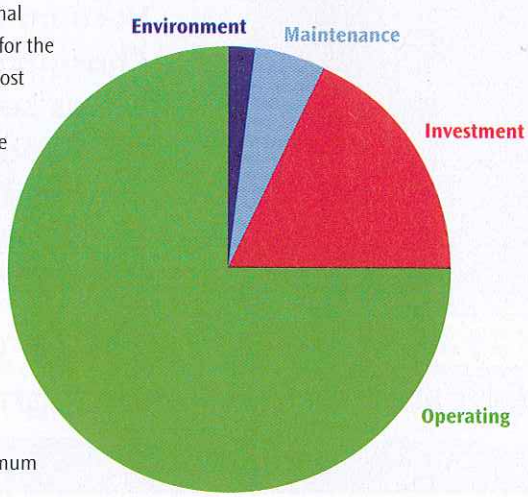
# Running away from the real costs – an inconvenient truth

Derek Moore from Johnson Controls International warns against the temptation to choose a compressor based on the initial purchase price.

It is disappointing that so little consideration appears to be given to the real cost of a refrigeration plant ownership. There is always an exceptional focus on the relatively small differential cost for the initial purchase and installation, when the most influential cost over the lifetime is the power consumption. Is it that few have the tools, the time or perhaps the inclination to make the necessary calculations?

A recent example is a project where the specification stated a preference for a particular make of compressor. It is believed that this was based on an assumption that they would provide the better operating efficiency and lower operating cost (see ACR Today August 2010 issue) simply because they had a lower maximum design speed.

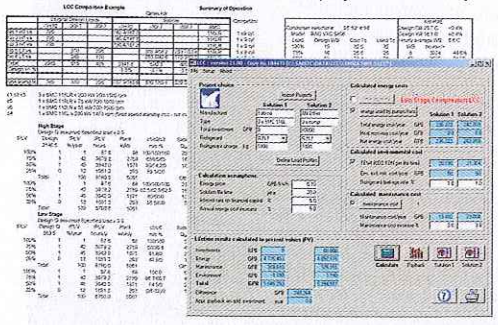
*Typical Life Cycle Cost Analysis*




The project was to service a new large distribution centre. It was reasonable to assume a seasonal load variation, due to ambient fluctuations, but essentially 24h, 365 days per year operation. In the absence of precise information, the part load profile of ARI standard 550/590 was assumed. Albeit this is intended for chiller comparisons, it represents a seasonally driven load profile and sets a percentage of time for operation at 100%, 75%, 50% and 25% capacity per year. The corresponding operating hours are multiplied by the respective capacity to secure 8760 (24 x 365) hour per year operation and a total annual cooling (kWh) duty. The ASHRAE weather data for plant location was used to estimate the seasonal variations in wet bulb temperature and the consequent condenser and plant performance.

The actual performance of both compressor makes were calculated at the various operating conditions using each manufacturer's published data. The full load condition was taken to be the actual maximum capacity of each of the compressor solutions, whilst the part loads were optimised to secure the minimum power consumption. Each compressor operation was adjusted for reduced condensing temperature due to both the available condensing capacity and the seasonal wet bulb temperature variation, to provide the identical total (kW) cooling at each part load condition, as well as securing identical full year (kWh) cooling duties.

*Full performance analysis*



## Like for like comparison

All compressors were equipped with variable speed drives and the part load operation optimised to reduce the compressor speed to a minimum, ensuring the lowest power consumption and longest service interval for each operation. Equal drive efficiencies were assumed. The calculated operating speed and hours were then used to determine the average speed of each compressor over the full year and, in turn, estimate the service intervals and cost for each compressor. The Sabroe service recommendations provide guidance for different operating conditions and speeds. The specified manufacturers information, indicated that the service interval "may be adjusted for other speeds and operating conditions", but no actual guidance was given. For fairness, the same proportional extension to the service intervals that Sabroe recommend was applied to all machines.

The parts included for each service interval were taken from each manufacturer's recommendations. The spare parts prices were the manufactures MLP prices (as typically charged to end users). The cost for oil was included at each of the recommended intervals. The labour time for service was estimated by technicians familiar with servicing each machine type and an equal hourly rate applied. A total cost for 20 years operation was calculated. Travelling time and costs were not included

The condensers were equal for each option. The associated cost of power, water, water treatment, etc was therefore not included, being equal to both schemes. This comparison was intended to establish the differences in cost, not the absolute cost, of each scheme.

## Calculating carbon emissions

Only the additional capital cost to the end-user related to the purchase on the specified compressors, as calculated by independent contractors bidding the project, was considered. An energy cost (total for consumption, maximum demand, standing charges, etc) was calculated at a modest £0.10/kWh, the annual interest rate on capital at a nominal 5% per year and energy increase at 5% per year. The plant lifetime was based on 20 years operation.

These analyses require a number of relatively detailed calculations to determine the relevant data. Here, two LCC calculations had to be made, one for the high stage and one for the low stage operation, and the results combined into an overall evaluation to reflect the total power consumption and maintenance costs. But in this case, the analysis revealed that the additional cost to the user for the specified compressor option was almost £250,000 over the life time of the plant.

This example is not intended to represent that Sabroe would always have the most advantageous solution, but simply to demonstrate that it is inappropriate to make assumptions about design and performance. If the refrigeration industry is to act responsibly - to improve efficiency, reduce greenhouse gas emissions and secure the best engineered solutions - it will have to be more professional about the choice of refrigerant, equipment and system design. Each project deserves to be properly evaluated to determine the most appropriate solution, however inconvenient that may be.