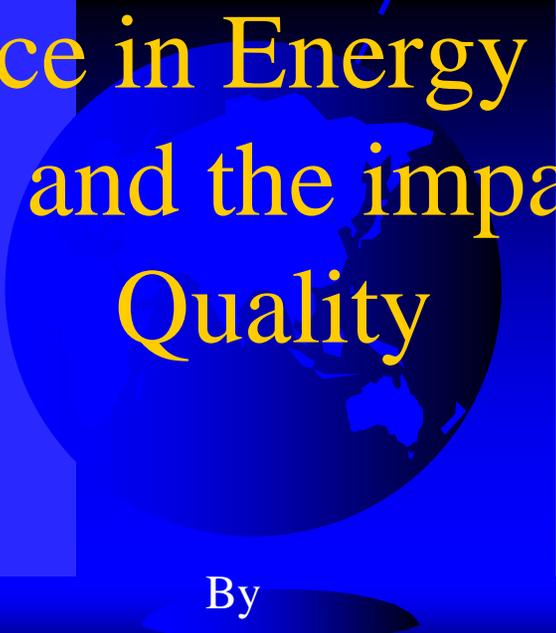


The advance in Energy Efficiency technologies and the impact on Power Quality



By

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PQsynergy2012

What is Power Quality?

- ☞ The characteristics of the supply voltage and the electrical system that affect the performance of the load
- ☞ The characteristics of the load that affect the electrical system or other loads..

Source Power Quality Inc Terry C, 1990



Electrical Energy Efficiency

☞ Same amount of work in the same amount of time with less Kilowatts.



Load categories

☞ Industrial

- Motors, lighting, building envelope, electronics

☞ Commercial

- Lighting, building envelope, electronics

☞ Consumer

- Appliances, lighting, building envelope

☞ Government



Parameters of Electrical Usage

- ☞ Voltage stability
- ☞ Voltage imbalance
- ☞ Amps to determine load characteristics
- ☞ Watts, KW, KW hr
- ☞ Power Factor
- ☞ Maximum demand
- ☞ Time of day usage
- ☞ Economic losses and return on investment requires data \$\$\$\$\$



Power Quality parameters Utilities

- Voltage, Sag and surges, micro-outages
- Sine wave waveshape,
- Voltage transients
- Voltage imbalance
- Harmonics
- Flicker
- Economic losses and return on investment requires data \$\$\$\$



The basics of energy savings

☞ Motors

- VFD/VSD reduce the energy not needed once the load is started
- Improve the control by electronic switching

☞ Lighting

- Change in technologies
 - ◆ Incandescent - Fluorescent - LED - speciality

☞ Electronic loads

- Increased integration of semiconductors

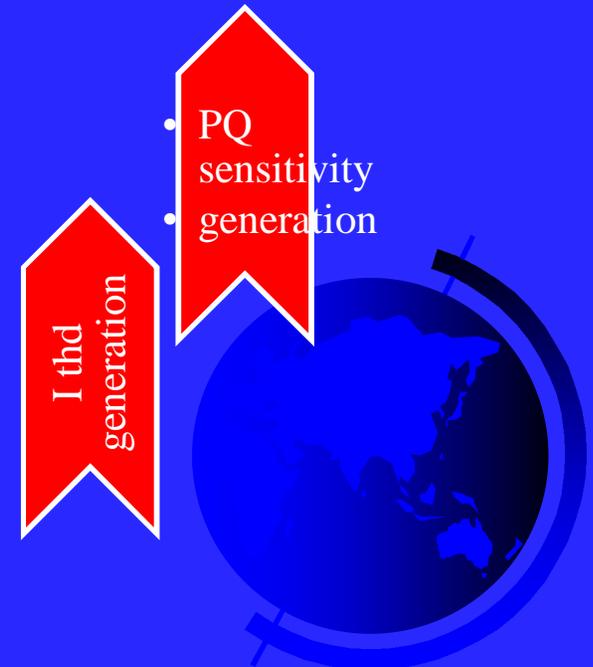
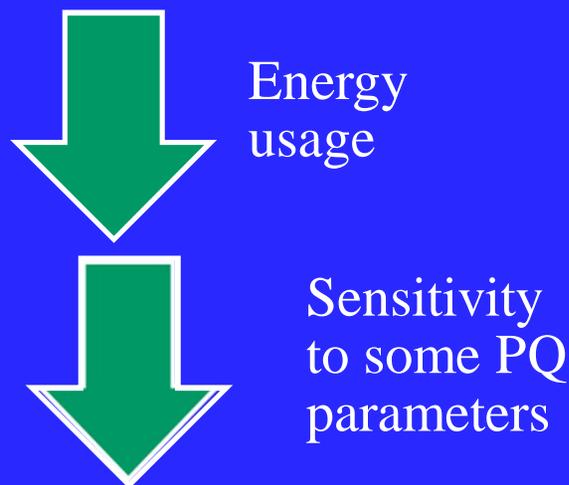
☞ Temperature

- Insulation, control and technology



The relationship Electricity usage to Power Quality situations (parameters)

- As energy efficiency of loads increases (decreases), it changes the sensitivity to PQ parameters
- and increases (decreases) the generation of harmonics.



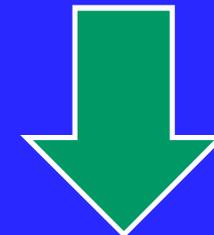
Computer power supplies (ac to dc)

– linear power supplies change to Switchmode.

- ◆ Voltage operating range went from +/- 5% to universal voltage 90vac to 240vac
- ◆ More sensitive to transients
- ◆ generate more harmonics

– Next generation

- ◆ PF corrected.
- ◆ Lower I_{thd} but at higher order harmonics



Energy usage

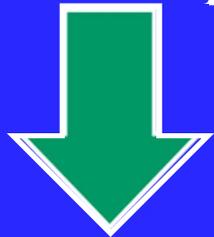


Sensitivity to Voltage levels



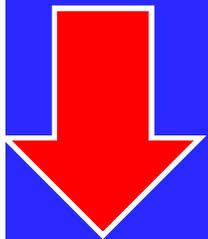
Lighting (22%)

☞ Incandescent lights to solid state ballast fluorescent lights



- Sensitivity to voltage reduced
- Increase in harmonics

☞ Next, LED lights



- Decrease in harmonics
- Decrease sensitivity to Voltage?

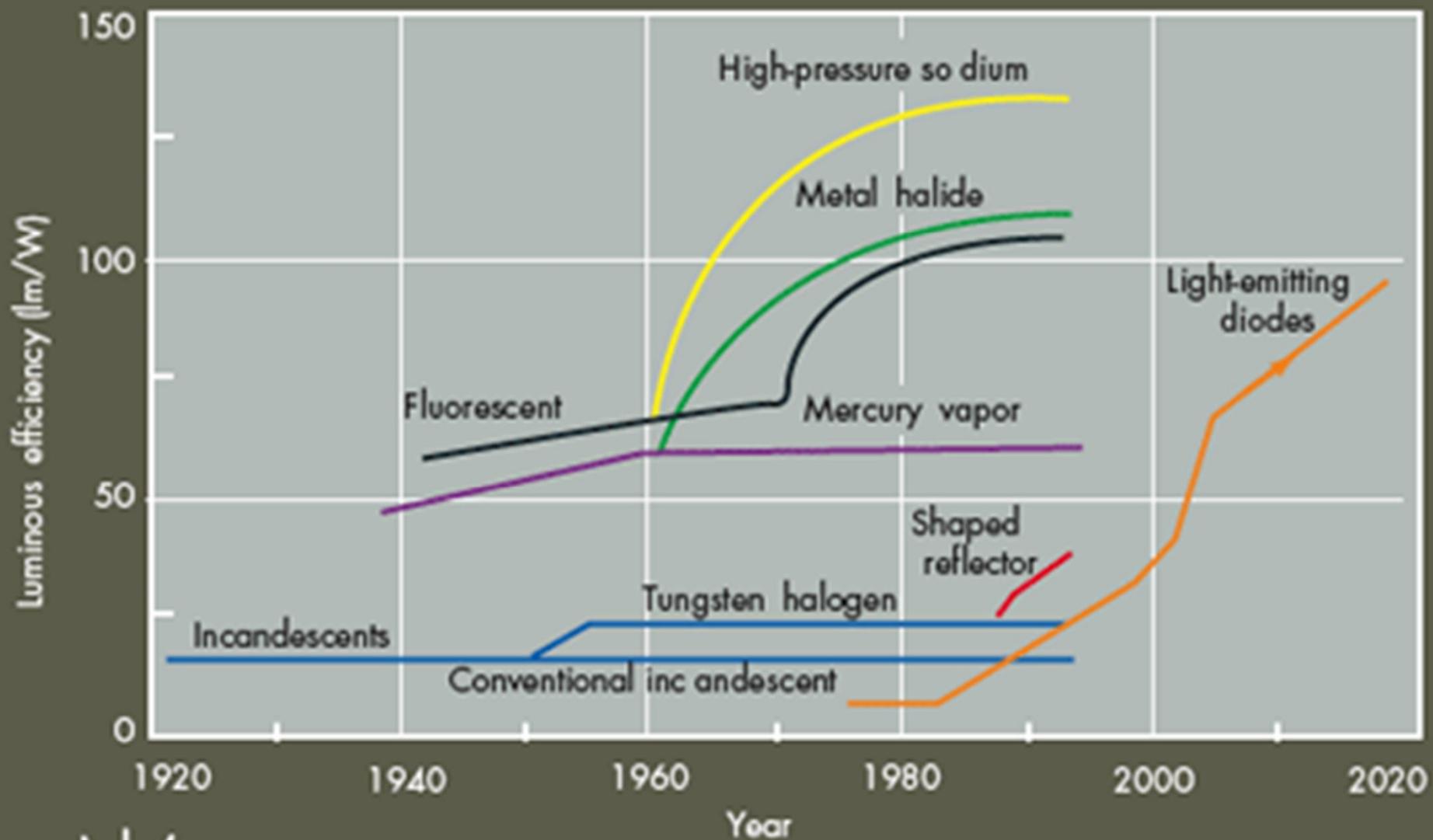


Harmonic generation



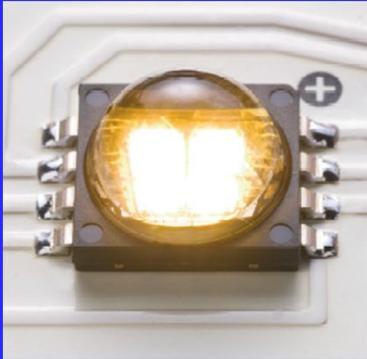
Energy usage





Lamp efficiency comparison and PQ sensitivity

9 mm



Harmonic
Generator

100 to 200 Lm/w 20,000 Hrs



100W Metal Halide

65 to 200 Lm/w

Voltage sags
Harmonics?



Harmonic
Generator

60Lm/W 8000HR



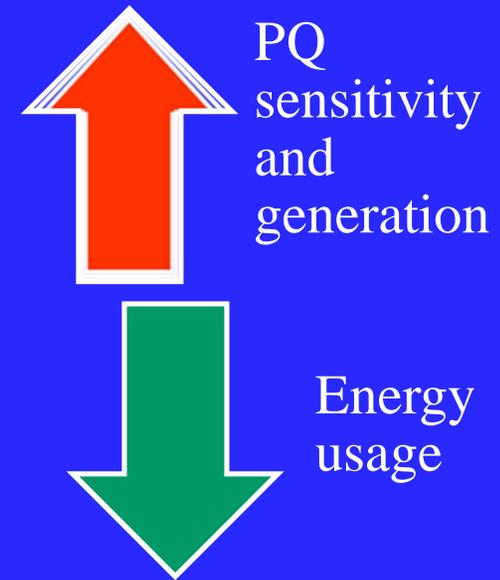
10 to 15 Lm/w

Voltage level
No harmonics



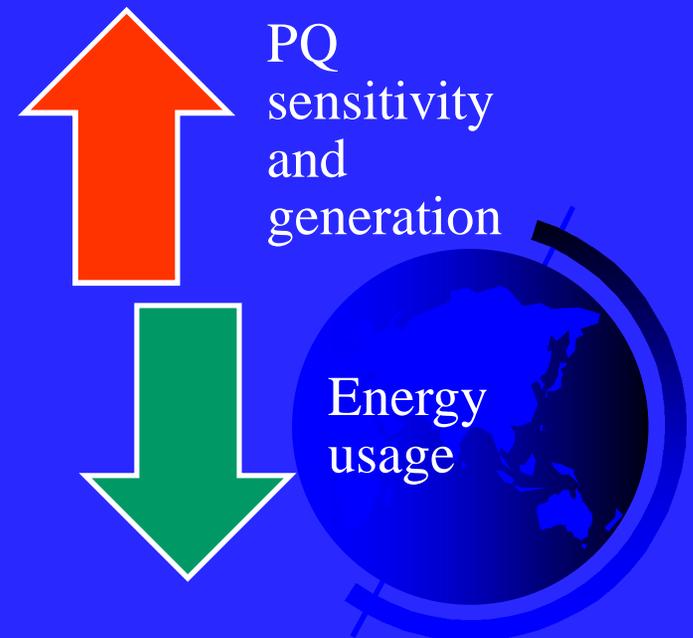
Light dimmers

- ☞ Lowers power used
- ☞ Increases Harmonics
- ☞ Sensitive to voltage transients
- ☞ Sensitive to voltage sags
 - Light blinks



Solid state lights (LED)

- Significant energy savings
- Sensitive to voltage transients
- AC to DC converter generates harmonics

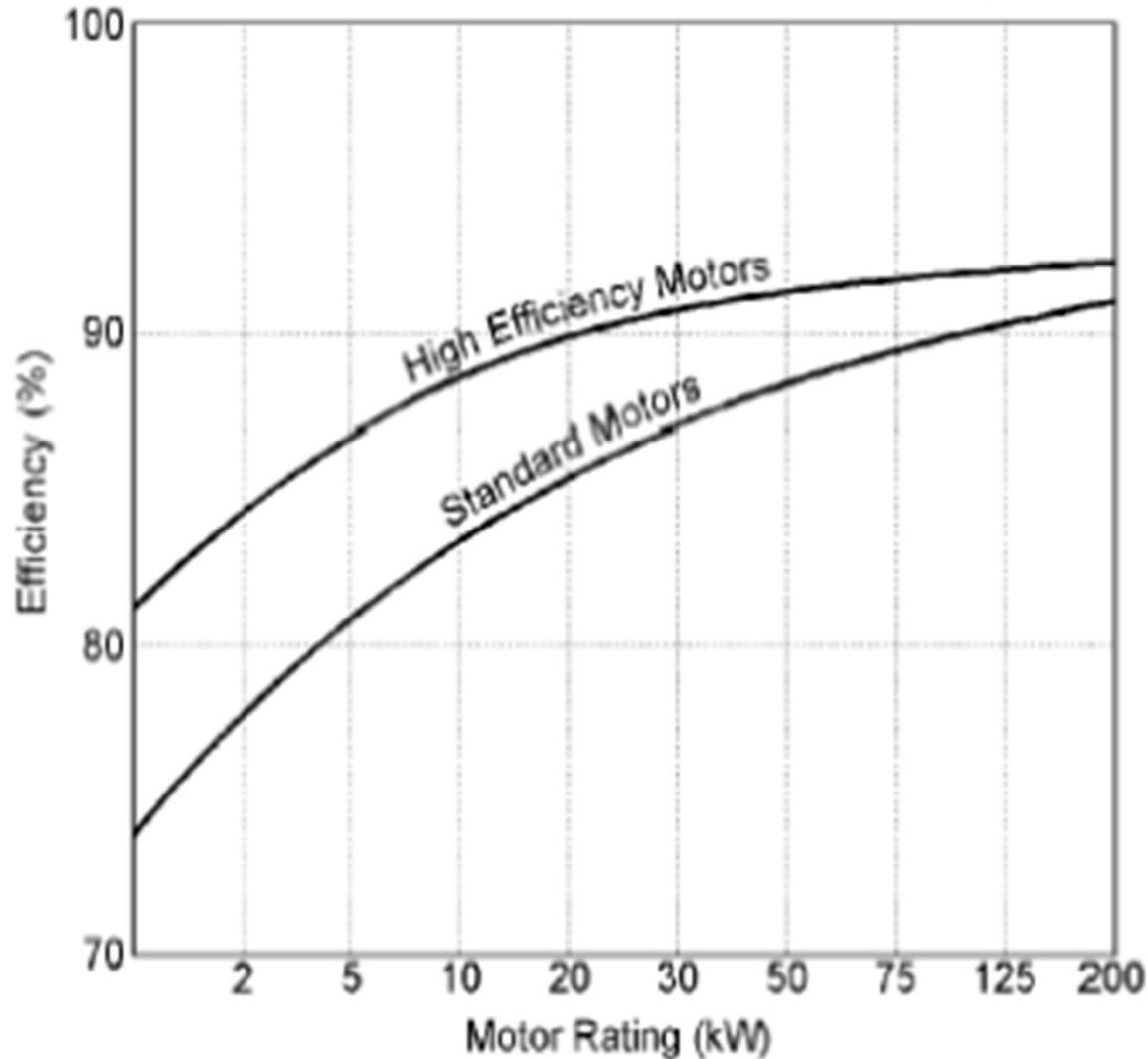


Motors

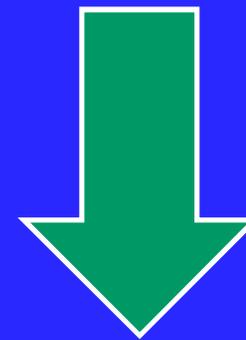
- **70% of electrical load (Industrial)**
- **High Efficiency motors**
- **Electronic controls for existing motors**
 - **Variable Speed Drives (VFD)**
 - **Variable Frequency Drives (VSD)**
 - **Softstart**



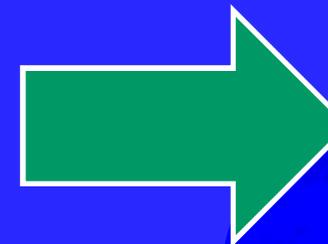
High Efficiency Motors



3% to 7%



Energy
usage



PQ
sensitivity



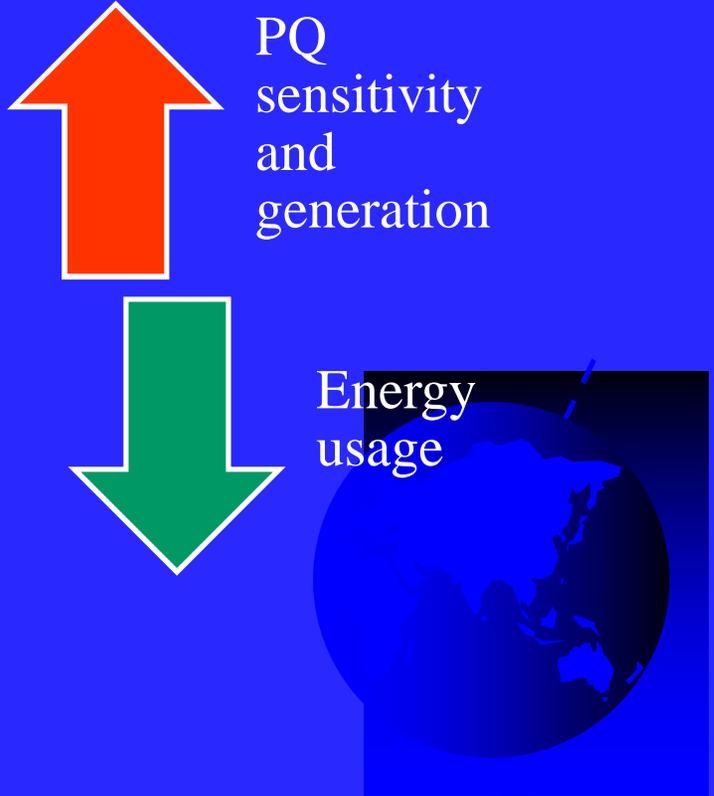
Add VFD (VSD) to Motors

☞ Variable speed drives

– Sensitive

- ◆ sags
- ◆ phase shifts
- ◆ Transients
- ◆ imbalance

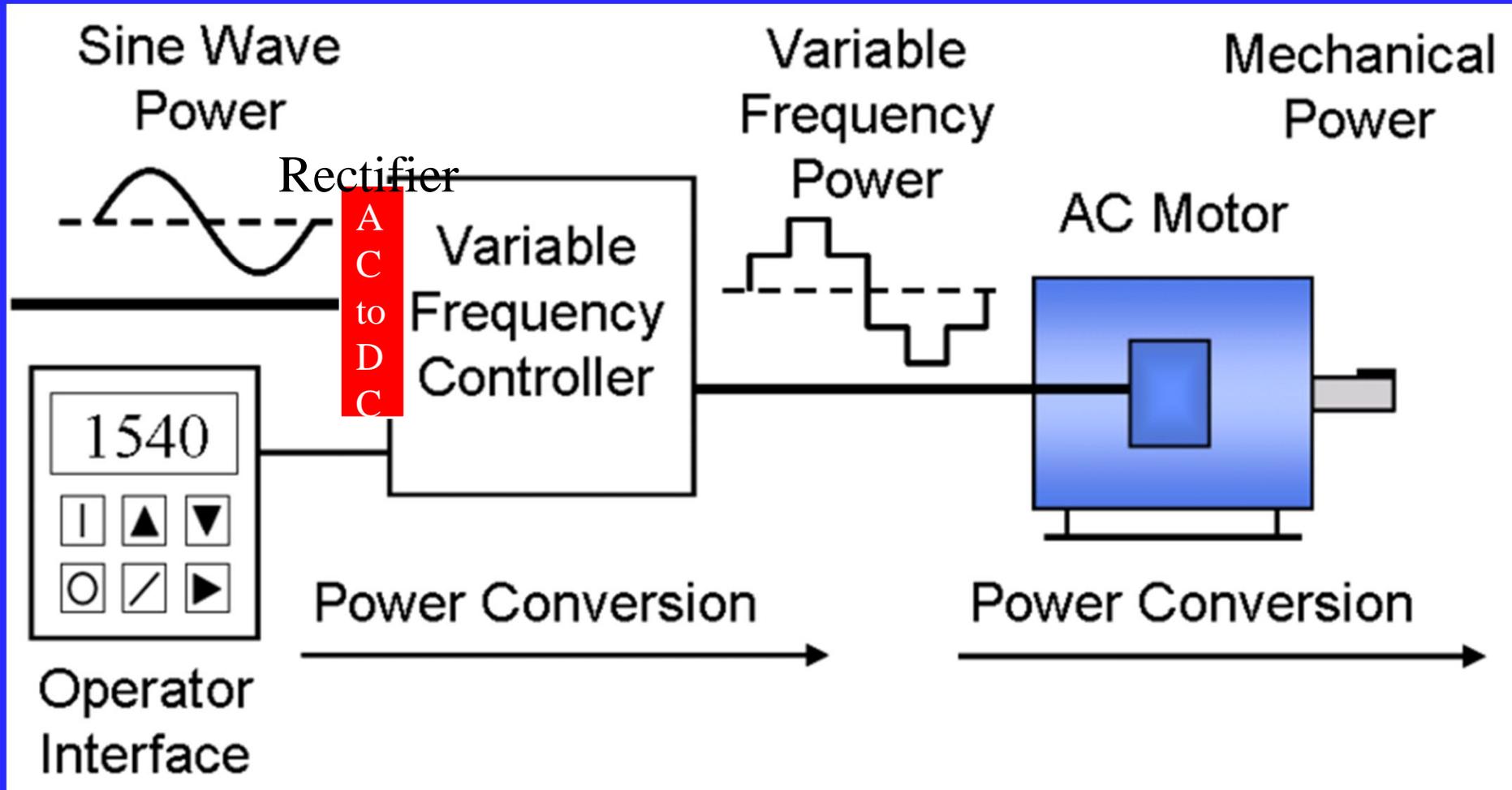
– Generates harmonics



PQ
sensitivity
and
generation

Energy
usage

How a VFD or VSD works



Drivers for change in PQ and efficiency

- ☞ Cost savings
- ☞ Improving control over processes
- ☞ Energy efficiency (Green World)
- ☞ Reduce size and weight of equipment by lowering power consumption
- ☞ Advances in technology
 - Semiconductor
 - Materials of all types
 - ◆ Insulation and conductors

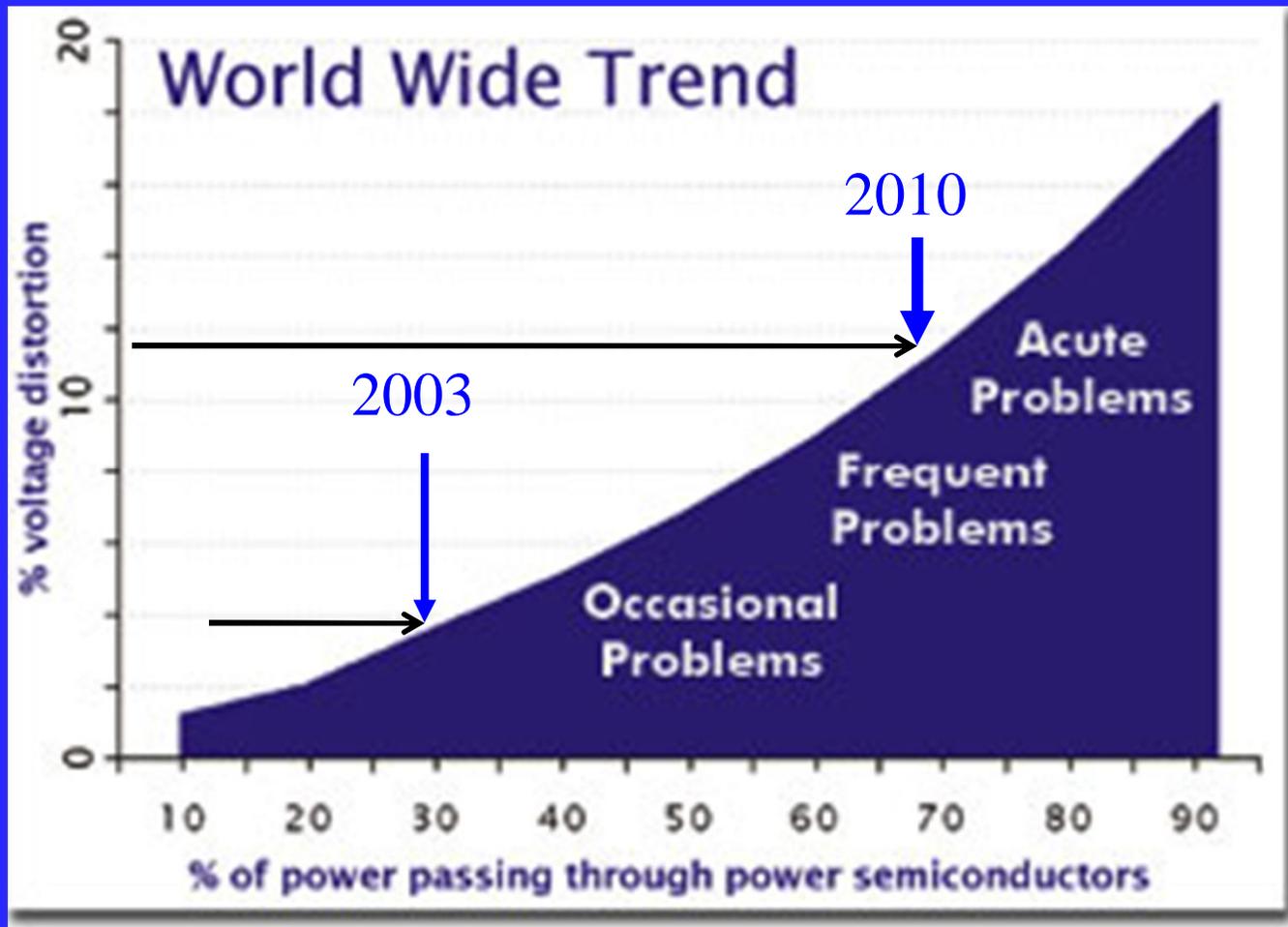


Changes in PQ at the equipment

- Over \$20 billion of power semiconductor products are installed annually
- 30 percent of all power flows through power semiconductors now
- That will grow to 70 percent by 2010 (EPRI)



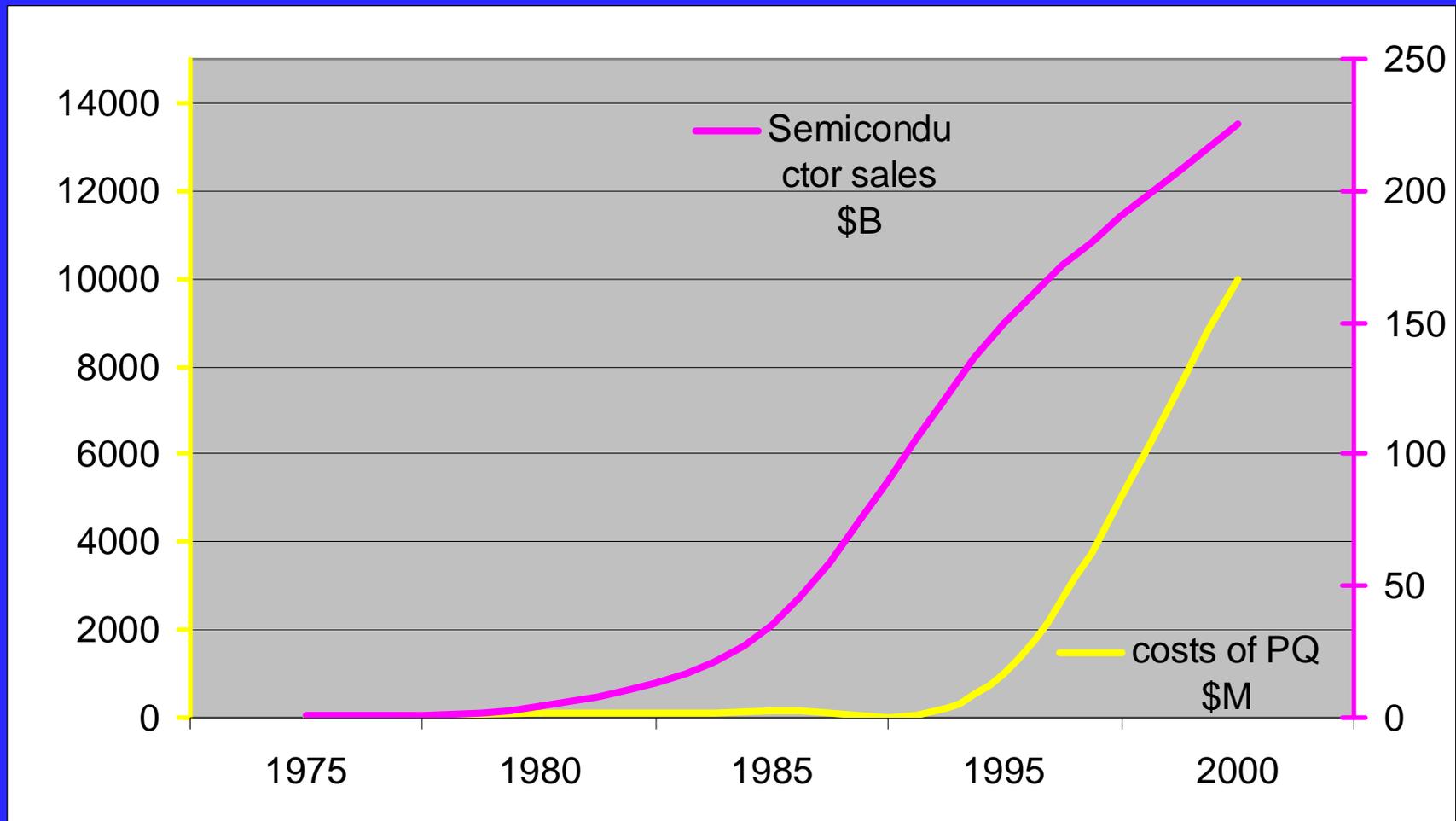
PQ Harmonics (costs) vs power thru a semiconductor switch



EPRI USA
estimates



Semiconductor sales vs PQ issues



Trends in Power Quality and efficiency Worldwide Utilities

- ☞ Continue increase attention to the PQ situations.
 - More aware of the \$\$\$ losses caused by low PQ
 - ◆ Harmonics
 - ◆ Low Power Factor
 - ◆ Network faults, voltage sags and customer complaints
 - ◆ Voltage imbalance
 - ◆ Flicker and the customer complaints
 - More monitoring to collect data to document the losses
 - More data reporting requirements by regulators
 - ◆ More standards



Trends in PQ and energy efficiency

- The loads will continue to change for better efficiency and control
- Standards
 - Power Measurements
 - Power Quality Measurements
 - Country standards for minimum levels of energy efficiency and Power Quality



Trends in Power Quality

- Electrical system designs will focus more efficiency, reliability and some Power Quality considerations if demanded by the end user
- Laws and regulators will include efficiency, Power Quality and Power Monitoring in their controls of electrical utilities



Future of the Power Quality monitoring

- More PQ monitoring points
 - Will provide instant PQ alarms
 - Data for failure analysis and system weak points
 - Customer access to real data from the network and their incoming voltage quality
 - Statistical data for hardware evaluation and future improvements



Summary

- ☞ Power Quality and energy efficiency are linked by economic reality. There will always be a management objective to lower costs and improve productivity.
- ☞ Improving the energy efficiency of equipment almost always has an impact on the Power Quality situation





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Thank you
xie xie

☞ <http://www.energyefficiencyasia.org>

