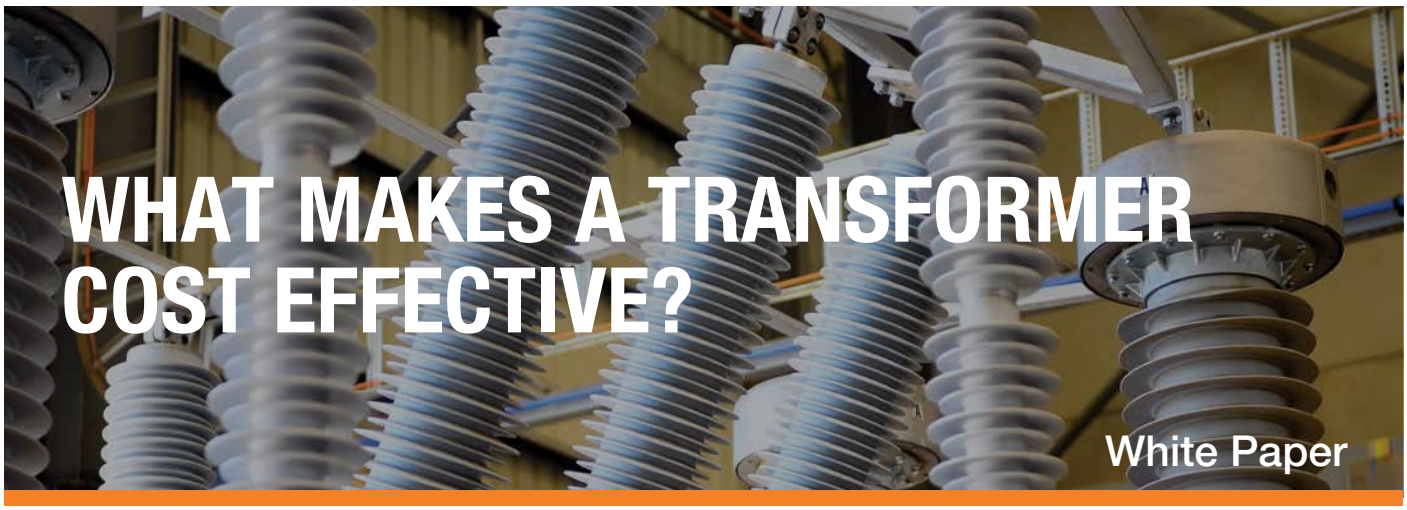


# WHAT MAKES A TRANSFORMER COST EFFECTIVE?

White Paper

**Transformers are highly efficient electrical devices with long life cycles. A transformer built for high efficiency and minimal upkeep will have a higher initial capital cost.**

**But in an environment of decreased capital spending, the economic benefits of purchasing a lower first cost standard transformer compared with a high efficiency unit are worth examining.**

**In producing a cost effective transformer for a client, transformer designers have an important role in finding the balance between delivering a low-loss transformer and controlling manufacturing costs.**

## What makes a transformer cost effective?

The initial investment should not be the only consideration. A 'total cost of ownership analysis', whereby all associated costs and savings are examined, is an important step in the transformer procurement process.

Over the life of the transformer, the cost effective choice may not turn out to be the lowest first cost option.

Power utilities understand the importance of the total cost of ownership analysis and when procuring transformers through tender or quotation, they include a price capitalisation formula in their comparison of competitive bids.

However many industrial and mining customers, to their detriment, do not fully utilise this important costing method.

## What is 'total cost of ownership'?

As a transformer unit may be expected to operate for up to and often in excess of 30 years, economic variables such as energy losses and maintenance costs should also be considered in a total owned cost analysis, calculated over the life span of the transformer.

This method allows buyers to compare the total cost of ownership between low cost (low efficiency) and higher cost (high efficiency) transformers and make decisions based on informed fact.

Often the highest ongoing cost of operating a transformer is energy losses. Losses need to be converted to a present value to determine the financial penalty likely to be incurred over the planned life of the transformer.

## Design and manufacturing considerations for efficiency and losses

Oil immersed and dry type power and distribution transformers are bound by energy efficiency standards (such as MEPS and HEPS in Australia) that specify the acceptable power loss levels of a transformer.

For utility companies, transformers can account for as much as 40% of network losses. This is essentially wasted electricity which over the life of the transformer can amount to huge financial losses.

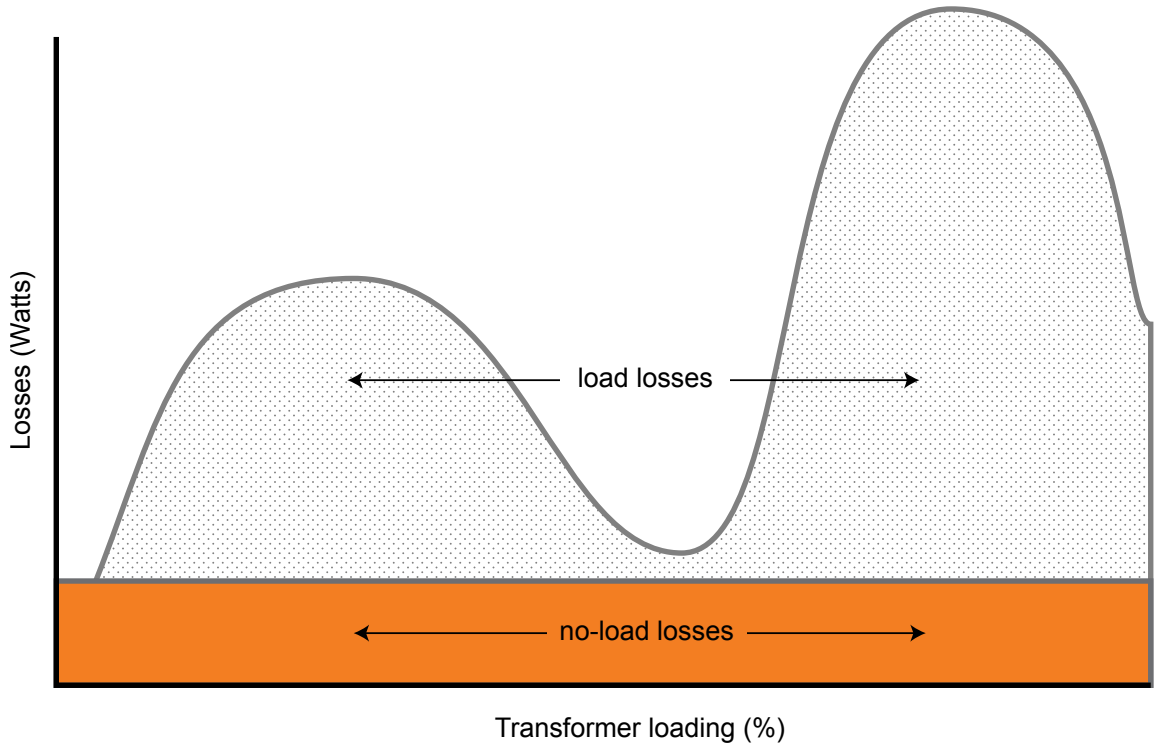
There are two types of losses: load losses, which are proportional to demand on the network at any one time and no-load losses, caused by the magnetisation of the core steel, which are constant and independent of the electric current.

Manufacturing a low-loss, high efficiency custom transformer requires optimised design, manufacturing methods and materials.

In high efficiency transformers, iron loss is minimised by the use of low loss core steel built in the most efficient core configuration and low magnetic flux density. Load losses are minimised using high conductivity material at low current densities.

The most cost effective designs optimise the cost of material, the cost of power lost and the cost of finance over the transformers expected life time.

The performance gain may only be 1-2% improved load loss at 100% loading, yet the savings over the life of the transformer may be significant.



## Transformer life cycle

The manufacturing cost is not the last cost of a transformer. A high efficiency model will reduce energy losses but will have other long term benefits, especially related to maintenance.

Efficient transformers run cooler, thus reducing the need for cooling mechanisms such as fans. The low temperature rise helps lessen stress on internal materials such as insulation and cellulose paper. With fewer fans requiring repairs or replacement, maintenance costs are minimised.

Environmentally, high efficiency transformers ultimately reduce consumption of fuel necessary to accommodate transformer losses.

## The economics of efficiency

By putting capital and operating costs into a total cost of ownership formula, purchasers can derive and compare the real value of transformer options of different efficiency levels and purchase price.

The below example compares the total cost of ownership of a standard efficiency and high efficiency power transformer over 25 years.

| Transformer | Purchase price* | Efficiency | No-load losses (kW) | Load losses (kW) | Capitalisation rate of no-load losses ($/kW) | Capitalisation rate of load losses ($/kW) | Cost of no-load losses ($) | Cost of load losses ($) | Cost of no-load + load losses ($) | Total cost of ownership ($) |
|---|---|---|---|---|---|---|---|---|---|---|
| 12.5 MVA oil filled, standard losses | $350,000 | 99.40% | 9.0 | 75.0 | 11,226 | 2,806 | 101,034 | 210,450 | 311,484 | $661,484 |
| 12.5 MVA oil filled, low losses | $375,000 | 99.51% | 7.0 | 54.0 | 11,226 | 2,806 | 78,582 | 151,524 | 230,106 | $605,106 |

## High efficiency transformer: the cost effective choice

The benefits are clear: purchasing a high efficiency transformer upfront will result in significant savings over the life of the transformer. Operators will also benefit from reduced maintenance costs as well as added environmental benefits.

For transformer manufacturers, the science is in providing the best value from the client's perspective, balancing a cost effective build with ongoing operational efficiency.

*purchase price in this article is for purpose of this calculation only and is not indicative of an individual custom transformer build by Ampcontrol.