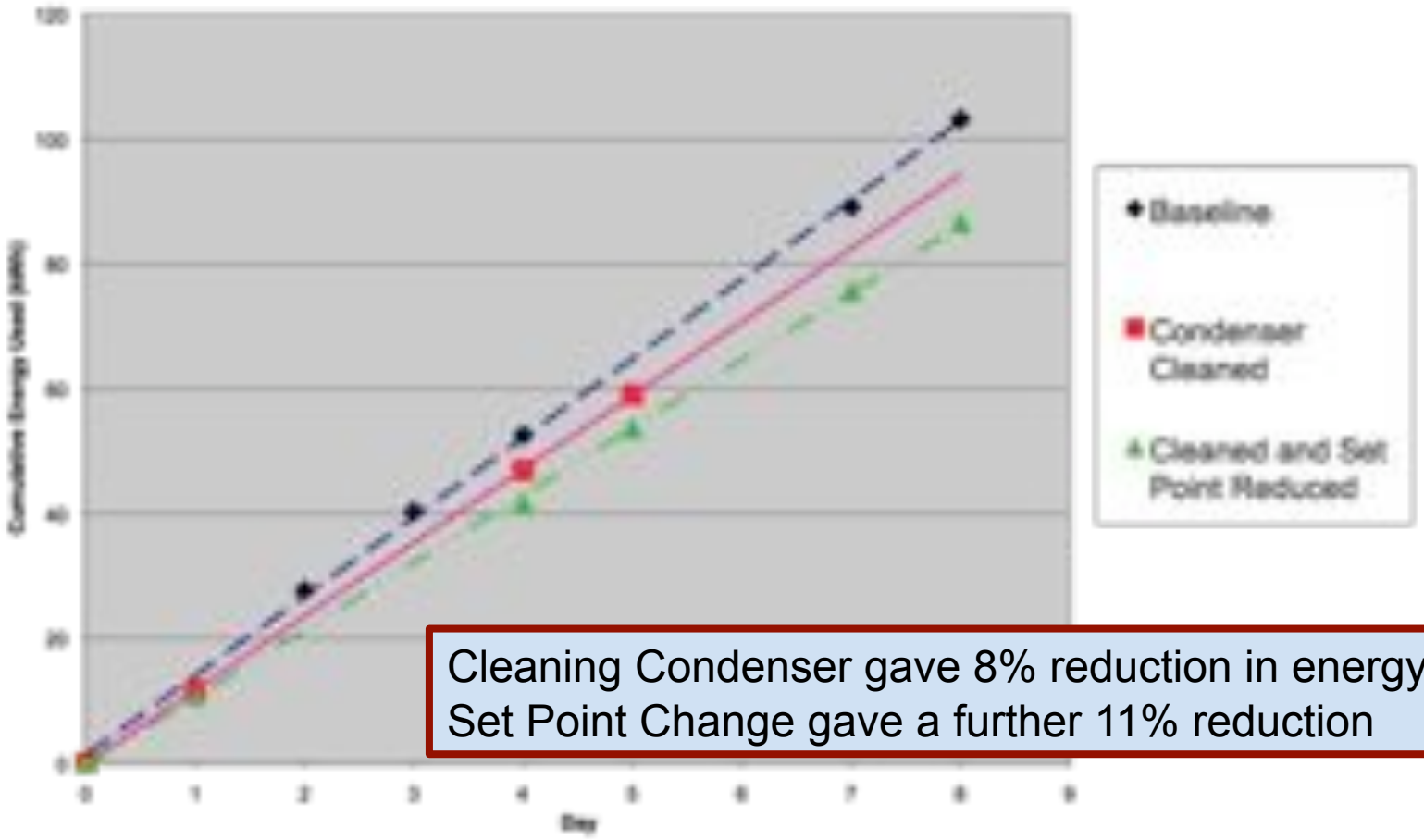
Case study: Changes

- Upright freezer using <40% of total refrigeration energy selected for energy saving changes.
- Accumulated grease and dirt cleaned from condenser



- Set point increased from -21°C to -16°C

Case study: Energy Savings



Cleaning Condenser gave 8% reduction in energy.
Set Point Change gave a further 11% reduction

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Simple Energy Saving Measures for Users (1)

- Minimise heat load
  - Ambient cooling for hot products (less heat to extract)
  - Reduce packaging (less to cool)
  - Fans and lights off (less heat inside unit)
  - Ensure door seals intact (less heat ingress)
- Efficient heat transfer
  - Reduce packaging (better ‘coolth’ transfer to food)
  - Wrap products (reduces moisture on evaporator)
  - Clean condenser (improves heat rejection to ambient)

Simple Energy Saving Measures for Users (2)

- ‘Optimised’ operation
  - Keep door closed as much as possible
  - Reduce fan speed when food close to air temperature
  - Thinner layers of products cool quicker (if airflow OK)
  - Load to prevent airflow short circuits
  - Set point no lower than necessary
- Environment
  - Site cabinets away from heat sources (cookers, direct sunlight, south facing walls, etc)

Conclusions

- Catering service cabinets are major user of energy with good potential for savings
- Relatively little data and few studies
- Performance is highly variable
- Substantial improvements can be effected at design stages (but purchase decisions based on capital cost can limit uptake)
- Simple user measures can make real improvements.

Thank you for listening

More information at:

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

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