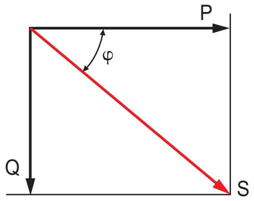
Reactive Power Management...

VMEPL
Integrated Power Solutions

Power Factor Correction Guideline



In this representation, the Power Factor (P/S) is equal to cosj.

Due to this higher supplied current, the circulation of reactive energy in distribution networks results in:

- > Overload of transformers
- > Higher temperature rise in power cables
- > Additional losses
- > Large voltage drops
- > Higher energy consumption and cost
- > Less distributed active power.

Principle of reactive energy management

All AC electrical networks consume two types of power: active power (kW)
and reactive power (kVAr):

- The active power P (in kW) is the real power transmitted to loads such as motors, lamps, heaters, computers, etc. The electrical active power is transformed into mechanical power, heat or light.
- The reactive power Q (in kVAr) is used only to power the magnetic circuits of machines, motors and transformers.

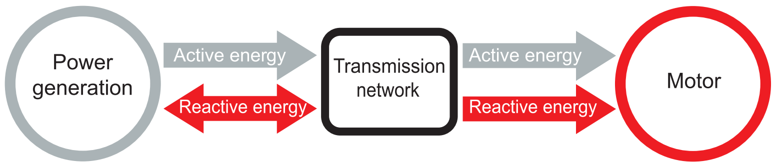
The apparent power S (in kVA) is the vector combination of active and reactive power.

The circulation of reactive power in the electrical network has major technical and economic consequences. For the same active power P, a higher reactive power means a higher apparent power, and thus a higher current must be supplied.

The circulation of active power over time results in active energy (in kWh).

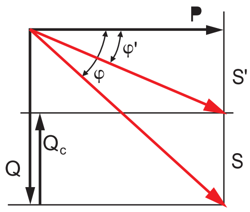
The circulation of reactive power over time results in reactive energy (kvarh).

In an electrical circuit, the reactive energy is supplied in addition to the active energy.



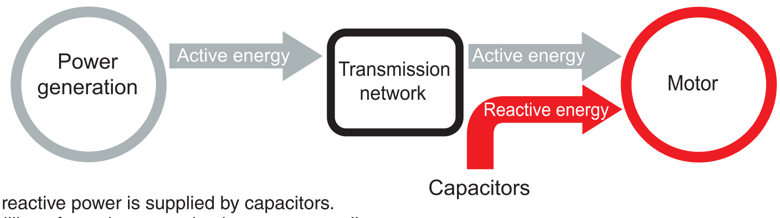
Reactive energy supplied and billed by the energy provider.

For these reasons, there is a great advantage in generating reactive energy at the load level in order to prevent the unnecessary circulation of current in the network.
This is what is known as **"power factor correction".**
This is obtained by the connection of capacitors, which produce reactive energy in opposition to the energy absorbed by loads such as motors.



The result is a reduced apparent power, and an improved power factor P/S' as illustrated in the diagram opposite.

The power generation and transmission networks are partially relieved, reducing power losses and making additional transmission capacity available.



The reactive power is supplied by capacitors.
No billing of reactive power by the energy supplier.

Other Power Solutions Products

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Benefits of reactive energy management

Optimized management of reactive energy brings economic and technical advantages.

Savings on the electricity bill

- Eliminating penalties on reactive energy and decreasing kVA demand.
- Reducing power losses generated in the transformers and conductors of the installation.

Example:
Loss reduction in a 630 kVA transformer PW = 6,500 W with an initial Power Factor = 0.7.
With power factor correction, we obtain a final Power Factor = 0.98.
The losses become: 3,316 W, i.e. a reduction of 49 %.

$$\text{Copper loss} = \left(\frac{PF_1}{PF_2}\right)^2 \times \text{ Full load copper loss}$$

$$= \left(\frac{0.7}{0.98}\right)^2 \times \text{ Full load copper loss}$$

$$= \left(\frac{0.7}{0.98}\right)^2 \times 6500\text{ W}$$

$$= 3316\text{ W}$$

$$\text{Savings} = 6500\text{W} - 3316\text{W}$$

$$= 3183\text{W}$$

Increasing available power

A high power factor optimizes an electrical installation by allowing better use of the components. The power available at the secondary of a MV/LV transformer can therefore be increased by fitting power factor correction equipment on the low voltage side.

The table shows the increased available power at the transformer output through improvement of the Power Factor from 0.7 to 1.

Power factor	Increased available power
0.7	0%
0.8	+14%
0.85	+21%
0.90	+28%
0.95	+36%
1	+43%

Example
Calculation for additional load in kW that can be connected by improving Power Factor

Load = 500 kVA
Initial PF($\cos\varphi_1$) = 0.7
Target PF ($\cos\varphi_2$) = 0.95
$\cos\varphi_1 = kW_1 / kVA_1$
$kW_1 = kVA \times \cos\varphi_1$
= 350 kW
$kW_2 = kVA \times \cos\varphi_2$
= 475 kW
Additional kW that can be connected = 475 - 350 = 125 kW
% of additional load = 125 / 350 x 100 = 36%

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