2

Dimensioning of cables, transformers and protective devices to meet energy efficiency requirements

SIEMENS

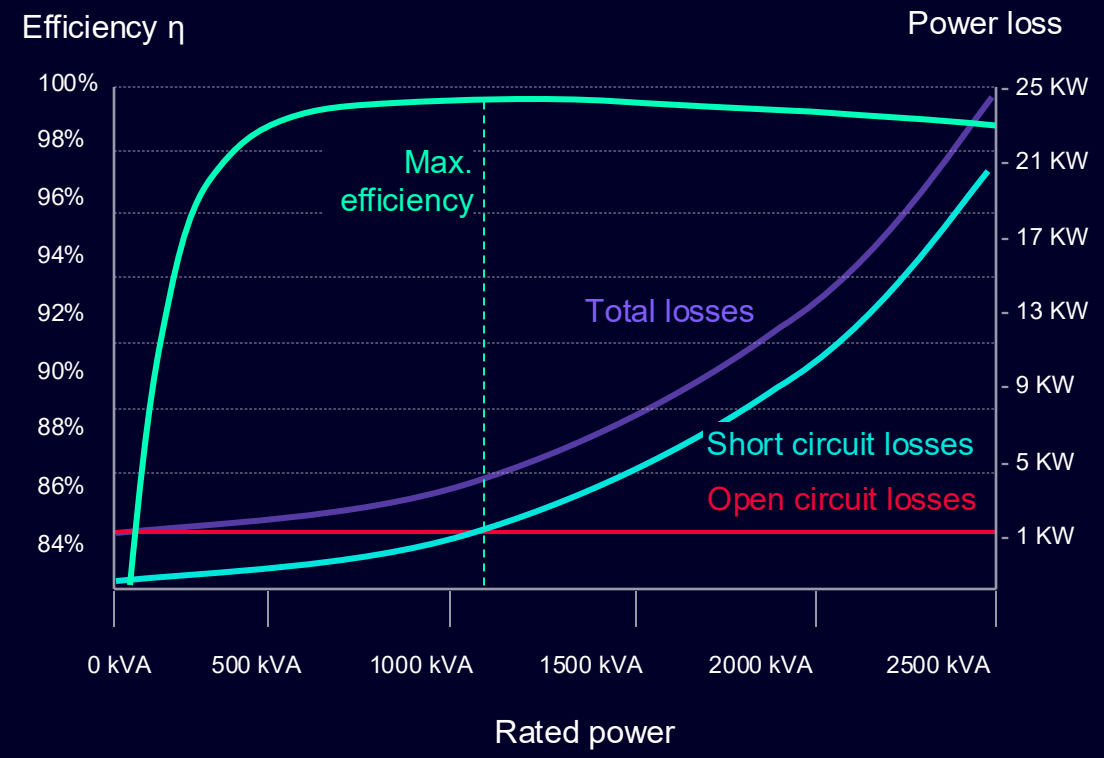
Selecting and dimensioning of the right transformer
Recommendation: Optimal utilization between 30 - 50%

Considerable **energy losses** may occur in the transformer. On the one hand, no-load operation losses, on the other hand, short-circuit losses.

The virtually constant **open-circuit losses** prevail in the case of low utilization.
In the case of greater utilization, **short-circuit losses** largely contribute to the total loss (squared to the current).

The **maximum**, relative **efficiency** in relation to the load is achieved when the **open-circuit and short-circuit losses** are the same.
This tends to be at around 30% to 50% utilization.

Schematic diagram of transformer losses as a function of capacity utilization



SIEMENS

Deliberate oversizing of cables for long distances saves energy

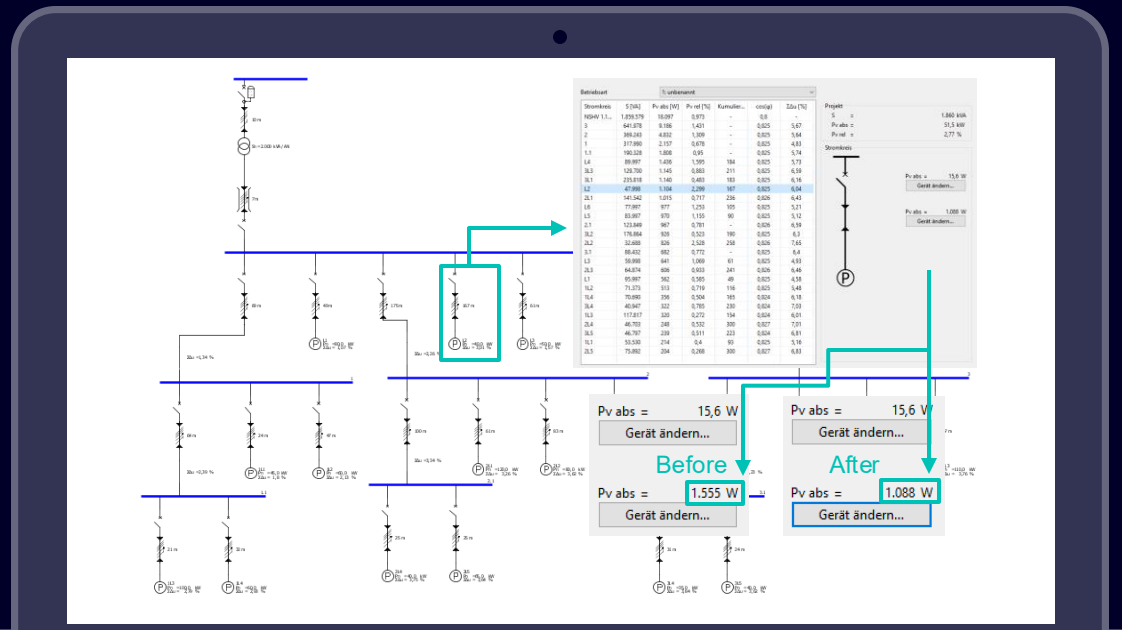
Example with low current (72 A)

The copper resistance value is: $R_{Cu} = p * \frac{l}{A}$

The power loss of the single conductor is thus calculated as follows:

$P_V = R * I^2 = 0.0196 \frac{l}{A}$ (p = dependent on material quality and at 55° conductor temperature)

By increasing the conductor cross-section **from 35 mm² to 50 mm²**, **energy consumption** is reduced at a rated power of 72 A and line length of 167 m **by approx. 30%** from 1.55 kW to 1.09 kW



Graphic and values from SIMARIS design

Savings*:

CO_2 in kg	Energy	OPEX
17,000 kg	**40,500 kWh**	**3740 € - 9360 €**
Additional investment:		**1030 €**

*Premises: Duty cycle 0.5; duration 20 years; CO_2 emissions 0.42 kg per KWh (electricity mix in Germany); CO_2 emissions for copper production 2.3 kg / kg Cu; electricity price € 0.10 to € 0.25

SIEMENS