

Electrical Energy Efficiency on the dairy farm

Your energy bill

Number of units consumed
X

Price(s) per unit

plus

Standing charge (electricity/gas)

Energy efficiency/carbon footprint

Current situation compared with *either*:
less energy consumed for same output

or:

Same input for more output

Benchmarking dairy energy use by CAFRE

Renewable energy – reduce carbon footprint

CAFRE Energy Benchmarking

Range of electricity use on dairy farms

	kWh/cow/year	£/cow/year
Highest	531	~£70
Average	350	~£46
Lowest	182	~£24

1 in 7 dairy farms in CAFRE survey were not on the 'Nightsaver' Tariff, costing them on average an extra £8 per cow/year

Electrical Energy Efficiency

Dairy Centre, Greenmount

Technologies installed include:

- Variable speed 'dry' vacuum pump
- Versatile dairy milk cooling system including high volume plate cooler
- Heat Recovery Unit
- DX bulk tank
- High pressure sodium lights in cubicle area (200 lux at cow level), with photo sensor and timed dark period
- Real-time monitoring of electricity consumption
- Real-time monitoring of milk cooling temperatures

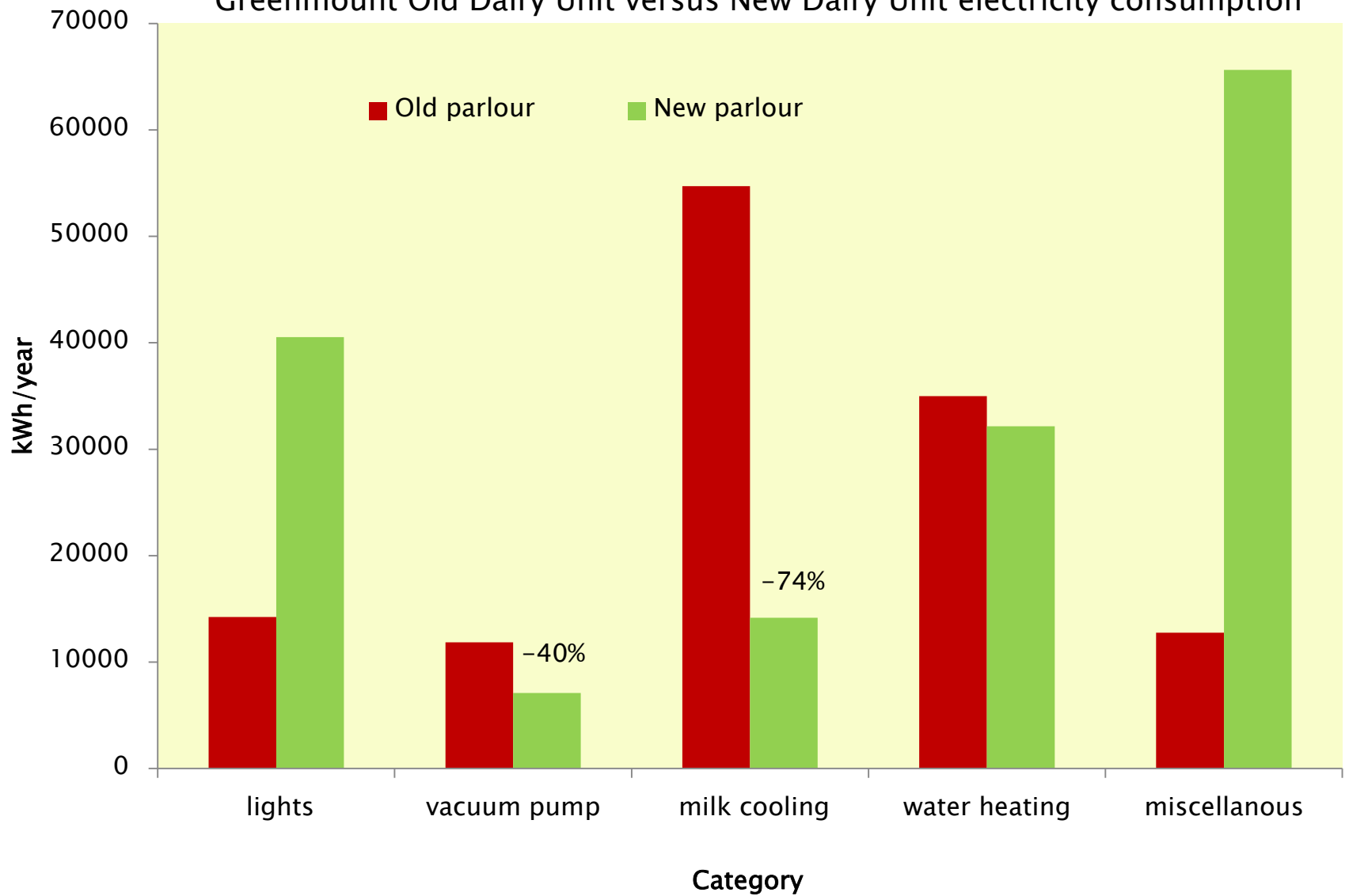
Electricity consumption comparison for Greenmount Old Dairy Unit and New Dairy Unit

kWh/year	<u>Old Unit</u>	<u>New Unit</u>	<u>Difference: New/Old</u>
Lights	14,242	40,539	+185%
Vacuum pump	11,866	7,107	-40%
Milk cooling	54,726 ^a	14,175 ^a	-74%
Water heating	35,000 ^b	32,167	-8%
Miscellaneous	12,759	65,646	+415%
Total parlour consumption	115,834	93,988	-19%
Total dairy consumption	128,593	159,634	+24%

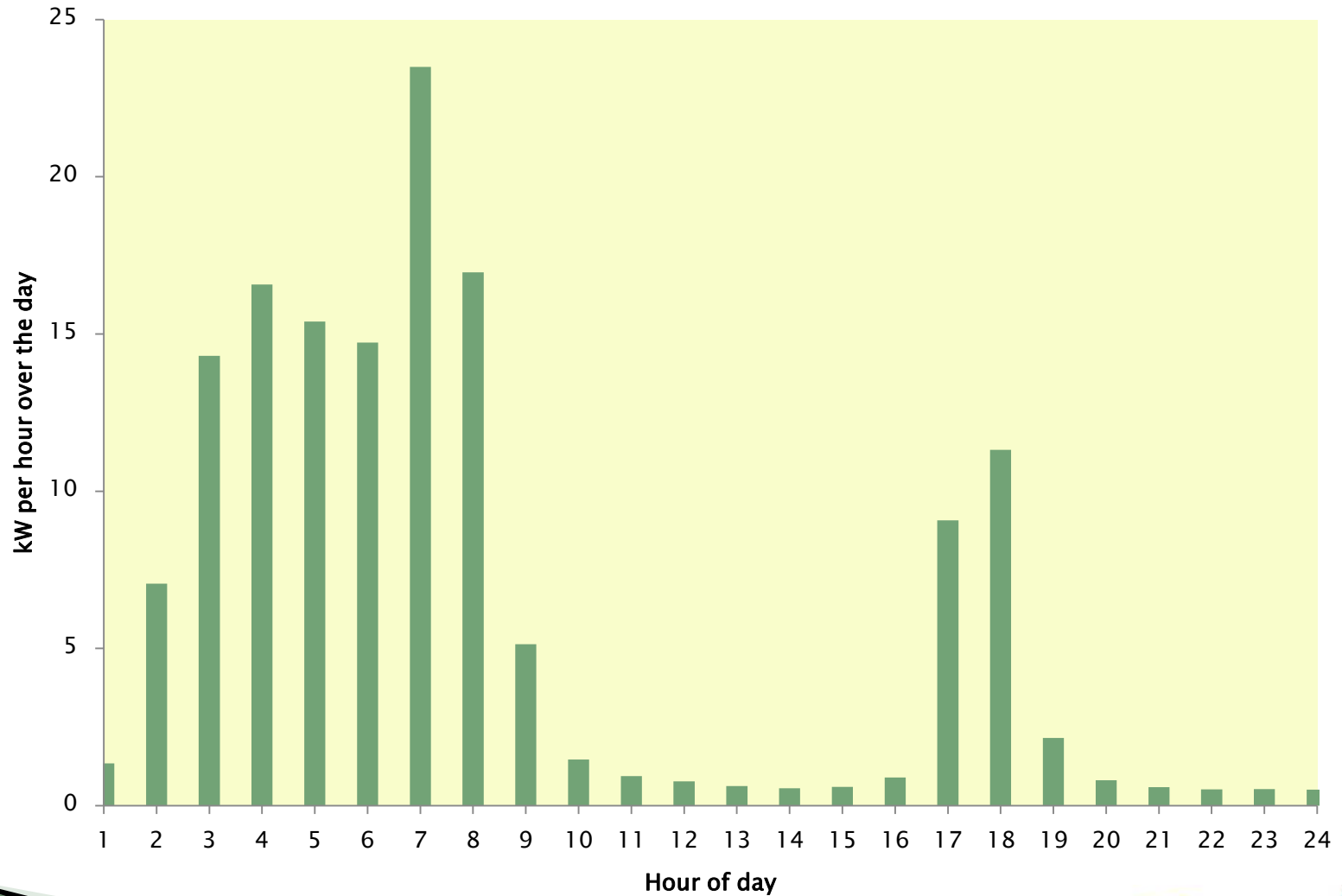
^a Milk cooling does not include plate cooler water pump electricity use

^b Twice/day water heating

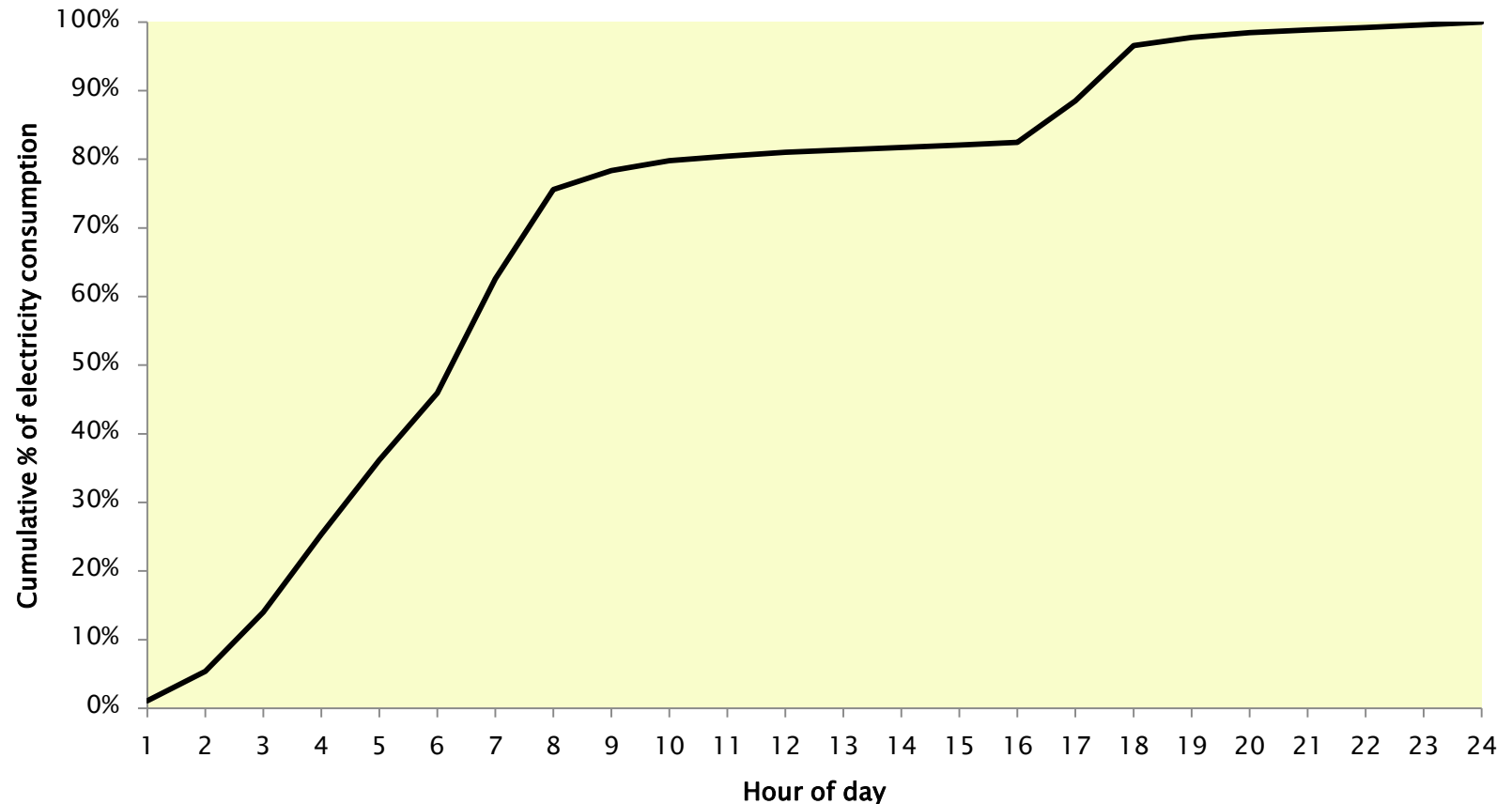
Greenmount Old Dairy Unit versus New Dairy Unit electricity consumption



Pattern of parlour electricity consumption in Greenmount New Dairy Unit

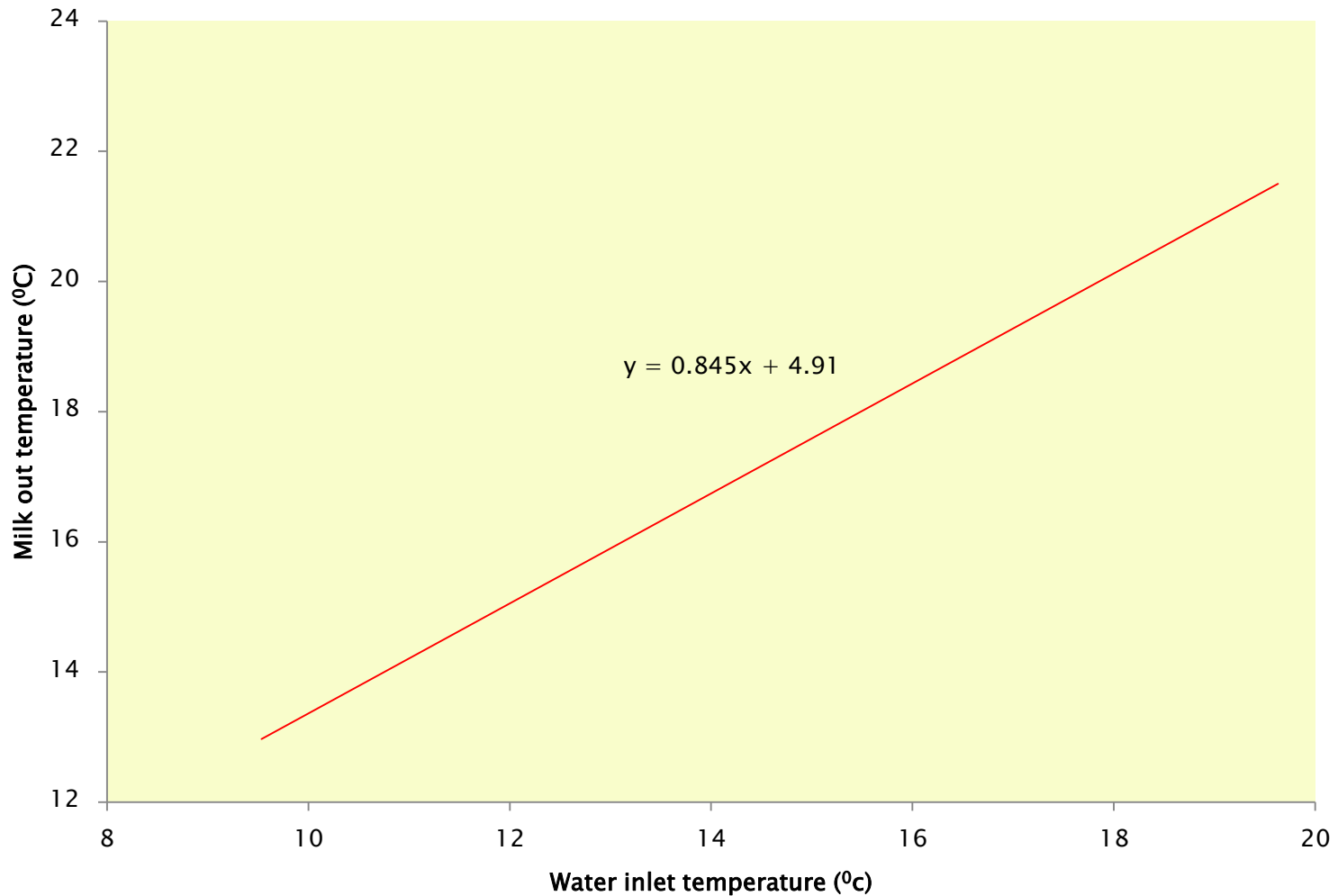


Cumulative pattern of parlour electricity use (vacuum pump, water heating, milk cooling)



76% of total electricity consumed by 8am

Impact of water temperature on milk cooling effect across plate cooler (Greenmount)



Direct correlation between water in temperature and milk out temperature

Milk cooling

Usually largest consumer of electricity on a dairy farm

Greenmount Versatile Dairy

Milk Cooling System

- High volume plate cooler using re-circulating water from header tank
- Slightly warmed water in header tank available for cow drinking and external parlour washing
- No water wasted due to re-circulation



Water header tank (30m³)



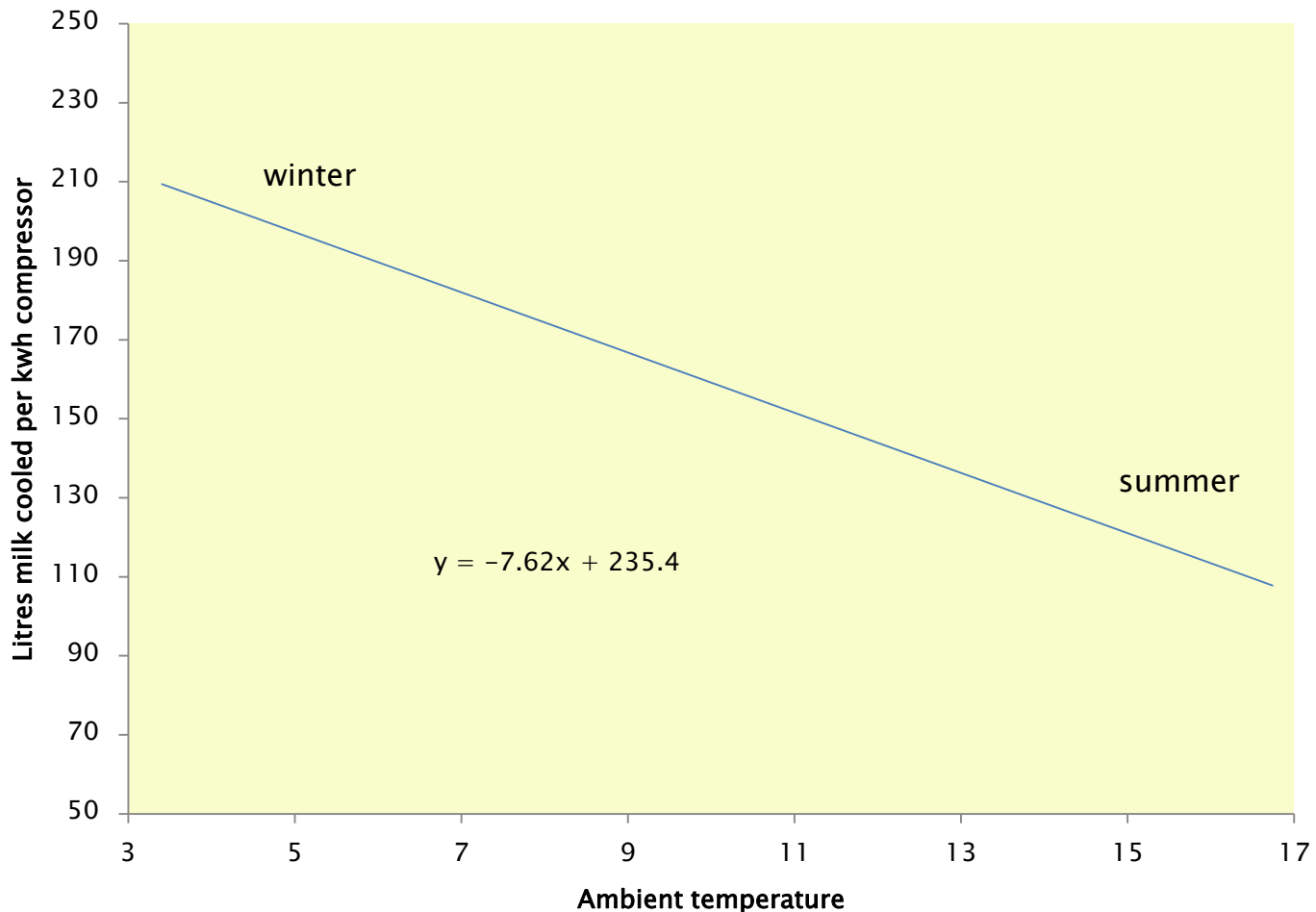
High volume plate cooler

Results from real time monitoring of plate cooler

	Milk temperature in	Milk temperature out ¹
Average for year	34.6°C	17.3°C
Summer	34.5°C	19.5°C
Winter	34.7°C	15.3°C

¹ 54% of remaining heat recovered by HRU

Effect of ambient temperature on bulk tank compressor cooling efficiency at Greenmount



Warmer milk post plate cooler and higher air temperatures in summer mean the compressor has to work harder compared to winter

Variable Speed Vacuum Pump

Positives

- Uses less electricity (up to 60% energy savings)
- *Greenmount experience; 4,760 kWh/year electricity saved (39%), compared to old parlour set speed pump*
~ £570/year
- It may be possible to convert an existing vacuum pump to variable speed

Negatives

- More expensive to purchase compared to standard set speed motor
- Usually requires 3 phase electricity
(can use inverter if only single phase available)

Online Decision Support Tool for variable speed vacuum pumping.

Screenshot of payback calculator for variable speed vacuum pump (DAERA website – online services – business tools)

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Location: [Home](#) > [Online Services](#) > [Business Tools](#) > Variable Speed Vacuum Pump Calculator

Menu

- + Calfre Business Applications
- + Beef Applications
- + Dairy Applications
 - + Buildings
 - + Business Management
 - + Energy Efficiency
 - Variable Speed Vacuum Pumping*
 - + Grass and Forage Management
 - + Nutrition
 - + Slurry and Dirty Water Management
- + Crop Applications
- + Pigs & Poultry Applications
- + Renewable Energy Applications
- + Sheep Applications

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Variable Speed Vacuum Pump Calculator

Milking Start Time

	Start Time	Finish Time
Morning	<input type="text"/>	<input type="text"/>
Afternoon/Evening	<input type="text"/>	<input type="text"/>
Third Milking	<input type="text"/>	<input type="text"/>

Electricity Information

Daytime price (p/kWh)	<input type="text"/>	Night time price (p/kWh)	<input type="text"/>
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Pump Information

Electrical motor size (kW)	<input type="text"/>	Full cost of new variable speed drive vacuum	<input type="text"/>
Full cost of new set speed vacuum	<input type="text"/>	% Electrical efficiency savings expected	<input type="text"/>

Results - Vacuum Pump

Run Time (hours/day)	<input type="text"/>	% of night time electricity usage	<input type="text"/>
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Results - Electricity

Vacuum pump	Standard	Variable
Electricity consumed/day (kWh)	<input type="text"/>	<input type="text"/>
Electricity cost/day (£)	<input type="text"/>	<input type="text"/>
Electricity cost/year (£)	<input type="text"/>	<input type="text"/>
Interest charge @ 5% per annum/year	<input type="text"/>	<input type="text"/>
Total annual cost	<input type="text"/>	<input type="text"/>
Potential annual saving with variable speed vacuum pump		<input type="text"/>
Payback period for variable speed pump		<input type="text"/>

Water heating

Generally 2nd biggest user of energy on dairy unit

Greenmount Water Heating System

- 900 litre tank filled with pre-warmed water from HRU
- Time clocks used to control when tank is filled and when emersion heaters (12kW) come on
- Water heated at night using cheap rate electricity
- Hot water must be at required temperature by end of morning milking
- Separate hot water tank for bulk tank washing with own time clocks to control filling and heating

Most dairy farmers use electrical energy for water heating, as it is convenient, reliable and relatively cheap to install, but not necessarily the cheapest per kWh. Alternatives include oil, gas and biomass. Other renewable energy options are a possibility, but require a 'top up' energy source to ensure water is at required temperature for the parlour hot wash.

Heat Recovery Unit (HRU)



- Move heat from cooled milk to water, needed for parlour hot wash
- Proper integration important with cooling system compatibility and for making best use of recovered heat
- Seasonality of milk production important
- Plate cooler reduces heat available for recovery
- A job for the expert

Heat Recovery Unit (HRU)



- Two types; flow and storage.
- Installed between compressor and condensing unit.
- Transfers heat from milk to water (water temperature up to 60°C).
- HRU must be fully integrated and compatible with milk cooling and water heating systems.
- Recovered heat must be used to reduce energy demand for water heating, otherwise no gain is achieved

Greenmount experience

- Storage HRU (500 litres) completely automated/integrated with bulk tank milk cooling and water heating
- Warmed water transferred to water heater via solenoids with timer.
- HRU extracts 54% of possible heat post plate cooler
 - equivalent to 31kWh energy as heat in water.
- Calculated savings, £900/year @ 8p/kWh night tariff.
- Greenmount HRU cost ~ £3000

CAFRE online calculators/decision support tool

DAERA website

- Online Services login in
- Business Tools and Calculators
- Dairy
- CAFRE Dairy Applications
- Energy Efficiency