Danfoss
Drives Solutions

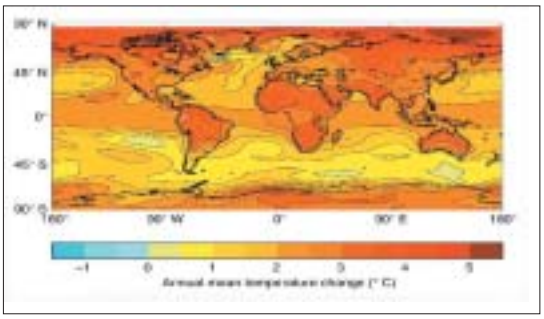
The Climate Change Levy. - driving your profits down?

- The CCL - is it reducing your profits?
- Are there any tax breaks?
- Enhanced Capital Allowances - are they worth having?
- What equipment qualifies for ECAs?
- Fans and pumps - how can they deliver savings?
- How can Danfoss help you save energy?

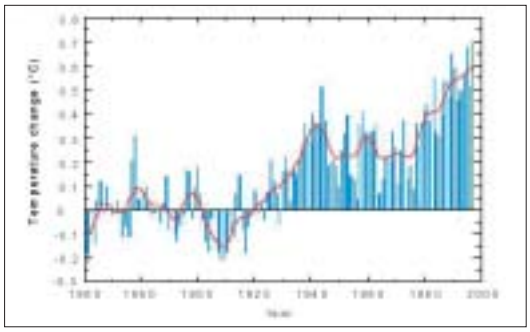
The Climate Change Levy and your profits.

Environmental Background

Following the Kyoto summit of 1997, as their contribution to a worldwide initiative to halt global warming, the UK government levied an additional charge on energy used by industry and commerce. The intention was not simply to raise revenue but through a cost penalty, to stimulate a significant reduction in energy usage and thereby to cut the emissions of greenhouse gasses, particularly carbon dioxide (CO^2).



World temperatures by 2050



Average temperature rise by 2050

"...the Climate Change Levy will be tax neutral."

Chancellor of the Exchequer

What's the impact of the CCL?

The Climate Change Levy (CCL) was put in place on April 1st 2001, and increased the costs of all carboniferous fuels, but most notably, electricity by 0.43p per unit since the greatest contributor to green house gasses is the electrical generation industry. Taking a commercial rate of 3p per unit as an example, this is effectively an increase of 14% on the energy bill of all industrial and commercial concerns.

Although potentially offset by a reduction in National Insurance Contributions, many consumers have inevitably seen their manufacturing costs increase and their profits reduced. However, for many companies, the CCL is a voluntary tax which can be avoided.

How to offset the Levy

The solution is simple. Invest in energy efficient technology, reduce the overall energy bill and immediately, every pound saved becomes a contribution to the bottom line without having to sell a single unit of production, or creates an improvement in overall competitiveness with long term benefits.

This is not a new opportunity, as wise companies have been assiduous in improving energy efficiency for years and many of the techniques are well proven. They produce energy savings so significant that they recover the costs within a very short period of time. The use of variable speed control on centrifugal pumps and fans is among the most effective techniques for volume energy savings within a short cost-justification period.

Is there any relief for large energy users?

Renewable energy is exempt

Some industries, for example, horticulture and those who use electricity for electrolysis, enjoy a temporary 50% discount. Energy from renewable sources such as wave and wind production is exempt, as is energy from qualifying CHP production.

IPPC company discounts

There are many energy intensive companies whose competitiveness would be severely affected by the CCL, most of whom fall within the Integrated Pollution Prevention & Control Regulations 2000 (IPPC) category, which defines the energy intensive sector. These regulations in any case impose a duty of best practice in energy savings on IPPC companies.

Recognising the burden on energy intensive companies, the Government set up Climate Change Agreements (CCAs) whereby 80% relief was allowed in return for audited savings by 2010, with two year milestones. Missed targets for energy savings means the discount is lost for two years and energy savings must be recovered before the company can rejoin. Relevant trade associations can provide details of negotiated discounts for each sector.

Copies of umbrella agreements may be downloaded from www.defra.gov.uk/environment/ccl

Win-Win opportunity

Greenhouse Gas emissions trading (Carbon Trading) was also initiated in April 2002 to allow companies with CCAs to sell their overachievement to companies who needed to make up a target shortfall. Some larger companies have achieved significant savings and put their surplus on the market, driving the price of carbon down to around £3/ton, but there has been no rush to take up the surplus.

However, there is a win-win opportunity here. Not only do energy intensive industries gain the benefit of the discounted levy, they also benefit from the savings from the energy reductions made.

The CCL - all stick and no carrots?

"Reap the benefits of energy saving - year on year on year."

National Insurance Contribution reductions.

In order to protect the competitiveness of UK firms, the revenues raised were to be returned to the non-domestic sector via a reduction of 0.3 percentage points in NICs. The benefits of this reduction are now being enjoyed, although more by some than by others whose workforce may be small in comparison to their energy usage, making it important to start saving energy.

Enhanced Capital Allowances

To further stimulate investment in energy efficient technology, the government now allows the expenditure on qualifying equipment to be offset against tax in the year of acquisition. This is a significant benefit allowing a much more rapid recovery of expenditure as compared with the normal tax requirement to write down capital purchases over a number of years, and it is simply claimed as part of the annual accounts. Effectively, the tax man gives you a substantial discount off your investment in energy savings technology in the first year – so long as the equipment is approved on the Energy Technology List. Then just reap the benefit of the energy saved – year after year after year.

For the full list of qualifying equipment, log onto www.eca.gov.uk

Action Energy Loans.

Small & Medium Enterprises (SMEs) can now apply for four-year interest-free loans of up to £50,000 for investment in energy savings technology. Applications for schemes with a payback of less than 5 years qualify. There is no catch, it is simply that SMEs have been slow to catch on to the benefits of energy reduction and they need greater incentive to invest. Whichever way you look at it, this is free money up front, easily paid for out of the energy savings, and it's not difficult to qualify.

Log onto www.actionenergy.org.uk for full details.

Carbon Trading

For those companies who receive the 80% discount on the levy, carbon trading allows them to sell surplus energy savings in the form of tons of CO^2 to further capitalise on over-target savings or buy some one else's surplus carbon to make up an energy savings shortfall by and thus retain the 80% levy discount.

The biggest carrot of all is the energy savings which can be made from implementing effective energy saving techniques, particularly fitting VSDs to some larger fans & pumps.

For more information log onto www.thecarbontrust.co.uk

Enhanced Capital Allowances - what equipment qualifies?

Qualifying Equipment

So far several categories of energy savings equipment have been listed as qualifying for ECAs. Others are currently under consideration.

For the full list and more details, log onto www.eca.gov.uk and click on 'Product and Claims'.

A complete list of qualifying manufacturers and their equipment is posted on the ECA website. Qualifying manufacturers may display the ETL logo.

Drive & Motor Eligibility

Motors and drives within the following categories are eligible:

- VSDs
- Switched Reluctance Drives
- Integrated motor drive units
- Single and Multiple speed motors (EFF1 & WIMES)

VSD Eligibility

Controllers or drives eligible under the ECA scheme are only those installed for liquid or gaseous movement applications such as pumps, fans and compressors. Initially the scheme is limited to those controllers designed specifically to electronically vary the frequency of a supply to a standard 3 phase AC induction motor. Only new equipment purchases qualify for the ECA.

Listed categories

- Variable speed drives
- Boilers
- Refrigeration equipment
- Motors
- Thermal screens
- Combined heat and power (CHP)
- Lighting
- Pipework insulation
- Heat pumps for space heating
- Radiant and warm air heaters
- Solar thermal systems
- Some compressed air equipment

What can be claimed?

Where VSDs are purchased for retrospective application to existing equipment for energy saving purposes, then the whole of the purchase, installation and commissioning cost is eligible.

Qualifying VSDs purchased as part of a larger piece of plant will also attract relief, relating to the cost of the VSD plus an allowance for the associated enclosure. A table of claim values can be found on the ECA website www.eca.gov.uk

"Danfoss VSDs on energy savings, qualify for 100% first-year capital allowances."

What are the ECAs and interest-free loans worth?

"ECAs are claimed in the same way as other capital allowances on the Corporation Tax Return."

Cash flow boost

Conventional tax relief on capital purchases means offsetting only 25% of the cost against tax each year on a reducing balance basis. This means 95% of the cost will have been offset after about 8 years. ECAs permit the whole of the investment to be offset in the first year. There is no increase in the total tax benefit but there is a significant boost to cash flow derived from the early recovery. The exact benefit will depend upon a company's accountancy procedures.

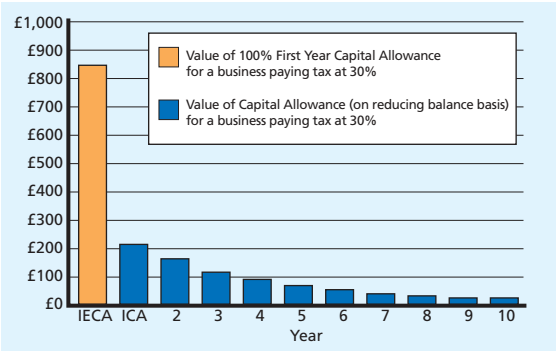
Free Money

For SMEs, the availability of interest free loans up to £50,000 over a period of four-years is quite simply free money. The exact benefit will depend upon a wide variety of factors in the individual company's financing. However, consider an investment in VSDs which self-recovers in two years. This means the energy recovery alone will be surplus to the loan repayments and profitability will be enhanced from the first day of operation.

Is it that simple?

The ECAs are claimed by a simple adjustment in the tax return. No special claim needs to be made. Any ECA loan request needs to be supported by a business case showing the energy saving which will result from the investment. Action Energy will entertain claims for a 5 year payback scheme. Very few drive applications to fans and pumps take greater than 3 years to self-recover their costs, many self-recovering within the first year. Danfoss will provide assistance to calculate the costs and benefits of a proposed installation.

ECA versus reducing balance recovery.



	Capital Allowance	ECA
Corporation tax rate	30%	30%
Percentage of expenditure to which allowance applies	25%	100%
Nominal investment value	£10,000	£10,000
Amount set against tax	25% x £10,000 = £2,500	100% = £10,000
First year tax recovery @ 30% tax	30% x £2,500 = £750	30% x £10,000 = £3,000
ECA cash flow benefit in first year		£3,000 - £750 = £2,250
Balance brought forward to year 2	£10,000 - £2,500 = £7,500	£0
Amount set against tax in year 2	25% x £7,500 = £1,875	£0
Second year tax relief	30% x £1,875 = £562.50	£0
Time to set full investment against tax	> 10 years	1st year

Life Cost Cycle - is it really that important?

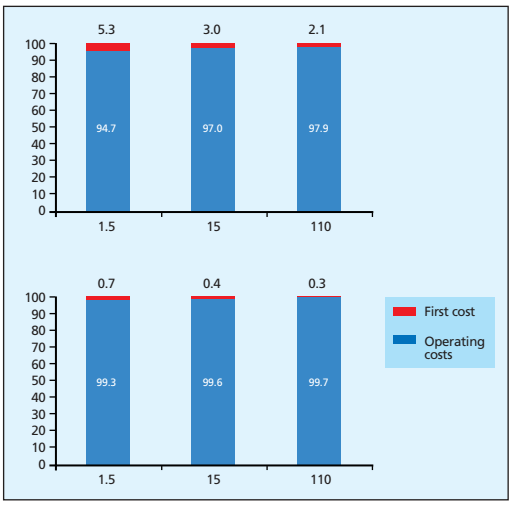
All too often, for reasons of contract competitiveness, and cheapness at the time of purchase, consideration of the life cost of a piece of plant is sacrificed on the altar of lowest bid. This short sightedness leads to significant energy wastage to the detriment of our environment and to substantial financial loss to the business. The effect of the CCL is to increase the running costs of inefficient plant, thereby making life cost considerations much more critical than ever before.

In fact, first-cost is frequently only the very tip of the iceberg. Recent government sponsored research reveals that the initial purchase price of a fan installation may account for a mere 2.5% of the life-cost of the equipment, maintenance another 2.5%, and the remaining 95% being accounted for by running costs.

But efficiency is not the end of the story when considering the true life-cost of a fan or pump installation. The application of VSDs offer a number of substantial benefits, frequently of greater monetary value than the energy savings alone.

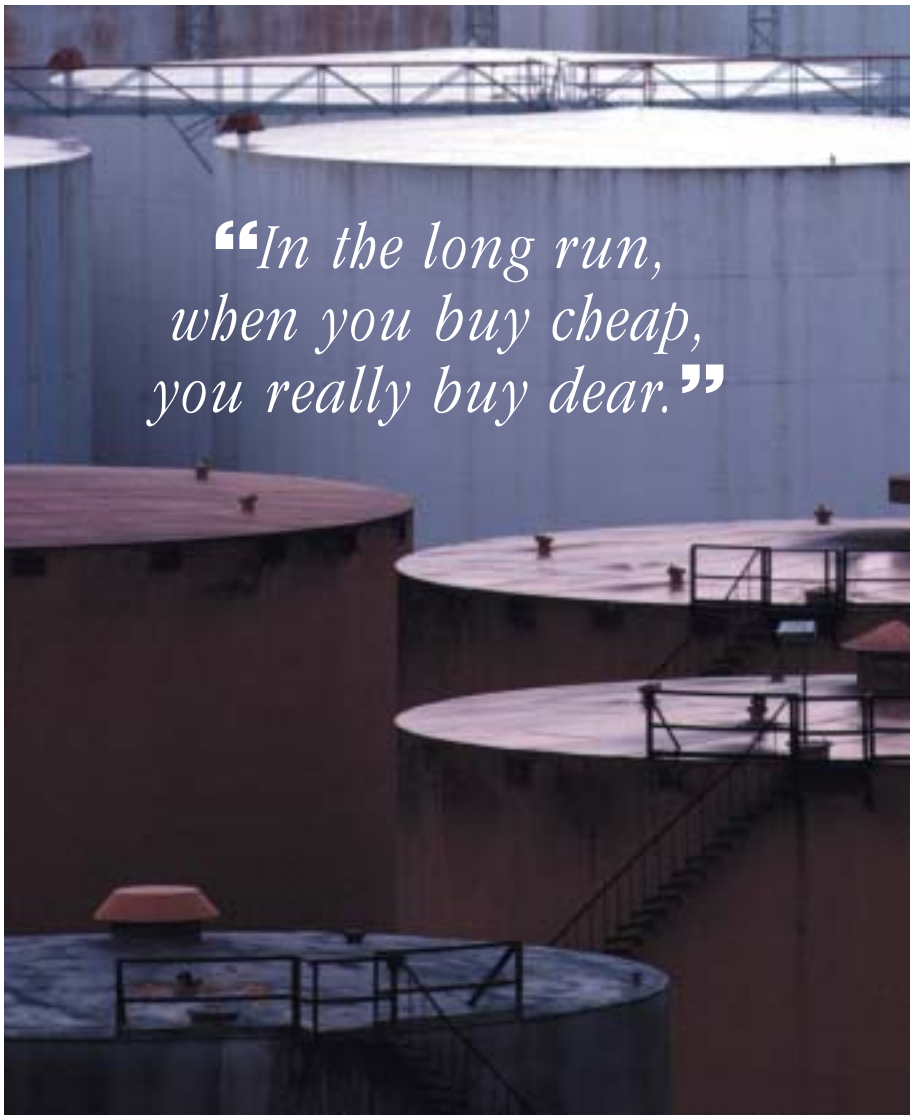
It is therefore vital that the full life-cost cycle of an installation should be considered and given greater weight than the simple first-cost.

First cost versus operating costs.



Additional benefits of VSDs

- Simplified mechanical installation leads to ease of commissioning, easier system balancing and reduced maintenance
- The ideal soft-start characteristics of VSDs leads to reduced maximum demand, less physical system stress and increased equipment life.
- Reduced fan speed leads to vastly reduced fan noise and improved comfort levels.
- Improved production rates, reduced material costs and improved product quality can be achieved through better system control.
- Hidden installation costs are removed with the elimination of star/delta starters and power factor correction capacitors and the use of lighter power cables.
- Drives monitor their own energy levels, eliminating the costs of extraneous energy monitoring equipment.



Fans & pumps - can they really

The Affinity Laws

All centrifugal fans and pumps operate against a set of 'affinity laws', which dictate how throughput volume, system pressure, absorbed power and noise vary with the speed of the fan or pump impeller:-

volume $\propto$ to speed
pressure $\propto$ to speed^2
power $\propto$ to speed^3
noise $\propto$ to speed^5

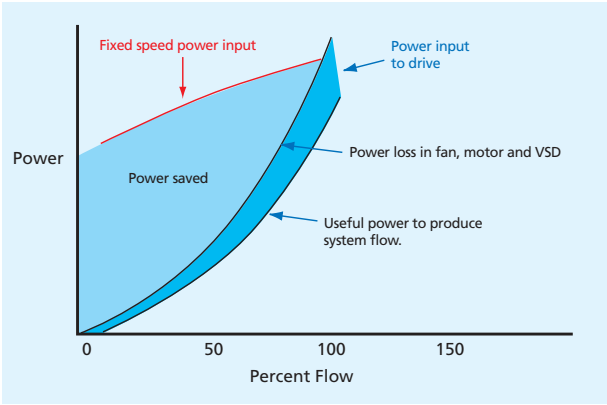
Put simply this means that reducing the speed of a fan or pump by 25% will roughly reduce its output volume by the same 25%. However, this will reduce the system pressure by some 40% and reduce the power absorbed by over 50%, at the same time, dropping the noise level to almost nothing. Thus if a centrifugal device is not required to deliver full rated output, then clearly running it at full speed is extremely wasteful and costly.

The cost of over-design

Almost without exception, all centrifugal devices are over-designed at the outset. This can be the result of many factors, such as providing for seasonal and daily highs and lows in air conditioning systems. This means the system seldom runs at full output. Even for those exceptional conditions there will be a degree of over-specification, which means that it is safe to assume that the majority of pumps in heating systems are oversized by up to 20%, frequently more, with the air movement fans similarly over-specified.

Likewise in industrial fans and pumps, over-specification is also the rule, frequently just to err on the safe side by selecting the equipment with the highest performance curve but also for reasons of over-optimistic anticipation of production needs. While this is not only more costly at the initial installation stage, it impacts considerably on the Life Cost Cycle of the installation, particularly on running costs.

VSD versus fixed speed power consumption

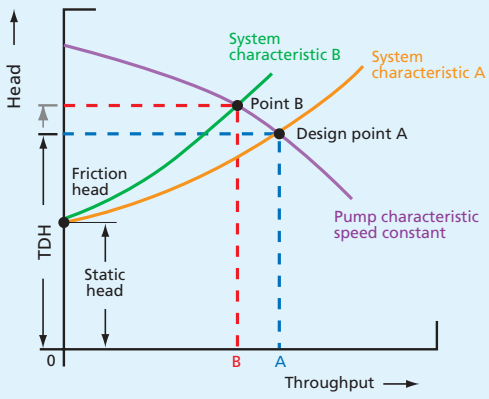


deliver big energy savings?

Traditional versus modern control methods.

Damping or throttling methods are commonly used to control fan and pump throughput, which although inefficient, have the benefit of cheap first cost. The installation of a valve in a pump system will effect rough control of the output but do little to reduce the energy absorbed. Similarly, a damper placed before or after a fan will also effect a degree of control but again somewhat inefficiently.

Speed control of the drive motor is therefore by far the most efficient method of accurately controlling fans and pumps.



Throttling A to B increases friction head and energy losses.

"Motor speed control is the most cost-effective method for fans and pumps."

Variable speed pump systems -

Pump Applications.

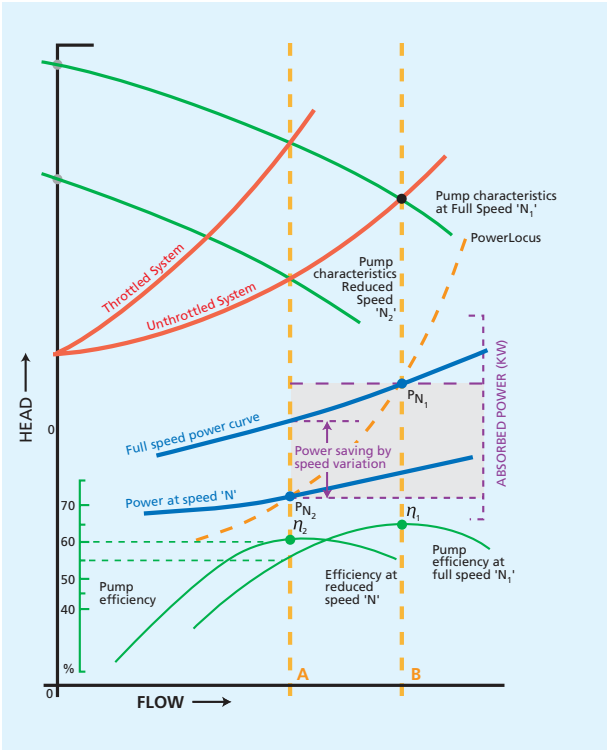
The energy costs of pumping to UK industry are over £1.4bn per annum, mainly for pumping water and it is estimated that over 20% of this figure could easily be saved. This results from the fact that most industrial pumps, as a consequence of over-specification at the system design stage, are not operating at peak efficiency flow and are throttled to some degree.

Calculating the energy saving potential of a pump system is made more complex by the pump and system characteristics. Although fans and pumps operate to the same affinity laws, the system characteristics of pumps are made more complex by the friction of the fluid through the system and the need to overcome the system pressure to the point where fluid flows from the outlet of the system.

This is known as the static head and represents a constant element of energy absorption from which no saving can be derived. Savings can only be made from the operating region known as the friction head. Throttling a pump effectively increases the friction head. For systems where the static head represents a high proportion of the total head, as in high lift pumping systems, possible savings are diminished.

The three sets of pump curves shows how throttling increases the head, while also reducing pump efficiency. Reducing the speed significantly reduces the head and allows the pump to work with improved efficiency.

Without the availability of these pump / system curves, predicting energy savings is made more complex. However, examination of the pump and its system can allow a rough estimate of the benefits to be made, and if appropriate a speed reduction trial can be conducted with a VSD on loan. Danfoss have aided many clients in this way.



Typical pump system curves comparing throttling and variable speed control.

what are the benefits?

Additional benefits of VSDs on pumps

The benefits of variable speed operation of rotodynamic pumps extend beyond simple energy savings:

- Elimination of system pressure surges from VSD soft-start characteristics.
- Reduced wear and tear, particularly reductions in cavitation wear.
- Reduced maintenance costs.
- More accurate control of pump throughput.
- Full control system integration of flow control via the VSD
- Reduced pump noise

Simple retro-fit.

IP54 versions of Danfoss VLT®6000 drives can be mounted close to the driven equipment with no need for expensive control cabinets.

This 37kW VLT®6000 drive is controlling the duty / standby constant temperature pumps in the plant room at Radisson SAS hotel at Manchester airport, saving over £3,200 per year.

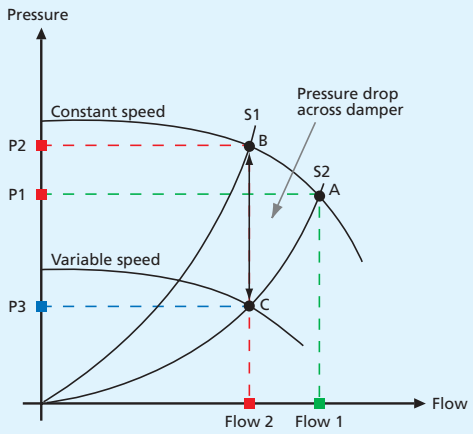
Good Practice Guide 249 (GPG249) 'Energy savings in industrial water pumping systems' is available from Action Energy and can be ordered online on www.actionenergy.co.uk

Fan systems - how do they benefit

Fan Applications

Fans share equally with pumps a propensity for being over-specified and every large fan should be viewed as an opportunity to save energy and money. Because there is no element of static head in a fan system, the savings are also much easier to predict. The fan curves show graphically the difference between operating a fan system with a discharge damper and on variable speed control.

Typical fan curves showing throttling and variable speed alternatives.



Point 'A' represents the design point 'Flow 1' of the system. Operating at point 'B' to achieve reduced 'Flow 2' on constant speed means creating a pressure differential across a discharge damper and operating the fan at reduced efficiency. Operating point 'C' also delivers 'Flow 2', but at much reduced system pressure P3, maintaining fan efficiency at a high level.

Since the power consumed by the fan is proportional to the flow times the pressure divided by the fan efficiency, the pressure difference between points B & C results in significant energy savings.

Therefore the savings = $\frac{\text{Flow x pressure diff. (P2-P3)}}{\text{fan efficiency}}$

Industrial fan applications

Large fan applications are found extensively through both industry and commerce. Industrial applications include boiler and furnace induced and forced draft fans. These can range up to several hundreds of kW. In addition to offering energy savings, these applications frequently offer the additional benefit of decreased fuel consumption through improved combustion conditions.

Commercial fan applications

In buildings, the major applications for large fans is for air conditioning systems. In older constant air volume (CAV) systems, inlet dampers are frequently employed and such systems offer enormous potential for energy savings and improved control from the use of VSDs on both supply and return fans. Drive installation on the existing motor is usually simple and the dampers can simply be left wide open so as not to impede air flow.

Variable air volume (VAV) systems also can benefit from variable speed control. Although the VAV boxes controlling individual zones offer individual control to those zones, pressure sensors in the supply ducts can effect overall system pressure control, dispensing with inefficient dampers. Due to the ratio between airflow and power consumption, even relatively small reductions in flow result in significant energy savings.

from variable speed control?

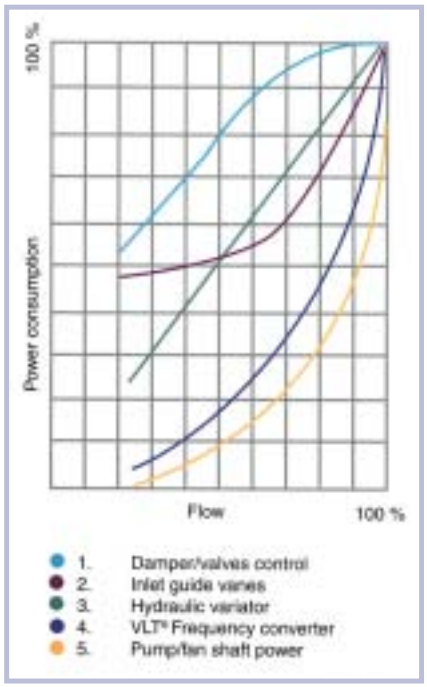
Motor suitability

Modern variable speed drives are designed specifically to operate at high efficiency with standard 3-phase induction motors. Danfoss VLT®6000 HVAC drives are additionally designed to run motors at their most economic by setting exactly the right motor magnetic flux conditions to suit the speed and load of the motor. This means that motor losses are minimised and the machine runs at its optimum operating point. The heating effect from the synthesised output waveform of modern VSDs is negligible but in any case, as fan loading drops off faster than speed, no motor derating should be required and most existing machines will be suitable for inverter drive application.

Where to find the savings

The larger the fan, the larger the potential savings, so examine the operation of the largest fans first. Consider the daily, seasonal or production fluctuations and to what extent the full output is required of the fan. Check damper louvres visually – many simply run well closed and these waste huge amounts of energy. When the system is in operation, check the motor operating temperature. If one can keep one's hand on the motor casing comfortably, then it is running at low output, poor efficiency and poor power factor.

VLT®6000 HVAC application booklet, free from Danfoss, contains vital information on fan and pump drive configurations.



Control methods - power consumtion comparison.

The proof of the pudding.

Energy savings went through the roof at Sandtoft

Sandtoft Roof Tiles fitted Danfoss VLT®6000 drives to the 37kW and 18.5kW combustion and cooling fans on their new tile kilns, and were able to achieve a 60% energy saving on like-for-like kiln firing cycles. On the older kilns, dampers were used to control combustion and cooling air cycles critical to final quality of the tiles. This meant at times running the fans at full speed with the dampers almost closed.
Now not only are the energy savings helping to offset the CCL, but fan noise has been reduced to almost inaudible levels on long cooling cycles.

Radisson SAS hotel achieved 70% energy savings

By fitting Danfoss VLT®6000 drives to their air handling units and chiller pumps, the 4 star deluxe Radisson SAS Hotel Manchester Airport has taken a major step towards a target 5% reduction in energy usage year-on-year. Now linked to the Building Energy Management System, the 11kW and 7.5kW drives are now under automated control and energy costs have dropped by almost £4,000 per system; a 70% saving, paying back the initial investment in only 10 months. The 37kW chiller pumps too are now recording savings of 45%, with payback under 18 months.

Linpac save £1,000 per month by replacing dampers

Linpac Automotive of Scunthorpe manufacture moulded automotive parts. Their paint spray booths employ inlet and outlet fans with filtration and scrubbing to ensure the quality of the paint finish and uncontaminated exhaust air. Constantly changing ambient conditions and in the spray booths demanded frequent manual resetting of the dampers on top of the spray booths, a time consuming and potentially hazardous process. Linpac fitted Danfoss VLT®6000 series drives to both inlet and outlet fans and achieved a number of benefits. Energy consumption was reduced by over £1000 per month, production benefits in terms of time and product quality were achieved and a potentially hazardous procedure has been eliminated.

"The energy benefits of VSDs on fans and pumps are well established."

Energy efficiency of buildings - a legislative imperative.

Building Regulations 2000 - Part L

Although the CCL alone makes a strong case for energy saving, for owners and operators of buildings, both commercial and industrial, the case is being made even more strongly by the introduction of new building regulations, which focus on the energy use in buildings.

The Building Regulations 2000, Conservation of Fuel and Power have been in place since 1st April 2002, and for the commercial sector, the important section is L2 or Part L as it is generally known, which refers to buildings other than dwellings. For more detail, the full text can be found on www.safety.dtir.gov.uk/bregs

Monitoring the power usage.

One aspect of Part L is that the user will have to be able to clearly identify where 90% of the power is being used, on the basis that you can't make conservation measures if you can't see where the usage is greatest. Electrically, one of the greatest users of energy in buildings is the air conditioning plant with substantial fan drives, chiller pump drives and cooling tower fans. In future the energy usage of these devices will need to be monitored. Where these are VSD driven, the drive can communicate directly to the building energy management system (BEMS), enabling remote monitoring and continuous reporting and recording of operating efficiency, without the need for expensive additional metering equipment. Danfoss VLT®6000 drives with flexible communications make monitoring easy and systems alterations child's play.

Enforcement by inspection.

Right from initial usage of the building, there is a requirement, enforced by inspection, to ensure that energy efficiency provisions have been made. Initial commissioning of a new system will need to be inspected by a competent person to certify that all systems are performing within design parameters and meet energy efficiency requirements. This means that meeting the new efficiency standards without variable speed control is unlikely and VSDs will need to be applied, as no modern building could operate efficiently without a fully adjustable, BEMS controlled air conditioning system.

More pain to come.

Adding to the energy emphasis of Part L, The EU Directive on the Energy Performance of Buildings has been enacted in EU law and will be implemented in the UK by Jan 2006. This will add the requirement, when a building is let or when change of use or ownership takes place, for a Certificate of Performance no more than 10 years old. While Part L is expected to save 1.3m tons of carbon (MtC) per annum by 2010, the EU directive will save an anticipated 64MtC per annum across the EU.

The bottom line.

In commerce, everything comes down to the bottom line and these new regulations will force business to take measures that ironically will improve their profitability by operating more efficiently. Maintenance costs will be reduced, noise will be lessened, equipment life will be enhanced, input power factor will be higher, generally building air-con systems will perform better and less carbon will be generated. It's a win-win situation for everyone.

CityPoint, London

"The new building regulations place greater emphasis on energy use within buildings."

Alan Aldridge
Executive Director of ESTA

ESTA
energy systems trade association

Danfoss is a member of the Energy Systems Trade Association Limited

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Danfoss VLT®6000 HVAC Power to beat the levy.

Danfoss - your ideal partner to help you save energy and offset the Levy.

Danfoss was the pioneer in the design and production of mass produced variable frequency inverters, launching the VLT®5 in 1968. Since then, with many thousands of drives in operation worldwide, Danfoss has made an enormous contribution to energy savings and reductions in environmental pollution. Today, as market leader in fan and pump drives for industrial and HVAC applications, Danfoss knows a thing or two about energy efficient drives.

This experience led to the development of the VLT®6000 series of drives, a range of drives dedicated and equipped to meet the needs of fan and pump applications. Designed to offer robustness and energy efficiency in the most demanding environments, the advanced technology of the VLT®6000 ensures it will run and survive under worst case conditions including mains fluctuations, mains phase loss and ambient overtemperature.

IP54 versions allow the drives easily to be retrofitted close to the driven equipment in plant rooms without the need for additional enclosures. Compatibility with most leading Building Energy Management Systems makes for easy incorporation to the control system, simplified commissioning and off-site monitoring of drive parameters and enegy performance.

Automatic Energy Optimisation (AOE) ensures that by fluxing the motor correctly for every operating point, the driven motor always achieves optimum efficiency under all speeds and loads, so not only do you benefit from reduced energy absorption from the motor, but also reduced energy absorption by the motor.

Fitting the Danfoss VLT®6000 series drives to your fans and pumps could make a highly valuable contribution to your energy efficiency plans, reducing, possibly even eliminating, the impact of the CCL, and adding substantially to the company bottom line.

Danfoss also knows a thing or two about how drives should be applied for best performance. For a **free** application survey, **free** energy savings software to help you calculate your potential savings and **free** technical data on the application of drives to fans and pumps, contact your local Danfoss Energy Efficient Drives specialist today – **you won't be wasting your energy!**

24 hour service and support 0870 241 7100 www.danfoss.com/drives

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