Reactive Power Compensaiton

Choosing the right solution

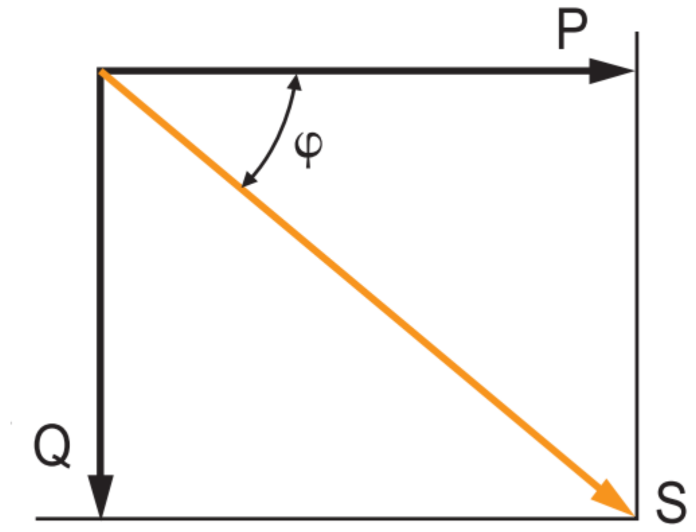
By: Pablo De Jarmy

Power Factor

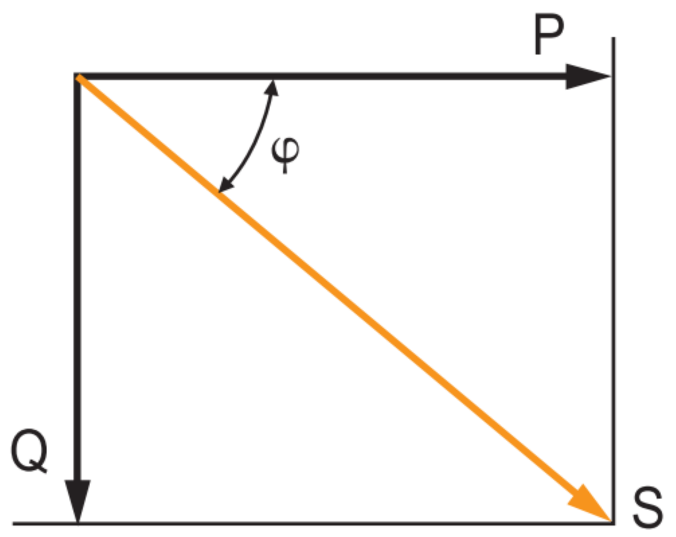
- Low power factor is one of the most easily identifiable power quality problems.
- It may have severe economic repercussions on your electricity bill.
- Poor power factor correction is a very likely cause for other power quality issues.

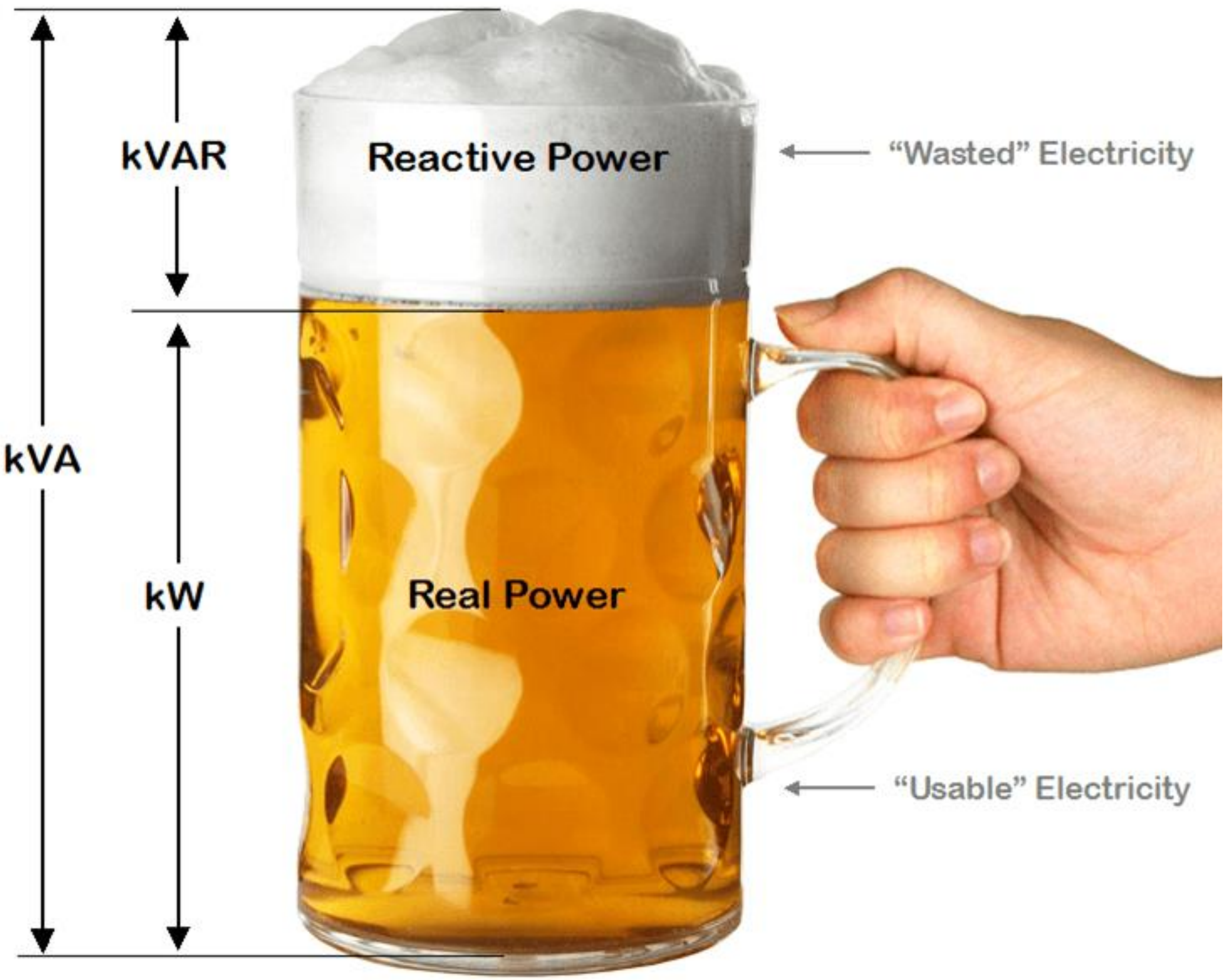
Power Factor

- On DC systems, steady state power is very straighforward.
  - P = V x I
- On AC systems, steady state power has something more to it.
  - **S** = **V x I** (Now we're using vectors).
  - **S** = P + jQ
  - $\boldsymbol{S} = S * \cos(\emptyset) + j * S * \sin(\emptyset) = \sqrt{P^2 + Q^2}$



Power Factor & Beer





Active Power Vs. Reactive Power

Active Power [P]

- Real power transmitted to loads such as motors, lamps, heaters, etc.
- This power is converted into mechanical power, heat or light.

Reactive Power [Q]

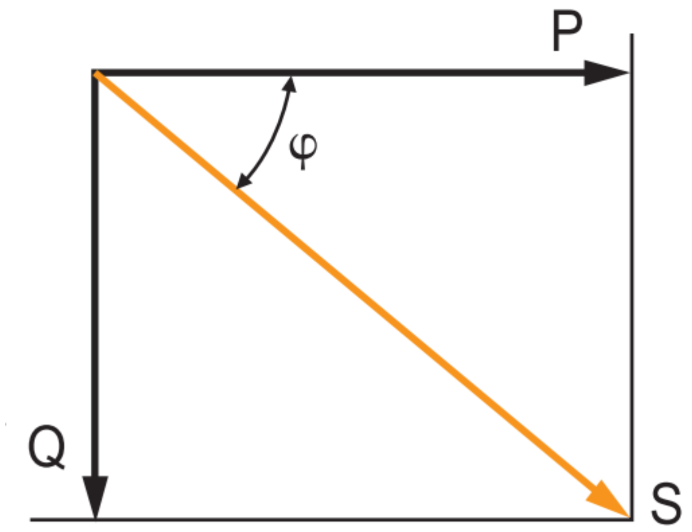
- Produces no real work but is essential for electrical machines to function.
- This power is used and produced in the magnetic circuits of power machines.

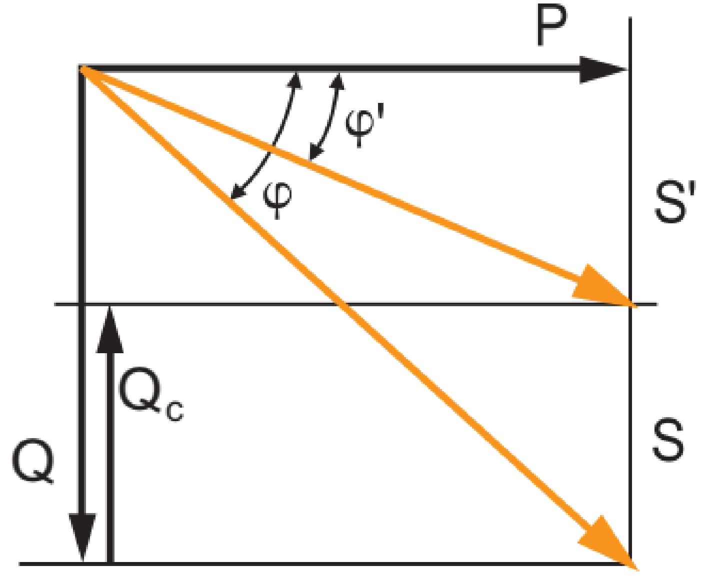
Power Factor

- Ratio of active power to total power.

- $PF = \frac{P}{\sqrt{P^2+Q^2}} = \cos(\emptyset) = \frac{P}{|S|}$

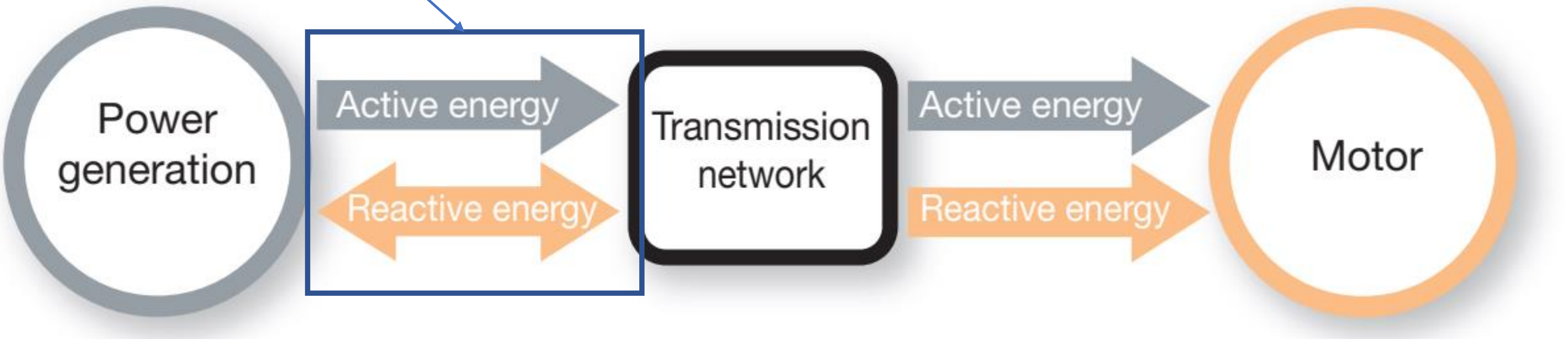
- PF varies between 0 and 1.
  - Best PF is 1.
  - Worst PF is 0.
  - Normal PF ranges between 0.6 and 0.9.





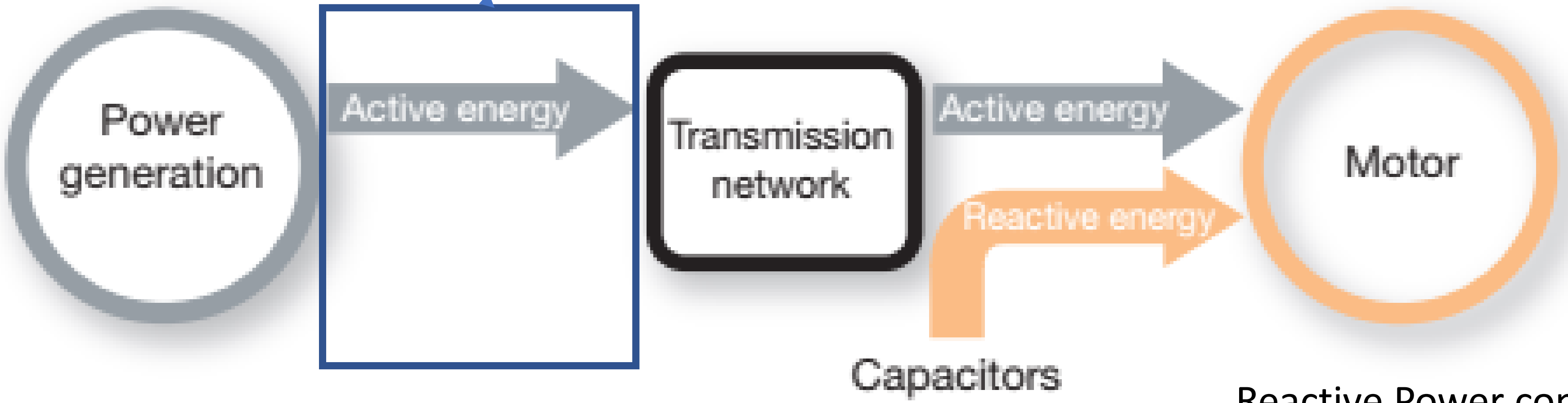
Power Flow

This is a wire carrying current. The more components in the current, the higher it becomes in magnitude.



Power Flow

This wire carries less significantly less current, while delivering the same amount of active power.



Reactive Power compensation 😁😁😁

Low Power Factor consequences

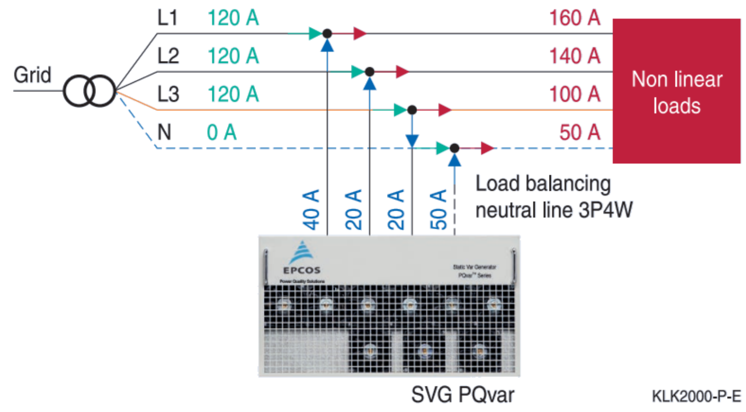
- TRANSFORMER OVERLOAD.
- HIGHER TEMPERATURE IN CABLES.
- SYSTEMWIDE LOSSES.
- LARGE VOLTAGE DROPS.
- ECONOMICAL PENALTIES
- LESS AVAILABLE POWER
- LARGE INSTALLATION SIZE

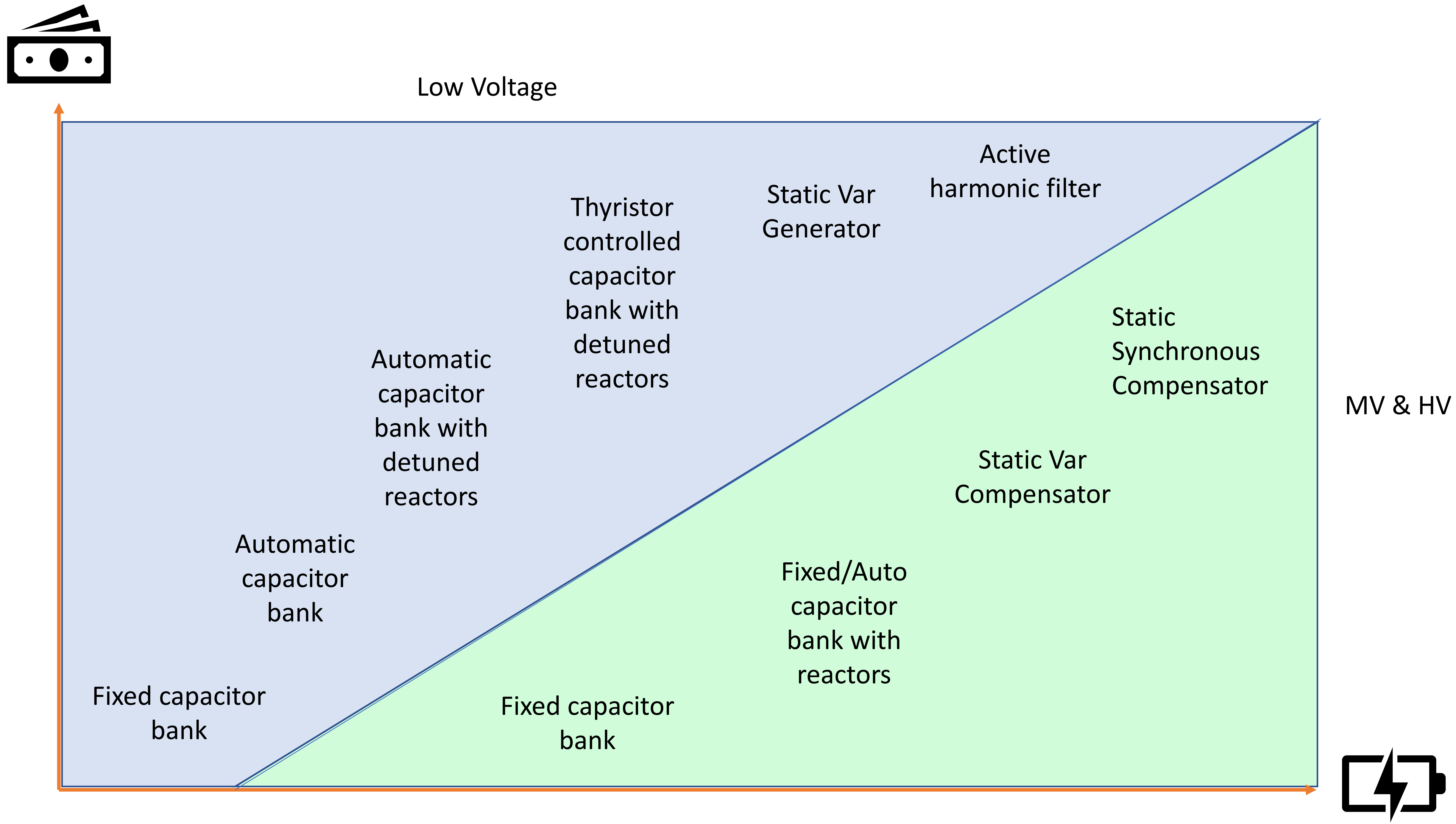
Power Factor Correction

- Passive compensation.
  - Traditional solution.
  - Any voltage level.
  - Suitable for almost all applications.
  - Low-loss solution.
- Capacitor banks.
  - Fixed or automatic.
- Capacitors with detuned reactors.
  - Fixed or automatic.
  - Mechanical or thyristor-controlled switch.
    - Hybrid solutions
  - Detuned factor 5.7, 7, 14 (most used values)
- Harmonic filters.
  - Capacitors with tuned reactors.

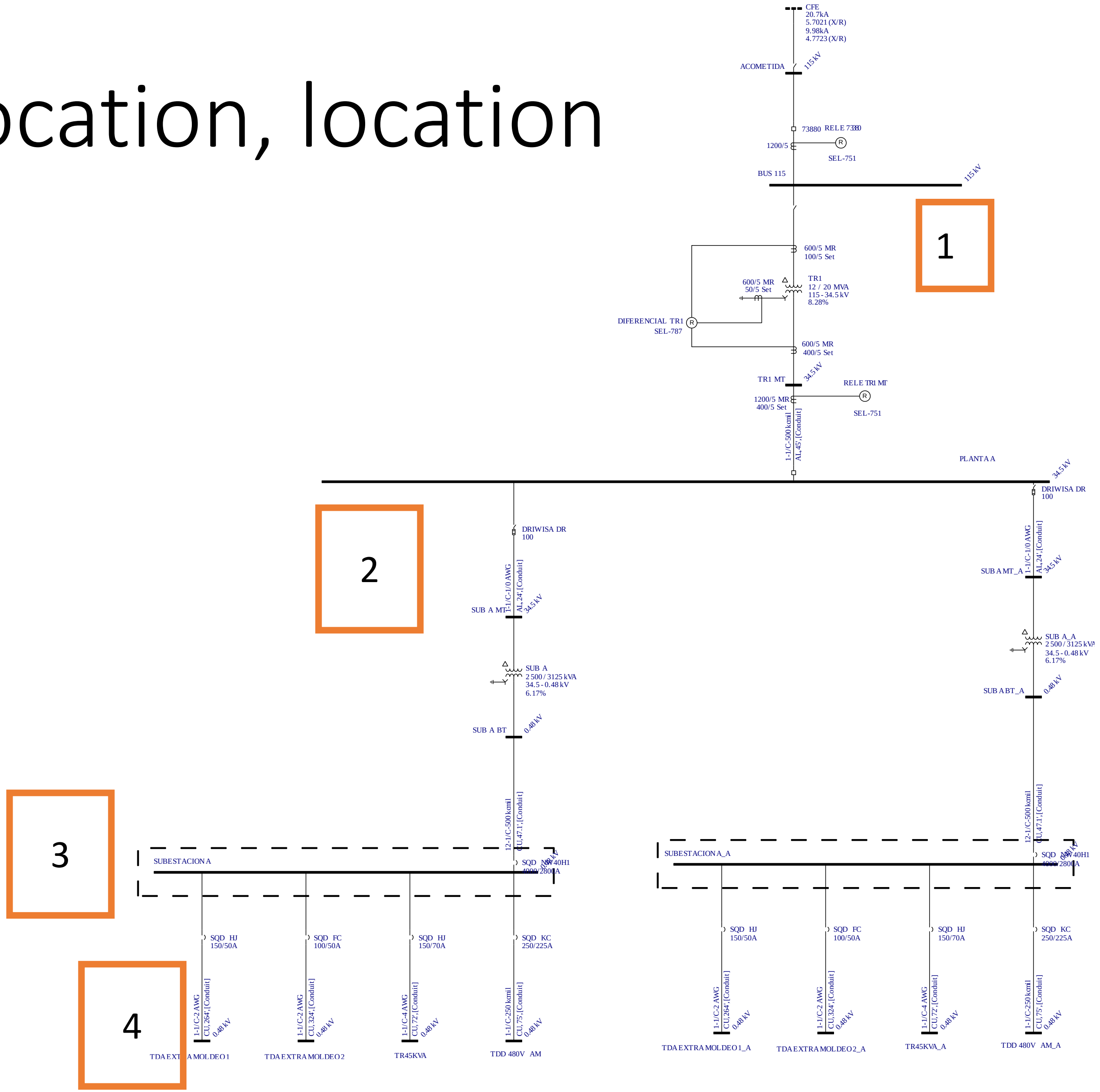
Power Factor Correction

- Active compensation.
  - Power electronics at heart.
  - Very fast response time.
  - More expensive.
  - For the most demanding applications.
  - For every voltage level.
  - Current balancing.
- Active harmonic filters.
- SVG (Static VAR Generators).




Low Voltage
Active harmonic filter
Static Var Generator
Thyristor controlled capacitor bank with detuned reactors
Automatic capacitor bank with detuned reactors
Automatic capacitor bank
Fixed capacitor bank
Static Synchronous Compensator
MV & HV
Static Var Compensator
Fixed/Auto capacitor bank with reactors
Fixed capacitor bank

Location, location, location



Too many questions 😫

- Low voltage or medium/high voltage?
- How many kVAr?
- Which frequency is the best for tuning (detuning)?
  - 4.2, 3.8, 2.7
- Where can I get the best bang for my buck?
  - Not just $/kVAr.
  - System performance must be considered.
- Where is the optimal installation point for decreasing losses?
- Where to find highest reliability.
- Consider voltage rise/drop when implementing a solution.
- Do I have a harmonic problem in my facility?

Two fundamental tools

Power Quality study with portable analyzer

+

EasyPower®
Power made easy.

Of course

EasyPower example

- Thanks for your attention!
- 10-minute Q & A.
- If you need more info, feel free to drop a line
  - P.dejarmy@encos.mx