

The background features a dark blue gradient with a large, semi-transparent speedometer on the left side. The speedometer has numbers 1, 2, 3, 4, and 5 visible. In the center and right, there are faint, semi-transparent images of electrical components, including what appears to be a circuit board and a transformer. A bright light source is visible in the upper right quadrant, creating a lens flare effect.

*Potential energy savings utilising
Variable Speed Drives*

Testing “The Cube Law”

Pete Winterbottom

UK Manager HVAC Drives

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***Rather than “renewables”, let’s
save the energy we waste first!***



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Why the focus on motors?

65%

**of the world's electrical
energy is consumed by them**

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***'95% of all motors
are estimated to be
oversized'***

***Building services design being
a typical example***

***Worst case design conditions,
plant is generally oversized***

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Example Fan Manufacturer



1. Sizes for worst case conditions
2. Adds margin
3. Chooses next motor size

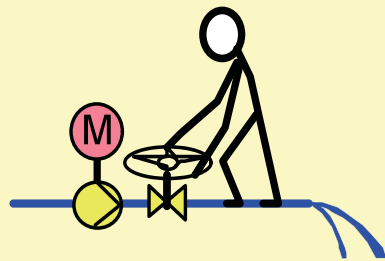
So in this situation, what do we do?

A. Take our foot off the accelerator and slow down

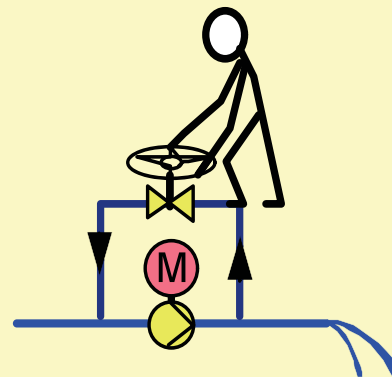


B. Keep our foot down and control our speed with the brakes

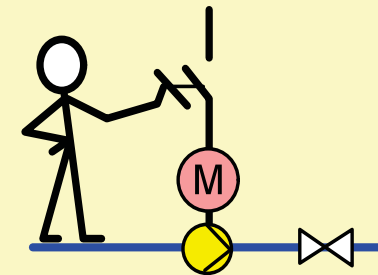
Thanks to the cube law,
frequency converters save 75%
of energy (when compared to
a valve or damper) at 40% flow



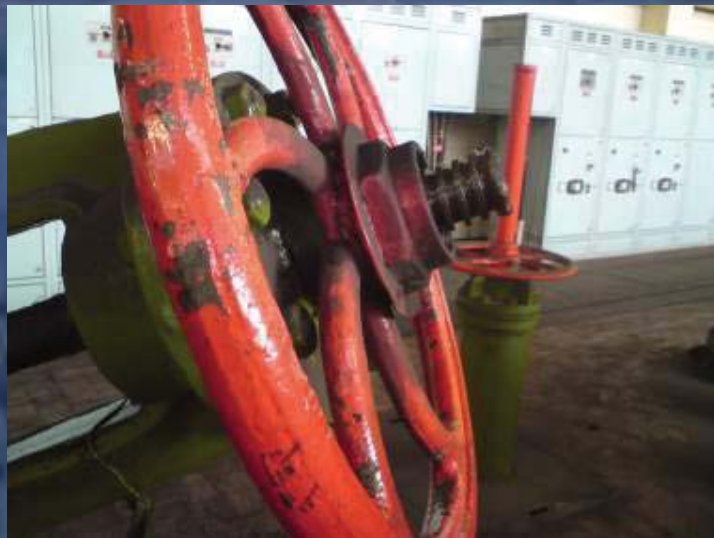
Throttling



Bypass control

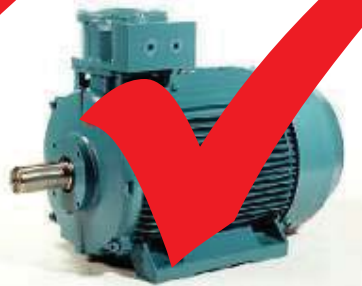
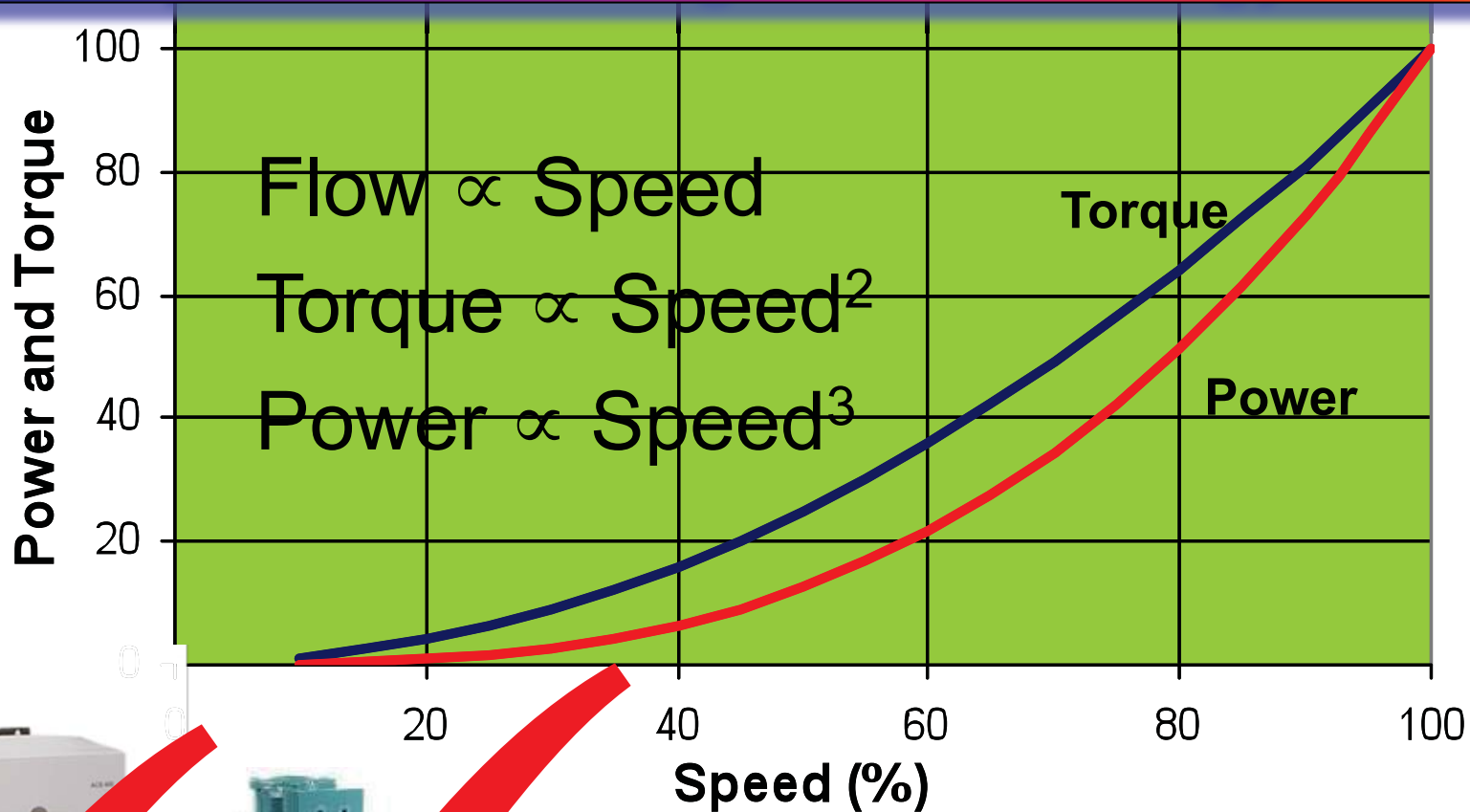


On-Off control

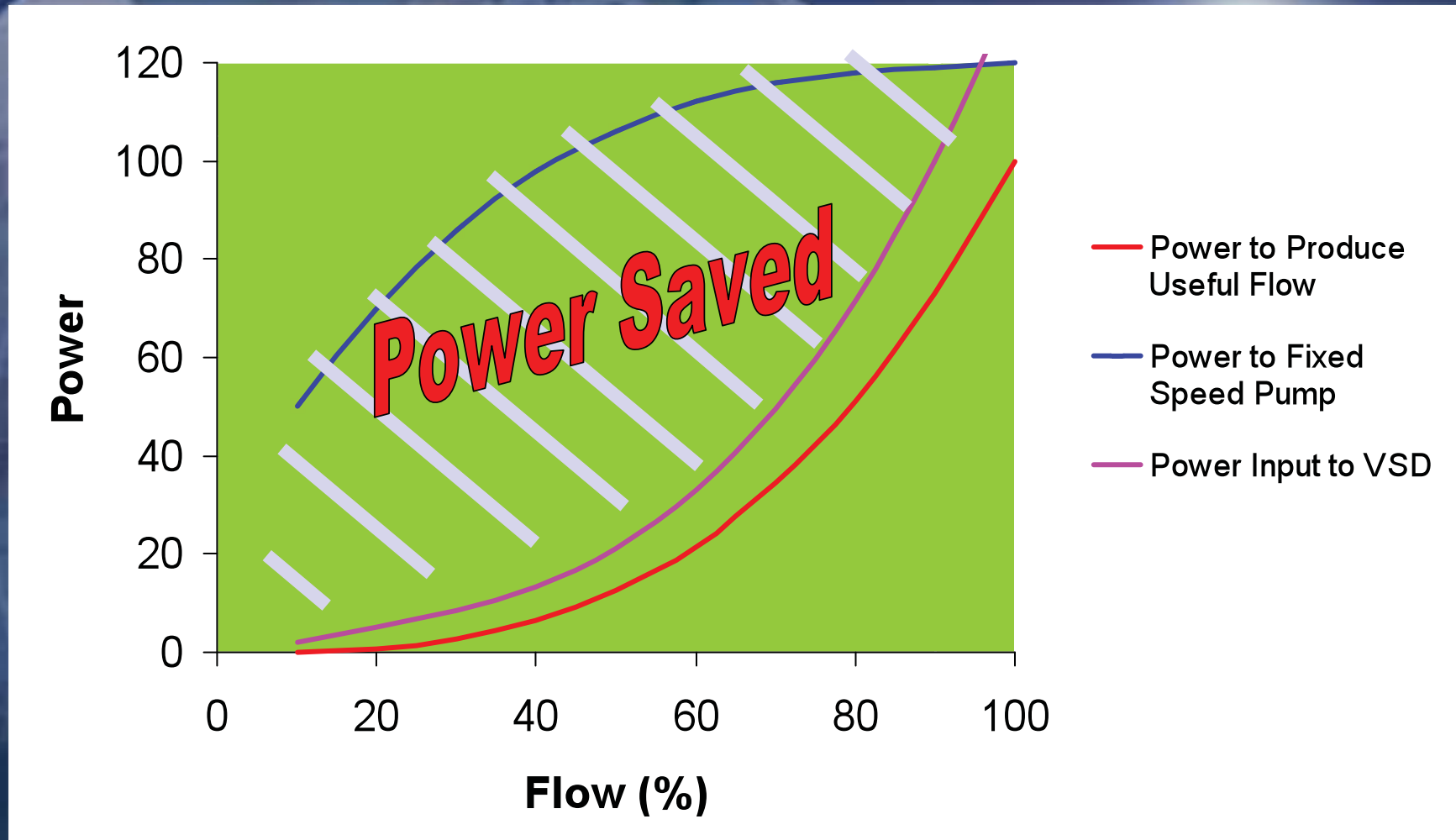


For variable torque loads...

20% speed reduction gives 49% energy saving



Fixed vs variable speed... The "Energy Rugby Ball"





Balloon Machine video

An air system demonstration is
available to view...

But this case study applies to a wet
system

*And it doesn't get much wetter
than Pool Water Pumps...*



The Sandcastle, Blackpool



Introduction

Sandcastle Water Park is the biggest utility user among the council owned facilities, and with an individual target to save eight percent of overall energy usage, the management of the park was keen to improve the energy efficiency of the pool installations, therefore the pool water circulation pumps was deemed to be a good place to start...

Circulation Pump System



Circulation Pumps

4 off Pumps rated at 15kW (30A flc)

Currently utilised in a 2 duty 2 standby configuration (typical operation)

Peak periods utilised 3 duty 1 standby configuration (typically after rain!)

Note: under TOTALLY manual control!

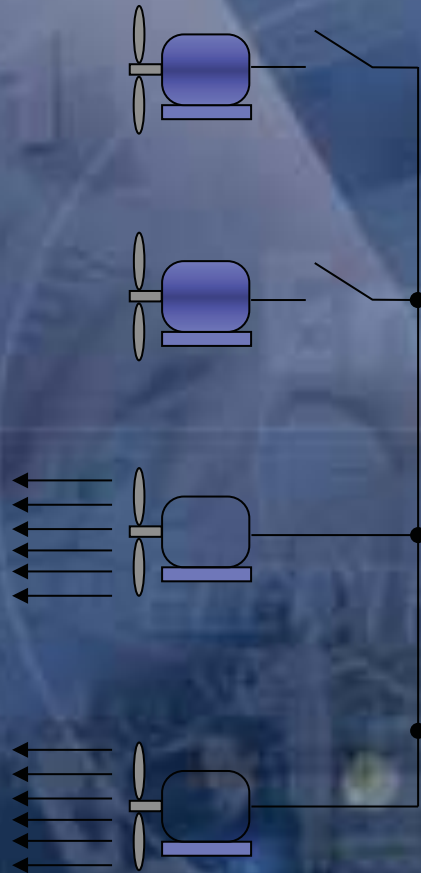
Parallel Pumping

Following discussions it was agreed that the flow rate **MUST** be maintained and could not be reduced, so the usual (and typical) way of achieving energy savings was not available

As the pumps are used on a continuous circulation system with low static head, a decision was therefore made to try “parallel pumping”, and here’s the theory...

“The Theory”... fantastic?

Flow = 50%
15kW Motors



Flow \propto Speed
Power \propto Speed³

VSD Calculations

Flow = 0.5

Therefore speed = 0.5

Power = Speed³

Power = 0.5³ x 60 kW

= 0.125 x 60 kW

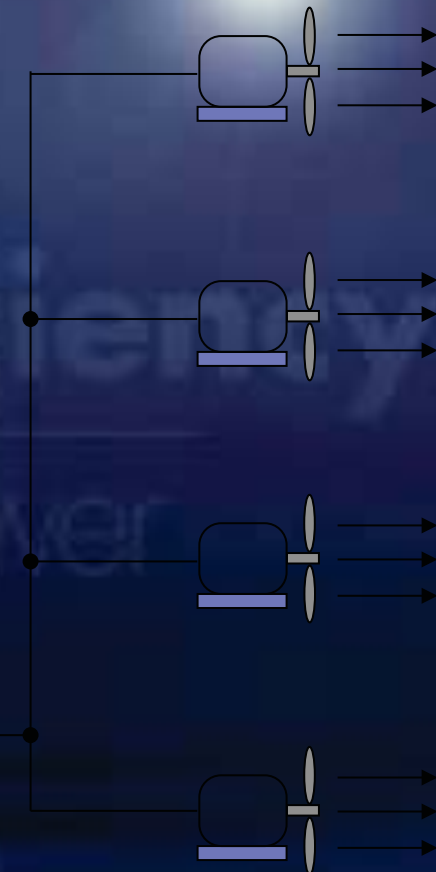
= 7.5 kW

30kW

7.5kW



Flow = 50%
15kW Motors



Flow Sight Glasses



The flow rate was checked using the existing configuration and was noted to be 1200 l/min

Sand Filter Pressure Gauges



This flow rate developed a pressure across the sand filters which was also noted as shown

Initial Findings

2 Motors consumed
2 x 17.4kW

Actual absorbed
power taking account
of the losses...

Total 34.8 kW to
achieve required flow



Panel Modifications



The start of the trial...

Variable speed drives
were installed...

3 Reduced speed
Motors @ 78%
consume 3 x 7kW

Total 21kW to achieve
the required flow



Start of Trial

4 Reduced speed
Motors @ 68%
consume 4 x 4.4kW

Total 17.5kW to
achieve required flow



Gauges

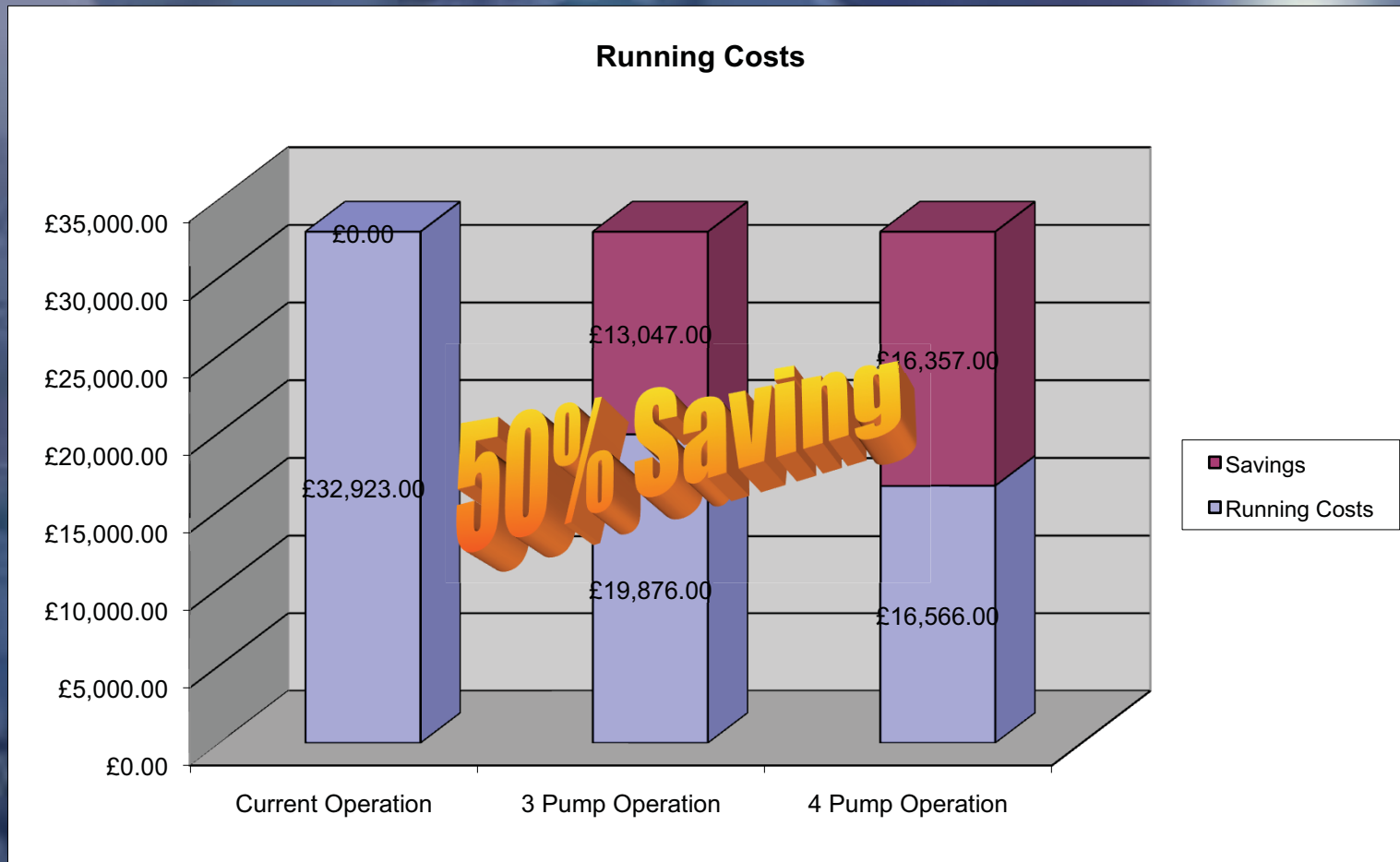


And crucially, the flow rate and the pressure drop across the sand filters had been maintained, fulfilling the client's criteria

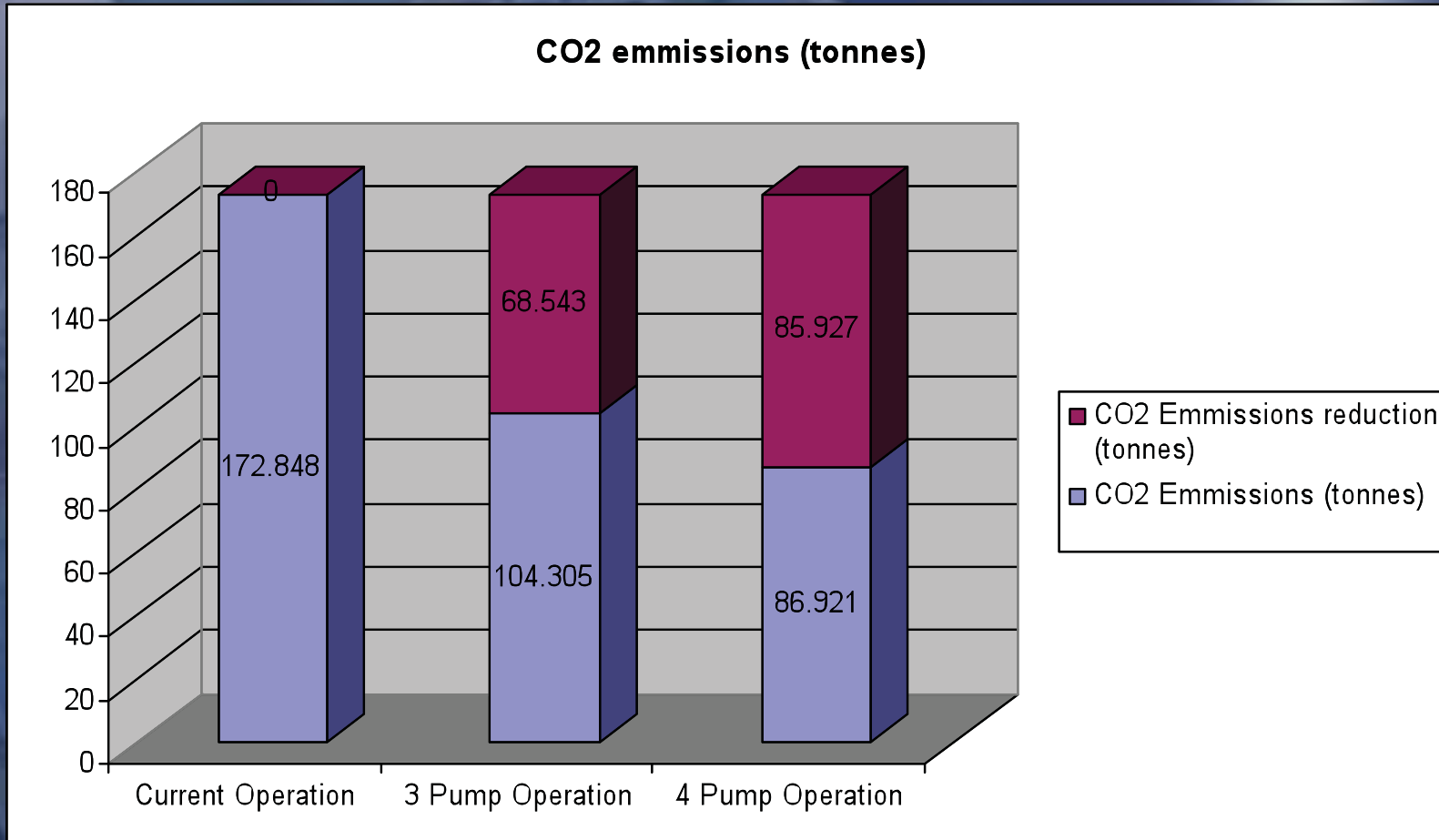
Summary

	Total Power Required	kW/h	Running Cost	CO2 tonnes
Current Operation	34.8kW	304 848	£32,923.00	172.848
3 Pump Operation	21kW	183 960	£19,876.00	104.305
4 Pump Operation	17.5kW	153 300	£16,566.00	86.921

INITIAL Running Costs...



CO2 emissions also halved...



Payback on investment...

	Investment	Pay Back
3 Pump Operation	£15,900	15 months
4 Pump Operation	£15,900	12 months

Ongoing Savings...

	Savings After 1 Year	Savings After 5 Years	Savings After 10 Years
3 Pump Operation	£13,047.00	£65,235.00	£130,470.00
4 Pump Operation	£16,357.00	£81,785.00	£163,570.00

Carbon Footprint...



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Car carbon footprint calculator

You can enter details for up to 2 cars

Mileage: miles

Choose vehicle:

Or enter efficiency: g/km (+15%)

Calculate & Add To Footprint

Total Car Footprint = 2.64 tonnes of CO₂ [Offset Now](#)

2.64 tonnes: 12000 miles in a UK 2008 FORD Focus, 2008¼ Model Year Onwards 1.6 Duratorq TDCi (109PS) 3/4/5 Door Saloon (+DPF), M5

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Impact of Installation...



The equivalent of
taking 32 family cars
off the road (at
average mileage)

Based on family saloon travelling 12000 miles per year

***AND THE BOTTOM LINE...
Customer Comment by the
Maintenance Manager***

Tony McNichol was heard to say: “I would not have believed it if I hadn’t seen it with my own eyes, and we didn’t have to think twice about giving the go ahead for a permanent variable speed drive control installation.”

The power of the cube law, and the energy saving opportunities are all around us.

Any Questions?

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