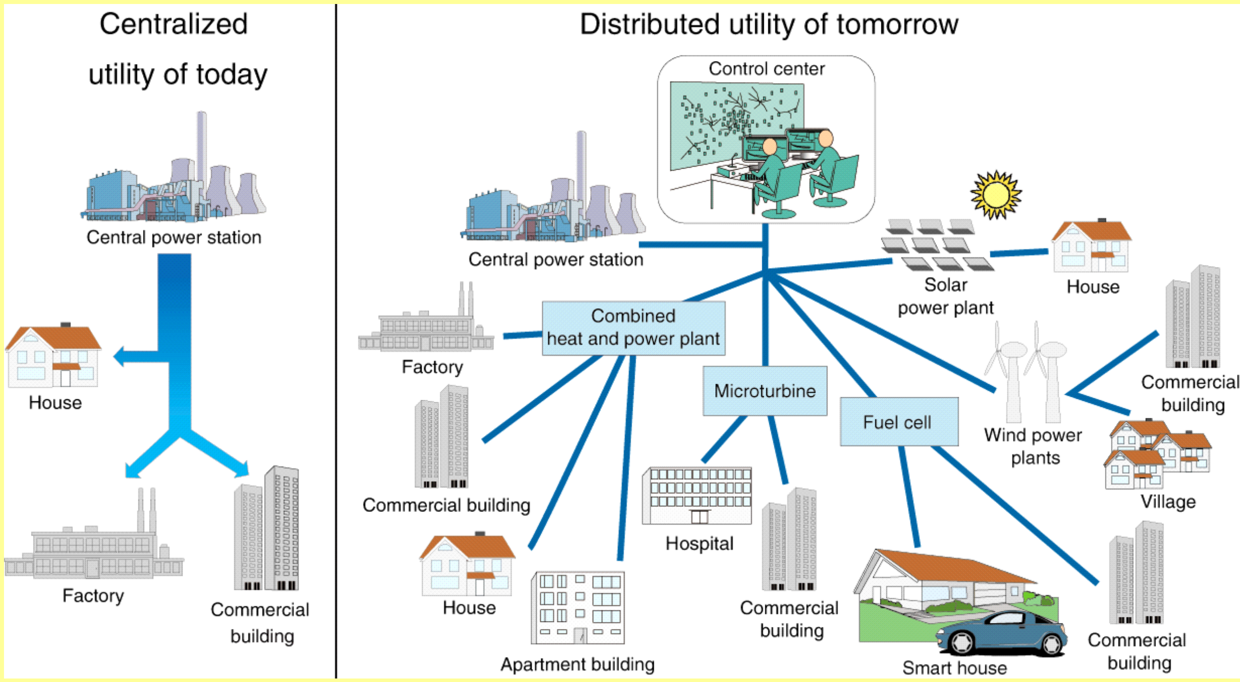
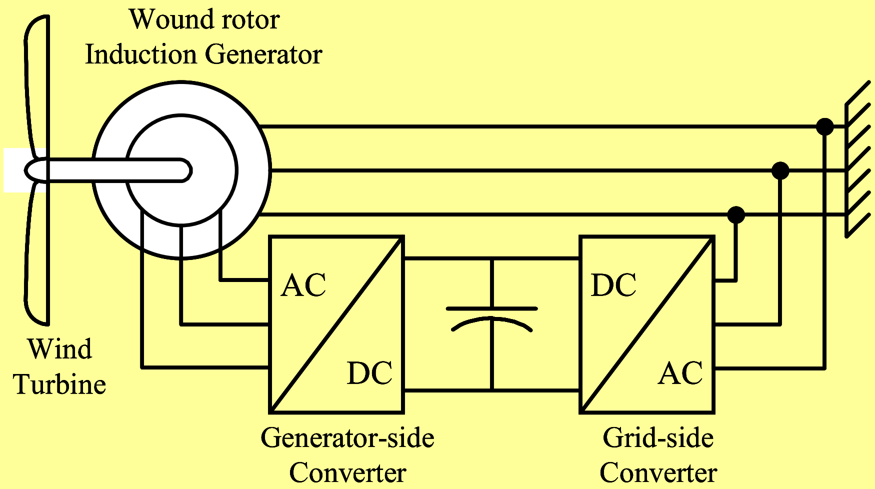
Utility-Related Applications of Power Electronics

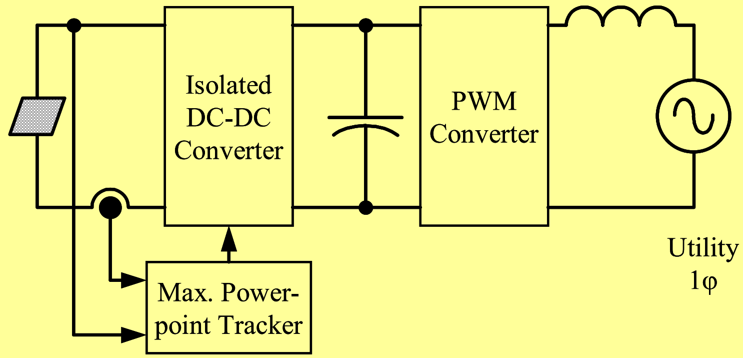
DISTRIBUTED GENERATION (DG) APPLICATIONS



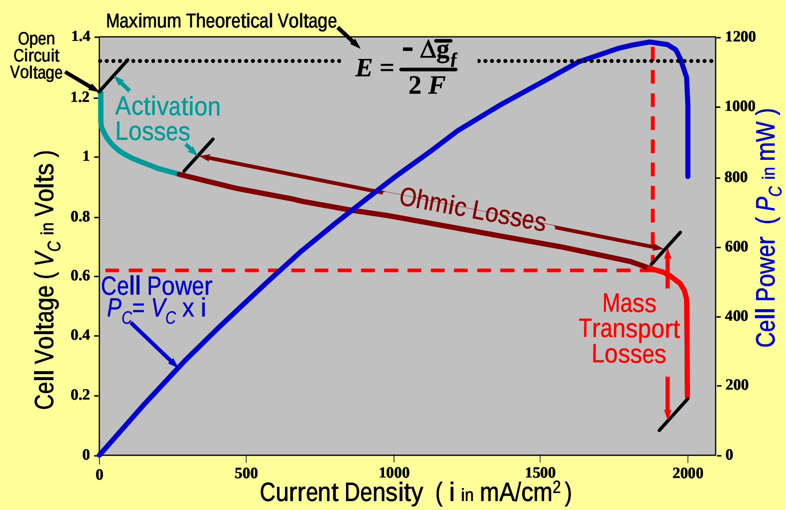
Wind-Electric Systems



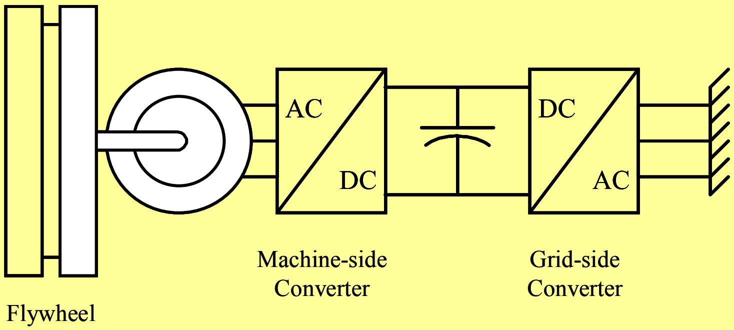
Photovoltaic (PV) Systems



Fuel Cell Systems

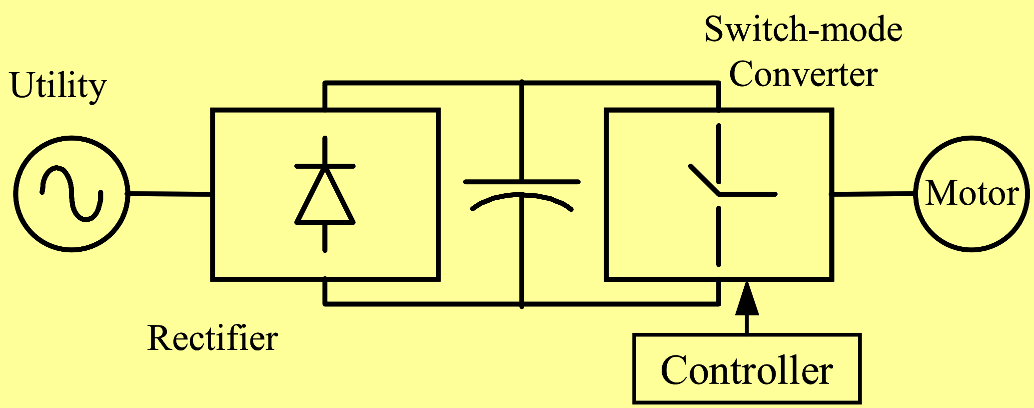


Energy Storage Systems



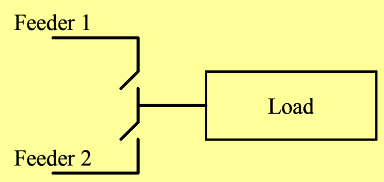
Micro-Turbines

POWER ELECTRONIC LOADS

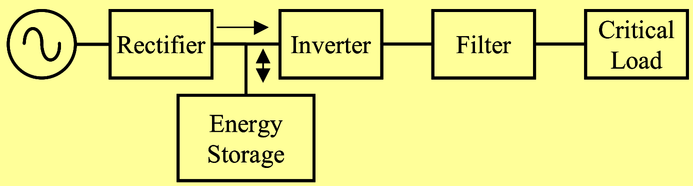


POWER QUALITY SOLUTIONS

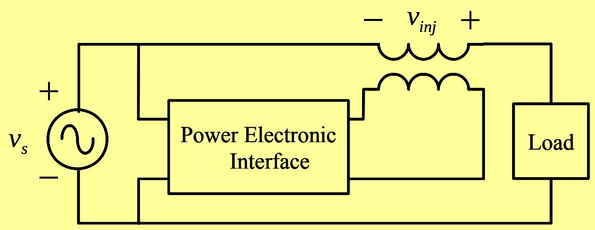
Dual Feeders



Uninterruptible Power Supplies

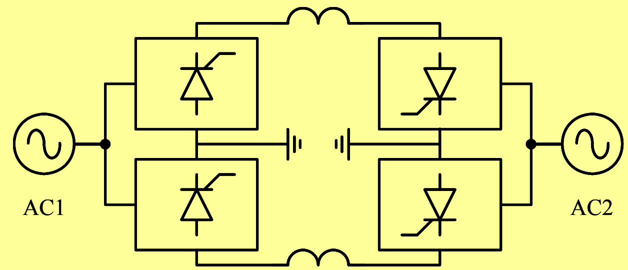


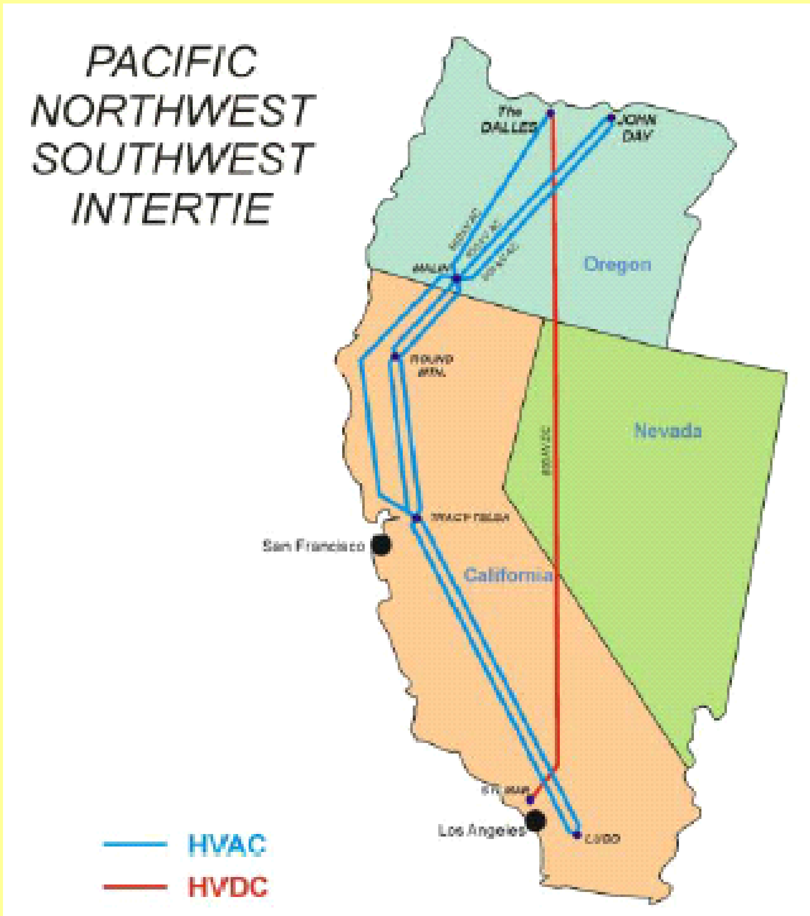
Dynamic Voltage Restorers



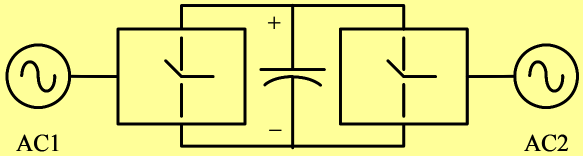
TRANSMISSION AND DISTRIBUTION (T&D) APPLICATIONS

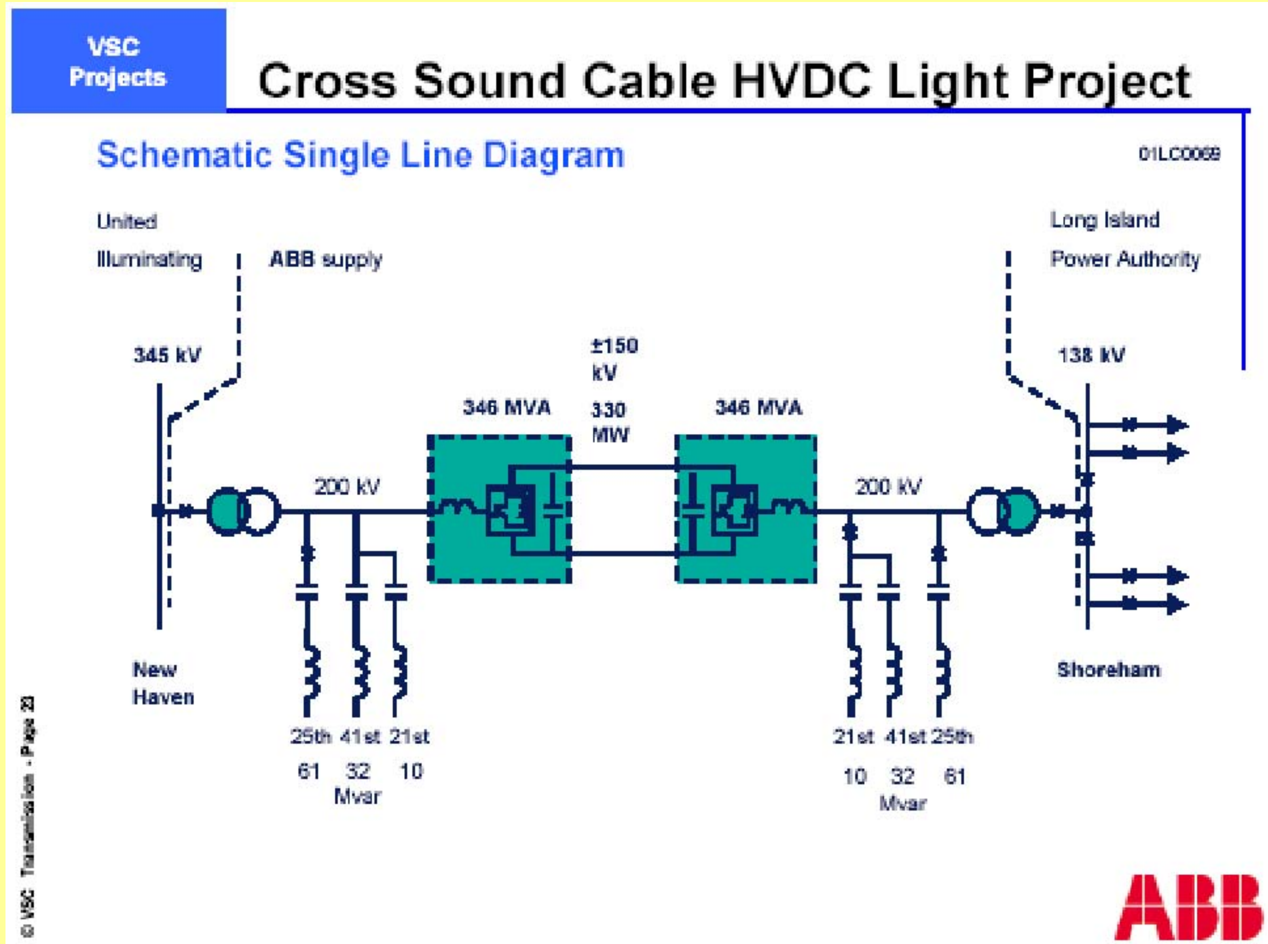
High Voltage DC (HVDC) Transmission



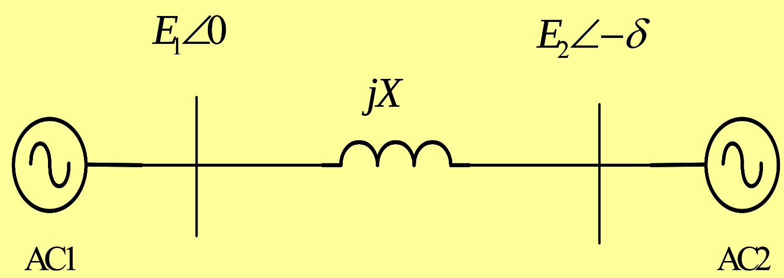


HVDC Transmission System using Voltage-Link IGBT-based Converters



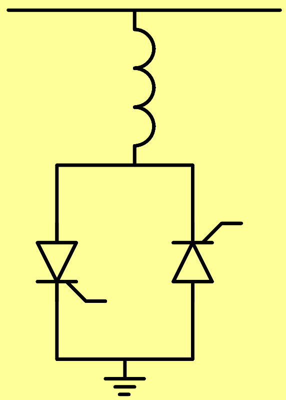


Flexible AC Transmission Systems (FACTS)

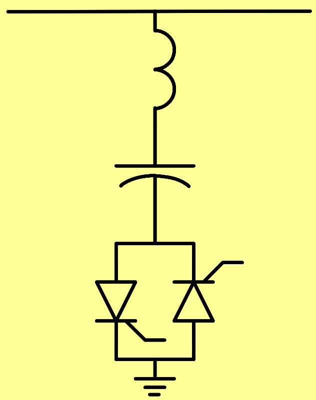


$$P = \frac{E_1 E_2}{X}\sin\delta$$

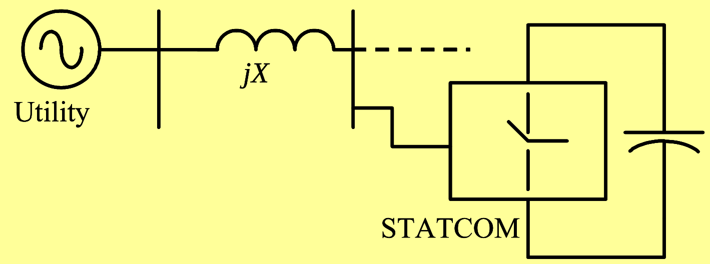
Shunt-Connected Devices to Control the Bus Voltage Magnitude



(*a*)

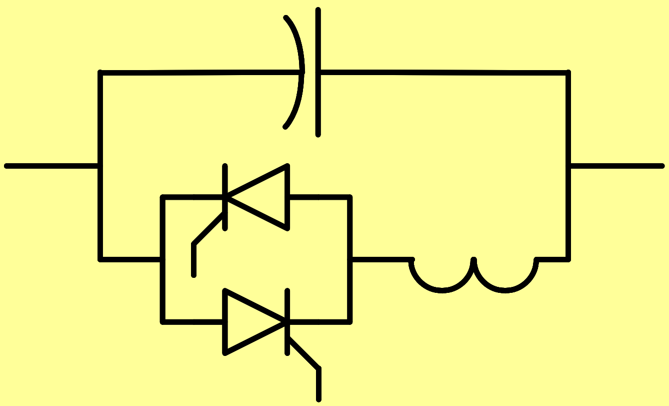


(*b*)

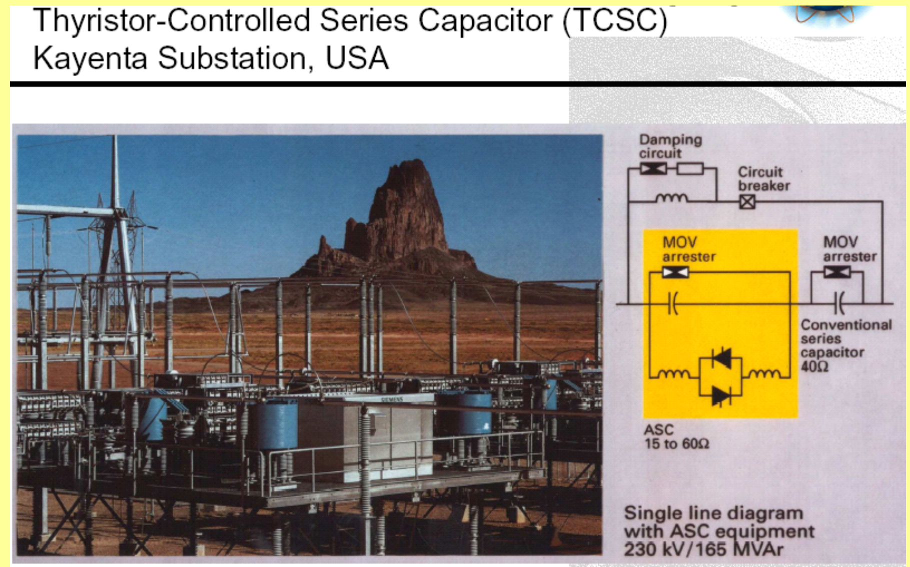


(*c*)

Series-Connected Devices to Control the Effective Series Reactance



(a)

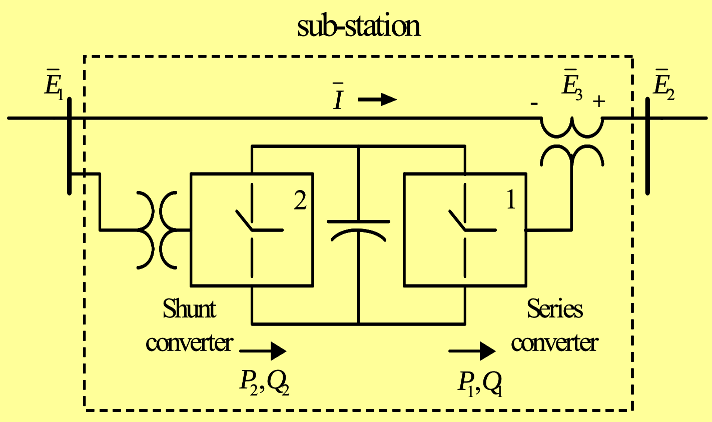


(b)

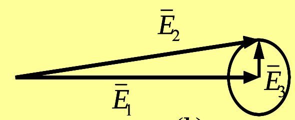
Unified Power Flow Controller (UPFC)

1. controlling the voltage magnitude E
2. changing the line reactance X, and/or
3. changing the power angle δ.

$$\bar{E}_1 + \bar{E}_3 = \bar{E}_2$$



(*a*)



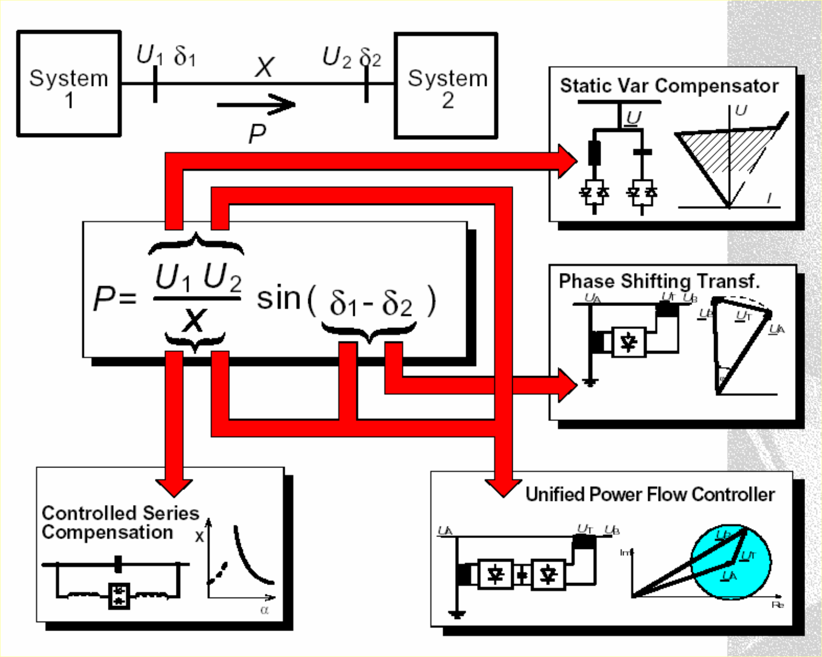
(*b*)

$$P_1 = 3\,\mathrm{Re}(\bar{E}_3 \bar{I}^*)$$

$$P_2 = P_1$$

$$Q_1 = 3\,\mathrm{Im}(\bar{E}_3 \bar{I}^*)$$

$$Q_2 \neq Q_1$$



System 1
$U_1\ \delta_1$
X
$U_2\ \delta_2$
System 2
P
$P = \frac{U_1 U_2}{X} \sin(\delta_1 - \delta_2)$
Static Var Compensator
Phase Shifting Transf.
Controlled Series Compensation
Unified Power Flow Controller

Summary

- Utility Applications of Power Electronics