AFFINITY LAW FOR CENTRIFUGAL LOADS
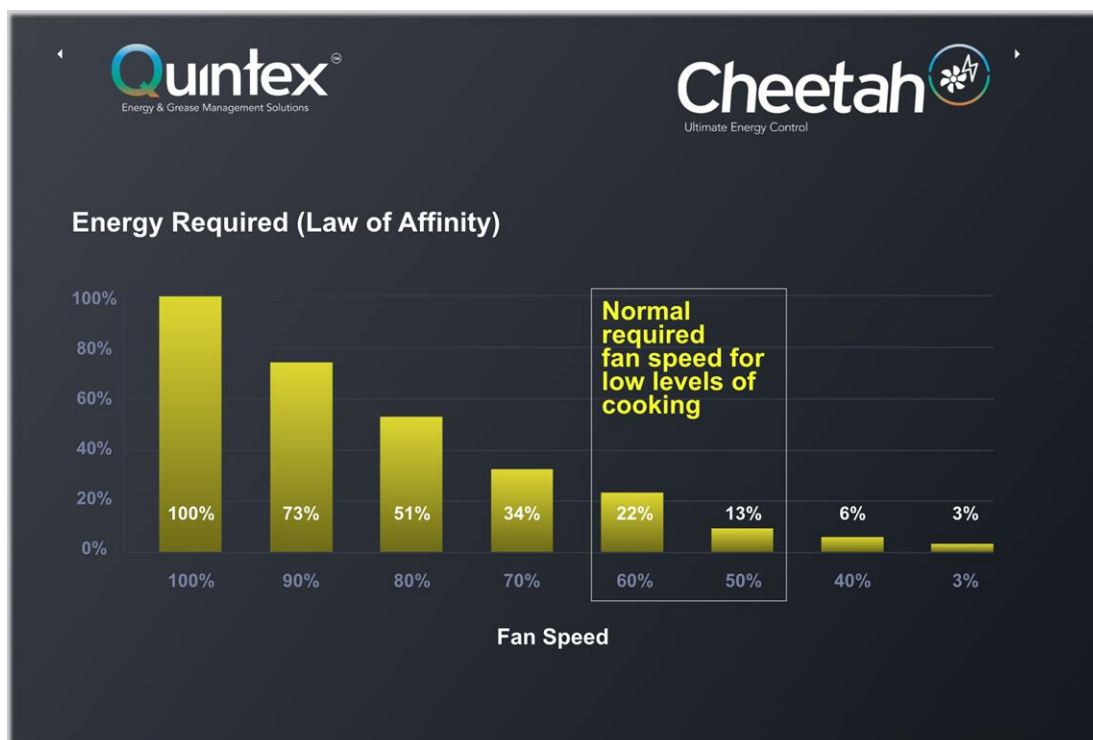
The scientific cubed rule is used to calculate

Fans & Pumps.

Summary

If you slow down a fan from **100% to 90 %**

it only uses 72% of the required power

Equally, if you slowed a fan to **50% it would only use 13%** of the required power

Explained

CALCULATIONS EXPLAINED

Fan Savings

The calculations for all kitchens are based on the actual current operating hours of the extract and supply fans as advised on site by the chief engineer. The absorbed kW ratings of the fan motors were from clamped readings taken on survey. Fan running speeds are from our standard calculation sheet based on our knowledge of the kitchen area. We use the following run speeds from 100% -40%

Fan Speed	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
Energy Usage	100.0%	72.9%	51.2%	34.3%	21.6%	12.5%	6.4%	2.7%	0.8%	0.1%
% of Running Time at Each Fan Speed										
3 Phase Grill Based	20%	10%	10%	10%	10%	40%	0%	0%	0%	0%

Fan Energy Saving Calculation

The fan energy saving is calculated by applying the 'Law of Affinity' as follows:
New power consumption = orginal power consumption x (new average frequency) ³

http://en.wikipedia.org/wiki/Affinity laws
Law 1c. Power is proportional to the cube of shaft speed. We have calculated the energy savings with referance to the above formula and the assumed fan speeds before and actual fan speeds after the installation of Cheetah

(as monitored by the system for each site).
Savings are therefore:
Power saving % x fan motor rating x operating hours

$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^3$$

Further Breakdown

In principle:

Fan Speed	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
Energy Usage	100.0%	72.9%	51.2%	34.3%	21.6%	12.5%	6.4%	2.7%	0.8%	0.1%

^^

Is showing how much energy the fan would consume at certain set points. I.E at 90% of running speed the fan will consume 72.9% of total energy.

3 Phase Grill Based	20%	10%	10%	10%	10%	40%	0%	0%	0%	0%

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This shows how much time (in %) we would expect the fan to run at certain fan speeds after Cheetah is fitted based on Grill equipment under the hood canopy.

And this is how we calculate the Savings with cheetah based off this information.