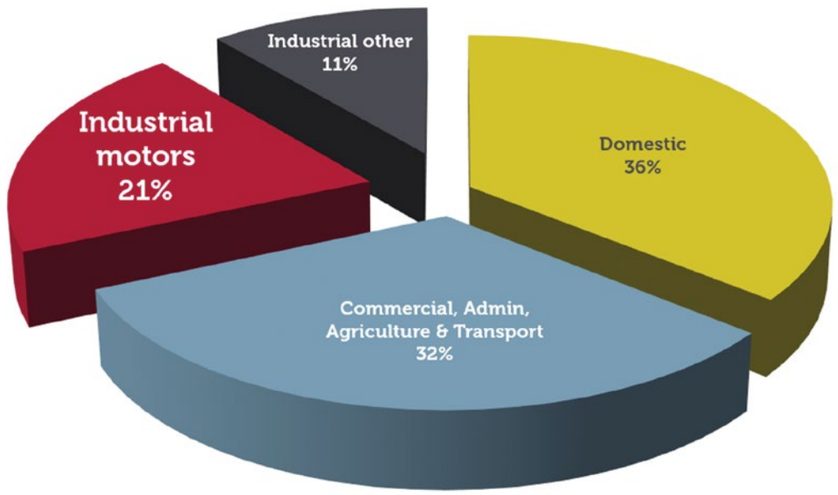
Energy efficiency remains top of the drives agenda

Twenty years on from our first Drives Supplement, and despite an almost evangelical campaign by the industry, the majority of motor driven systems still have no adequate form of control or automation that would switch off when needed or turn down when possible. Steve Brambley reports.



Some 21 percent of UK electricity consumption is by industrial electric motor driven systems

Energy: it is a vital component of life and we depend upon it to keep our houses, cities, businesses and transport functioning. At the same time as being so reliant on it, we often take for granted that there will always be a supply and continue to consume as if there is a limitless resource. We are converting fossil fuels into electricity at an unsustainable rate – it is estimated that in a single day we consume the equivalent of all the plant matter that grows on land and in the oceans over the course of a whole year. And behind this end-user consumption lie a number of energy conversions to deliver the final energy use.

Switching on your bathroom light involves a chain with losses throughout the system – typically, burning coal to generate heat, which makes steam to drive a turbine, that generates electricity which is then distributed to houses where it is converted into light and (mostly) heat. Less than 1 percent of the energy stored in the coal is converted into light energy, with the other 99 percent being lost in the supply chain. And I haven't even mentioned the energy needed to extract and transport the coal or running a power station and a national grid.

Unnecessary electricity consumption is clearly an enormous waste of a dwindling resource and the effort to deliver it. Using less by being more efficient should be a primary goal, as should controlling a process to only run when needed and at the right level for the conditions.

This isn't just a long term issue though (if you think that running out of reserves in 70 years' time can be called long term). In the much shorter term we have the issue of peak demand being greater than the supply. There have been several examples of rolling blackouts in countries around the world in the last decade, notably in the USA and South Africa. Here in the UK, we haven't really experienced blackouts since the miners' strikes and three day weeks of the 1970s. However, the risk of consumers being disconnected is increasing.

Each year, Ofgem (Office of Gas and Electricity Markets) publishes the Electricity Security of Supply report, which analyses the UK energy market and the likelihood of supply not meeting demand. The 2015 report (https://goo.gl/NZzNHx) doesn't make for very positive reading with an increase in uncertainty and a decrease in margins compared to the previous year's report.

For winter 2016 the de-rated margin (the amount of spare capacity available) is estimated at between 0-4 percent resulting in a LOLE (loss of load expectation) of 2-15 hours per year. In last year's report the LOLE was predicted to be 0-3 hours, so the situation has worsened, mainly due to the risk of plant closures and demand uncertainty.

Clearly, there is a danger of having no margin over peak demand and a potential for consumers losing supply. There are two solutions – generate more or use less. In my opinion, using less is the only option that is going to extend our ability to keep generating energy from fossil fuels. Generating more energy is only going to reduce the time we have to develop sufficient capacity in renewables and further research into alternatives such as nuclear fusion.

Some people talk about the electricity supply/demand problem as "keeping the lights on". Personally, I believe we should be thinking about keeping the lights off more often. In addition to doing the right thing for the planet and our descendants, by using less energy, there is one compelling incentive - money. Using less energy now will not only save on cost now, but also in the future. As electricity prices continue to rise (they have doubled in the last ten years) then any investment in saving energy now will be an insurance against the rising cost of an essential purchase.

As Henry Ford said, "If you need a machine and don't buy it then you will ultimately find that you have paid for it but don't have it". It is still true today, and in the context of this article could be rephrased "What you save by not investing in efficient systems, you lose multiple times in energy costs".

The difficulty tends to come with that word 'investment', particularly in uncertain economic times. I would argue though that given a short enough payback period, that investment will not only pay for itself quickly but many times over.

GAMBICA represents the industrial automation sector and within that area our members supply various forms of motor control - fixed speed (contactors, soft-starts) and variable speed (variable speed drives). Motor control is one of the areas where industry has the largest potential to save energy and thus save money and improve competitiveness.

It is estimated that two-thirds of industrial electrical consumption is by motor driven systems (pumps, fans compressors, conveyors, hoists, etc) which equates to about 20 percent of the UK electricity generated. For each electric motor, over 96 percent of the lifetime cost is in energy, with the purchase cost being only 3 percent. Not only is the amount of energy consumed by electric motors massive, the potential for savings is also significant.

The Ecodesign Directive is progressively increasing the minimum efficiency levels of electric motors placed on the market, which is a good first step. The more efficient IE3 and IE4 motors will consume somewhere in the range of 3-10 percent less energy than the IE1 motors that can no longer be sold in Europe.

However, there's a much greater potential saving at the system efficiency level. If we take the motor along with the control system and the load (a pump or fan, for example) as the system, then we can realise savings of 30-80 percent with appropriate technology and tuning to the application.

Using automated fixed speed control such as a contactor or soft start, it is very simple to save considerable amounts of energy by simply switching systems off when not needed. It sounds a very basic step, so much so that it is often forgotten. The number of conveyors or compressors that run non-stop even when not needed add up to a lot of wasted energy.

Where a pump or fan system can be speed controlled, there is a similar gold mine of energy savings to be had. Reducing speed by 20 percent can result in a 50 percent energy saving on some systems. Continuously controlling the speed to meet changing conditions - for example, in ventilation or cooling systems - will save a substantial amount of energy compared to 'always-on' systems that use electricity whether needed or not. Many systems have been designed by cautious engineers that result in oversize motors for the application, so varying the speed can help to mitigate here too.

Where a pump or fan system can be speed controlled, there is a gold mine of energy savings to be had

Our experience is that the majority of motor driven systems do not have an adequate form of control or automation that would switch off when needed or turn down when possible. The potential saving if this was done across the whole of UK industry is the equivalent of the output of Drax, the UK's highest capacity power station and single largest emitter of carbon dioxide.

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