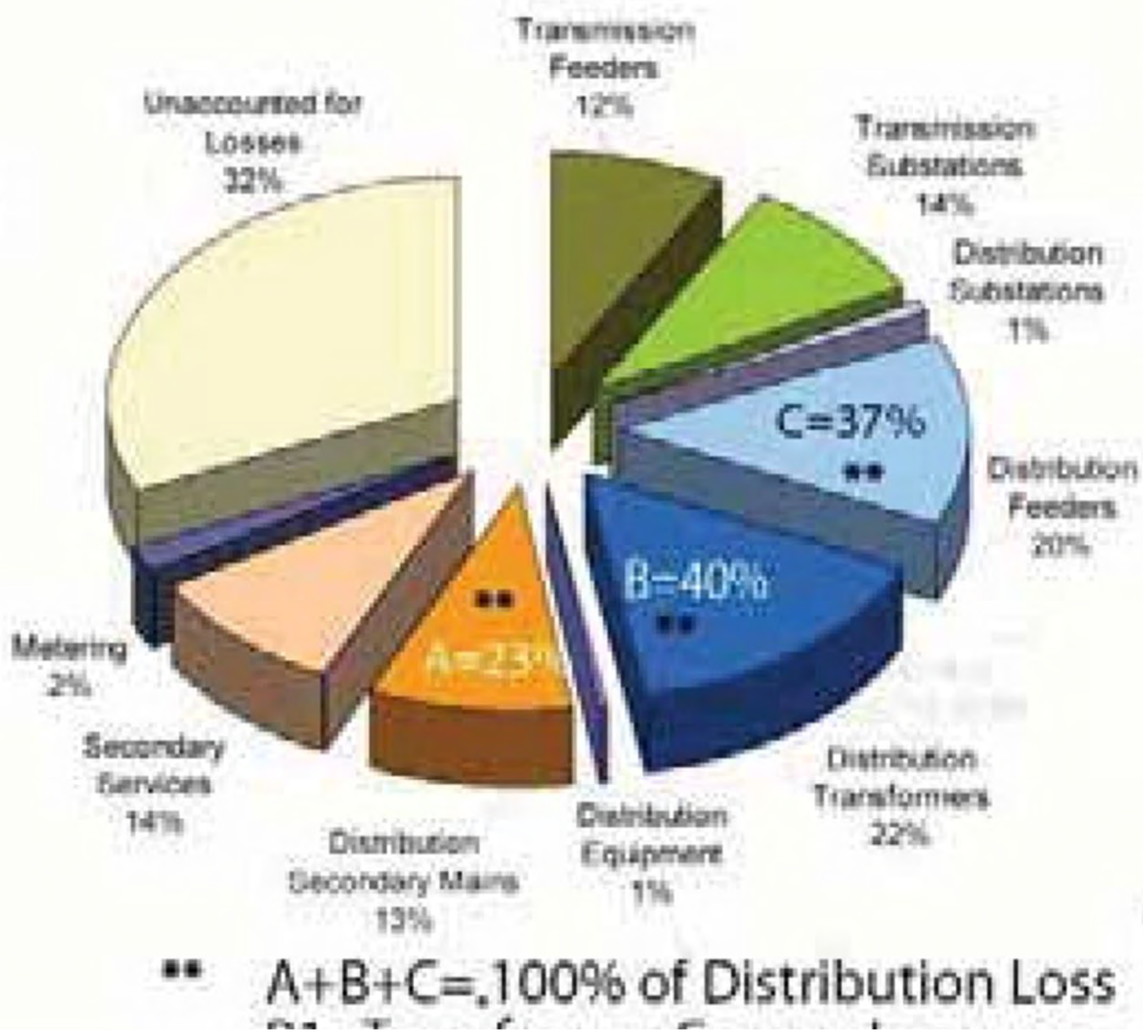
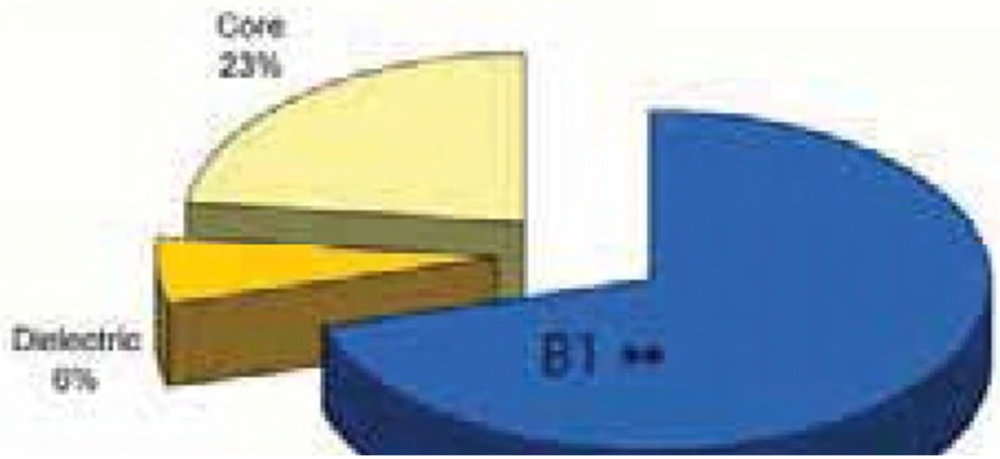
POINT OF LOAD PFC

- A perspective
- Sreeram Dhurjaty, PhD, LSMIEEE,
- Distinguished Speaker IEEE CTSoc

Con Edison



- 1.2% Transmission Losses
- 3.6% Distribution Losses
- 2.2% Other Losses



** A+B+C=.100% of Distribution Loss

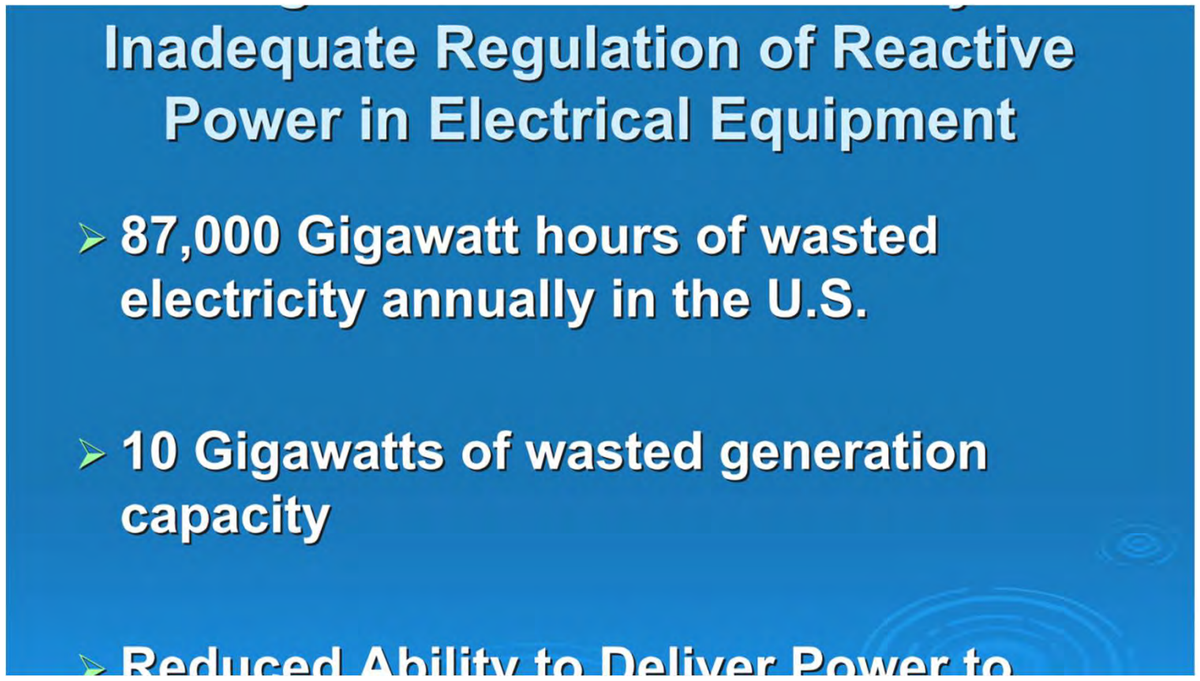
Reactive Power Losses – U.S.

- 0.3% Distribution System Line Loss
- 1.7% Customer Premise loss
- 2% Total Loss
- =10 Gigawatts average

- = The Total output of five 2 GW power plants

- (Indian Point Nuclear Plant is 2 GW)

From NYSERDA study 2011



Apparent Power
Measured in VA

$S = V\,I$

S

Q

Reactive Power
Measured in VAR

$Q = V\,I\,\sin\theta$

$$S = \sqrt{(P^2 + Q^2)}$$

$$kVA = \sqrt{kW^2 + kVAR^2}$$

θ **Phase Angle**

P

DAILY EXCESS GREENHOUSE GAS EMISSIONS RESULTING FROM REACTIVE POWER

- 2 Pounds of CO_2 / KWH x 10 million KW x 24 Hr
- = 480 million pounds of extra CO_2 Emissions
- = 240,000 tons extra CO_2 Emissions

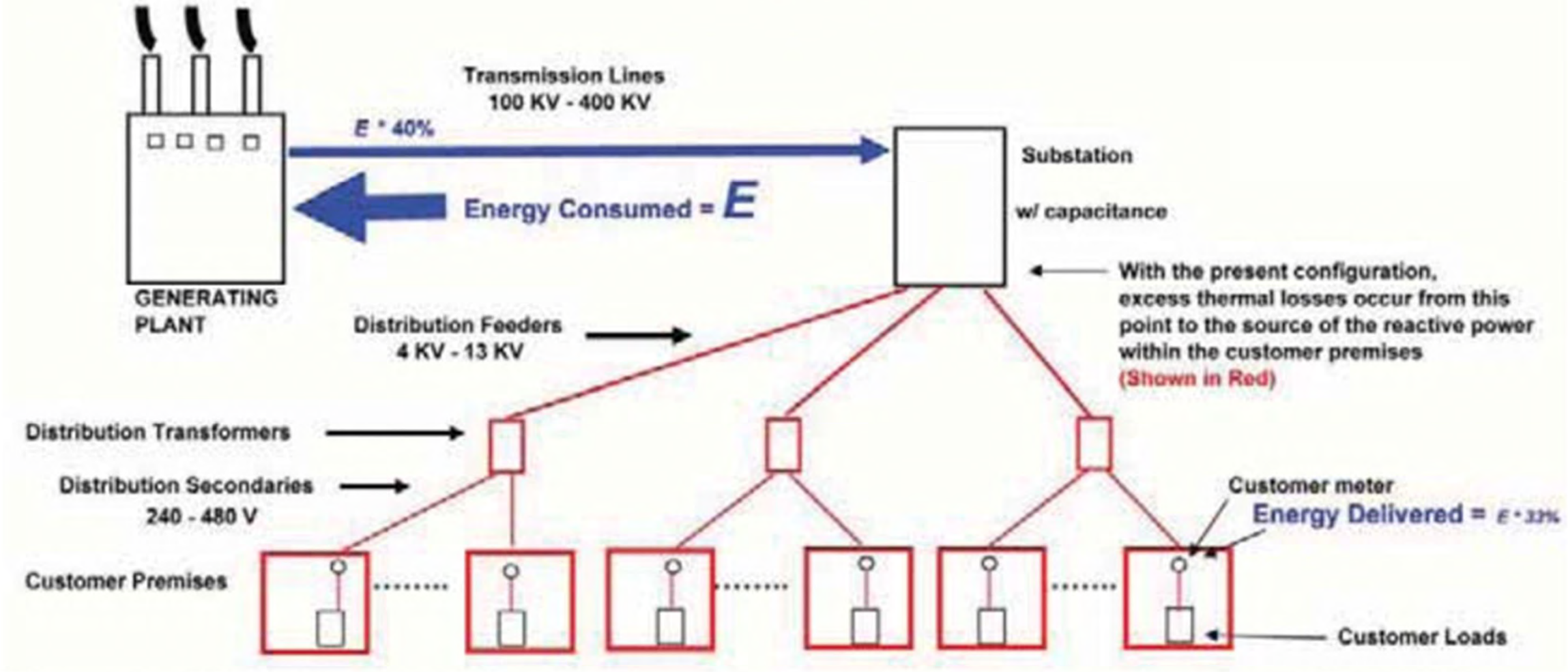
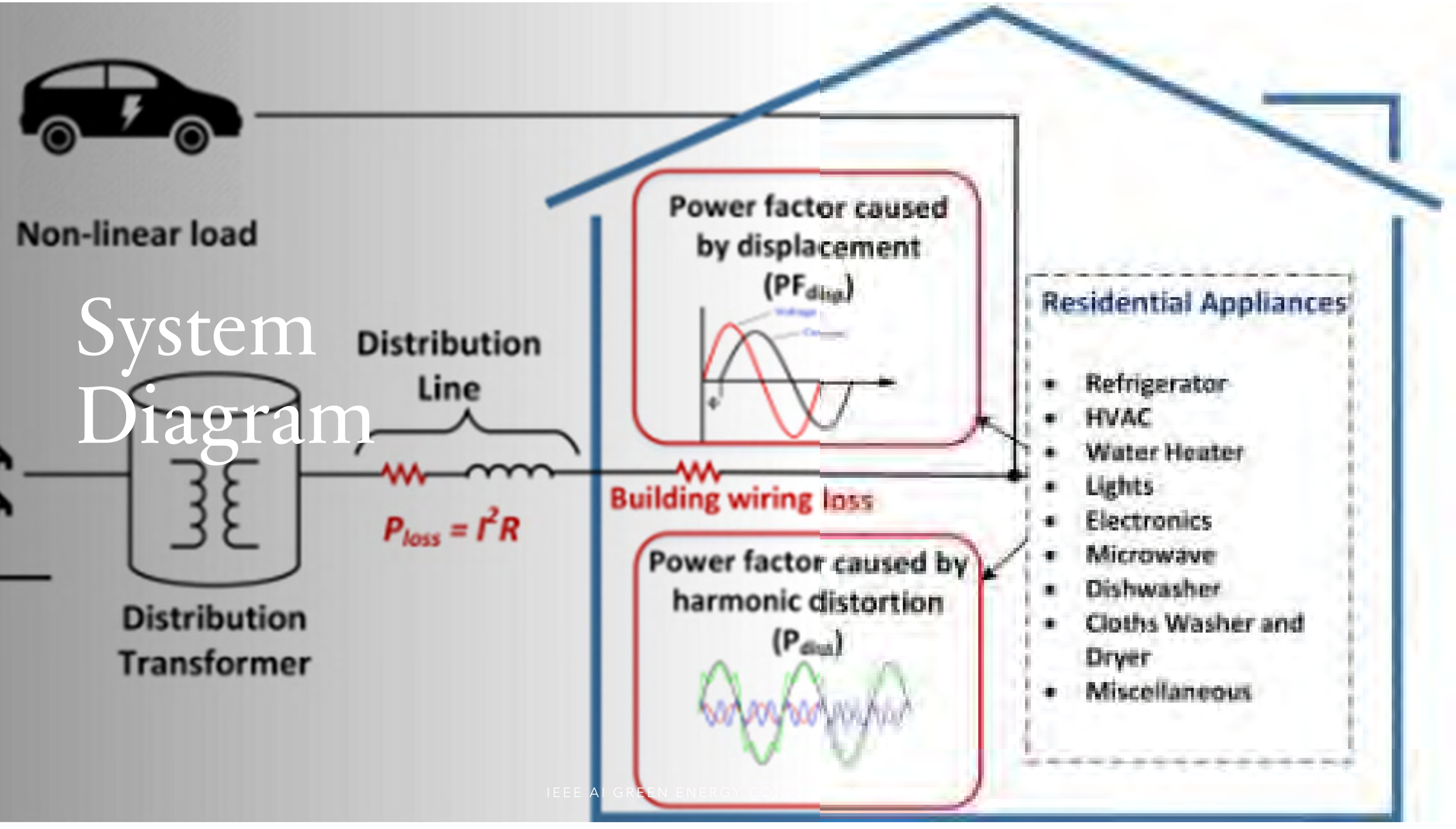
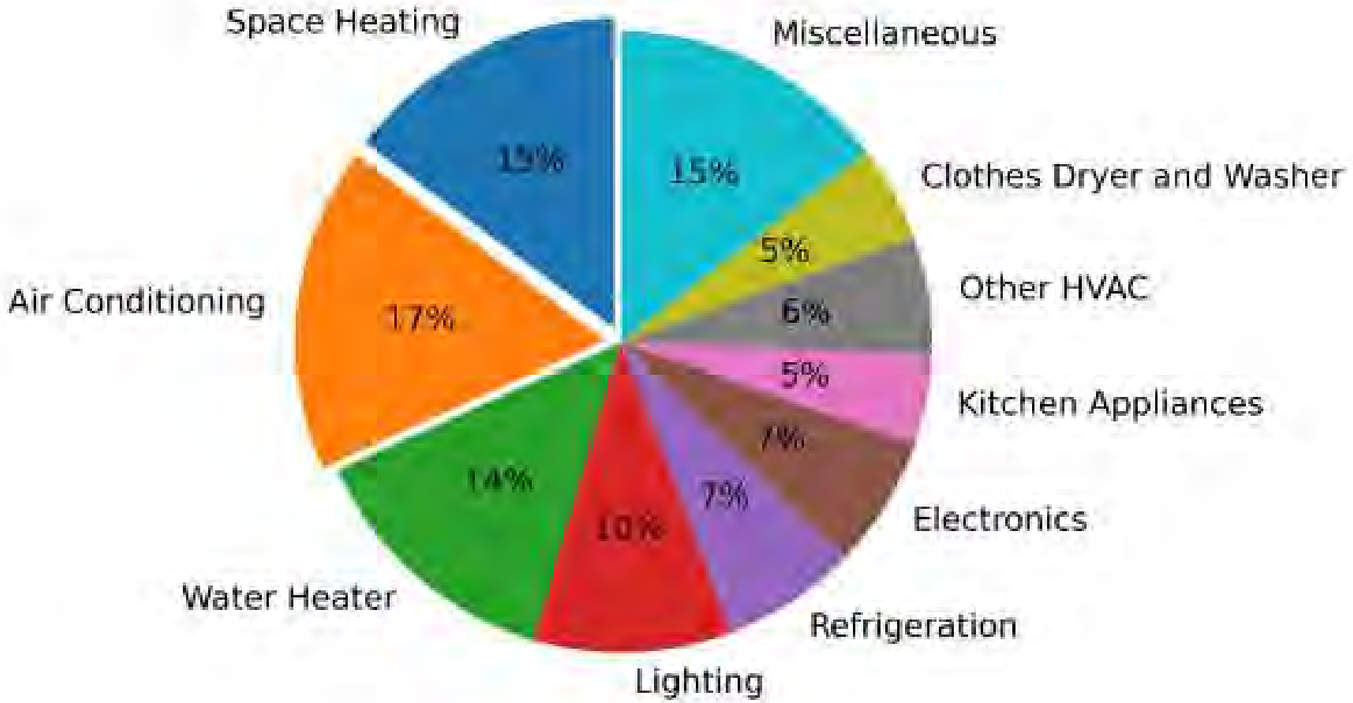


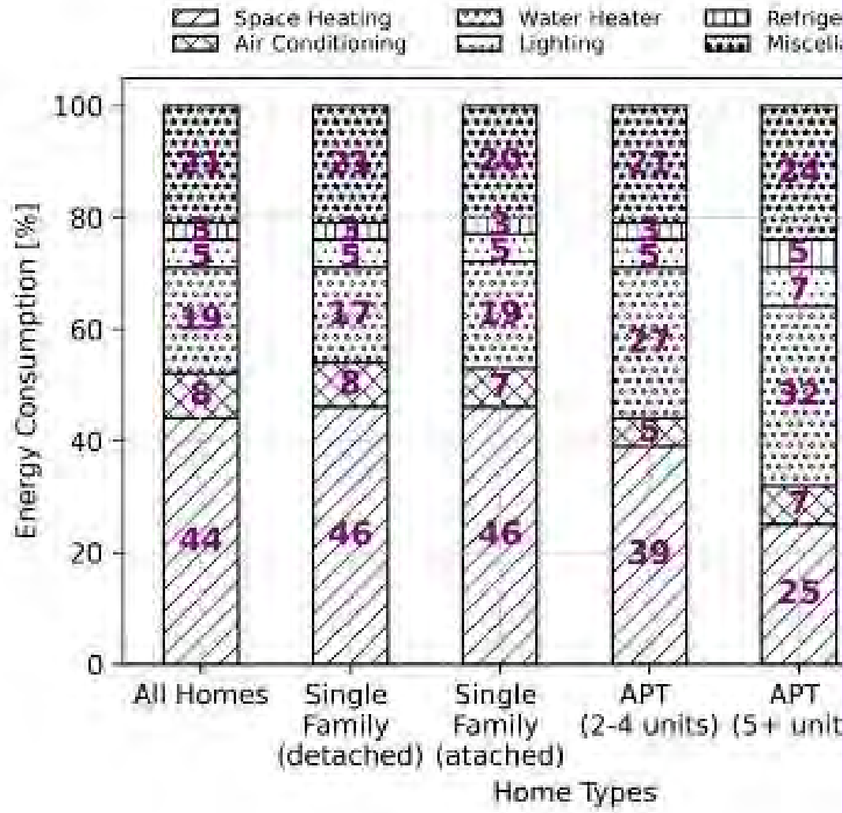
Figure 4 – Block diagram of the electric power transmission system. At present, the utilities correct reactive power at the substations. The distribution system, shown in red, operates with a less than optimal power factor. "At Load" power factor correction will reduce the losses on that entire part of the system

System Diagram





(a)



(b)

Figure 3. Residential energy use survey results for 2015 provided by the U.S. Energy Information Administration. Provided are (a) annu different appliances of a typical residential building in the U.S. and (b) end-user energy use distribution by different types of U.S. homes. En the losses in electricity generation and delivery.

Why at Load PFC?

Many old buildings have corroded wires and contacts

- Reactive power sloshing around wiring from the panel to the load
- Can cause I2R Losses in the wiring and contacts

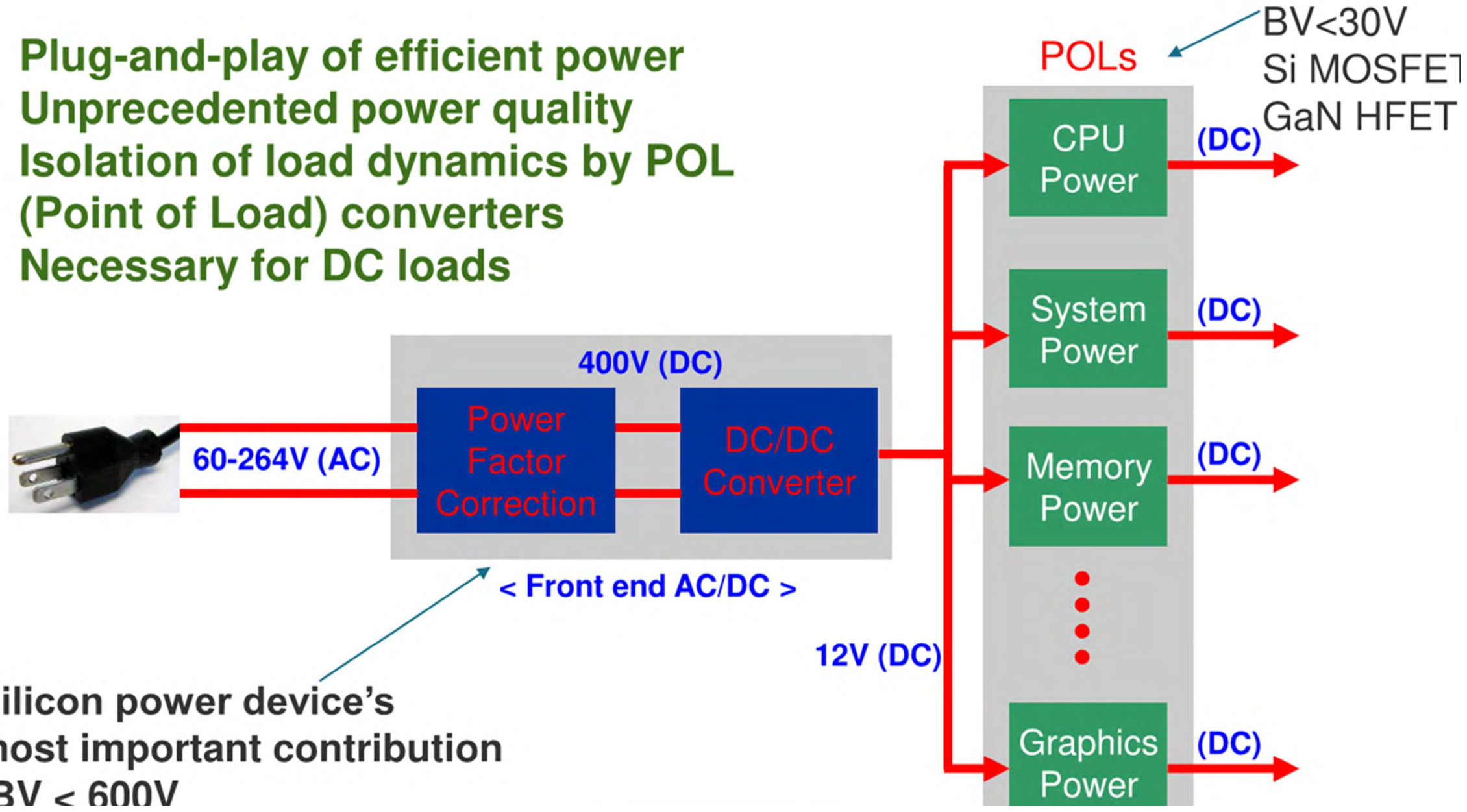
Correction at the service entrance does not help the consumer

- Residential consumers pay for KW, does not save money
- Adds more resistance to the circuits
- Does not solve the thermal loss issue due to wiring

Passive at load PFC correction using a capacitor

- Improves PFC up to about 0.9, decreases thermal losses
- Fewer harmonics than at service entrance
- Creates transient loads due to capacitors during recovery from power outage

- **Plug-and-play of efficient power**
- **Unprecedented power quality**
- **Isolation of load dynamics by POL**
- **(Point of Load) converters**
- **Necessary for DC loads**



Silicon power device's most important contribution (BV < 600V

What next?

Future appliances should incorporate active PFC

- DC Switched reluctance motors for efficiency and low cost

Charging of EVs with high-Voltage DC

- Minimize copper loss due to high currents, especially Level 2
- Use Bridgeless rectifiers forhigh efficiency

Use Bidirectional Solid-State Transformers

- AC and DC taps
- Use in Hospital Power Isolation to replace conventional isolation transformers
- Connect to the energy internet
- Use AI for power management

Thank You

Questions?

s.dhurjaty@IEEE.org
585-317-5027