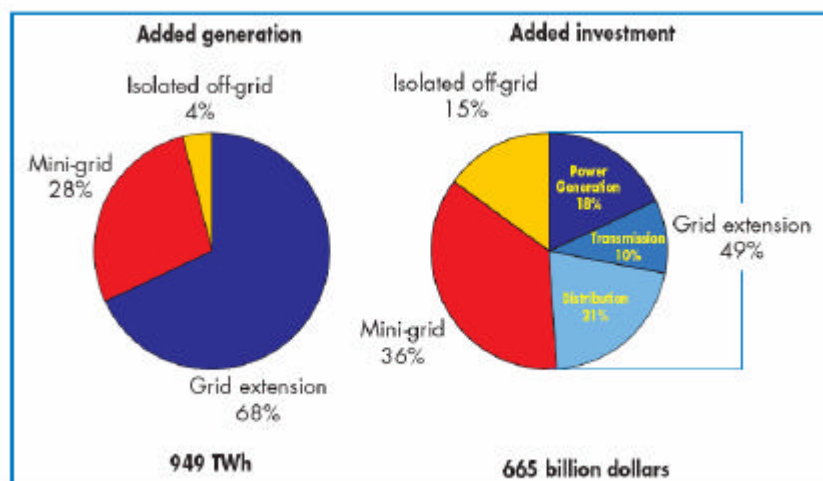


# ELECTRICITY

<b>1. FUTURE ENERGY SCENARIO.....</b>	<b>1</b>
<b>2. GENERATION &amp; DISTRIBUTION OF ELECTRICITY .....</b>	<b>2</b>
<b>3. PHASE OF ELECTRICITY.....</b>	<b>4</b>
<b>4. ACTIVE &amp; REACTIVE POWER .....</b>	<b>5</b>
<b>5. POWER FACTOR CORRECTION .....</b>	<b>5</b>
<b>6. ELECTRICAL LOAD MANAGEMENT.....</b>	<b>8</b>
<b>7. ELECTRICITY BILLING MECHANISM.....</b>	<b>9</b>
<b>8. TRANSFORMERS .....</b>	<b>11</b>
<b>9. ELECTRICITY FORMULAE.....</b>	<b>13</b>
<b>9. REFERENCES.....</b>	<b>14</b>

## 1. FUTURE ENERGY SCENARIO

The electricity consumption per capita is often used as an indicator of a country's development. In developing countries, industry is the largest consumer of electricity and about 30 percent of people still has no access to electricity.



Note: Added generation is in 2030; added investment is cumulative over the period 2001-2030.

**Figure 1: Added generation & investment by 2030**  
(International Energy Agency, 2004)

The International Energy Agency predicts the following scenario for 2030 (IEA, 2004):

## Electrical Energy Equipment: Electricity

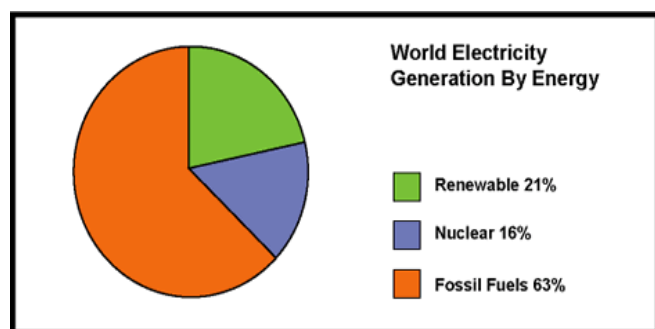
- Access to electricity in developing countries reaches 78 percent of the population, with an average consumption per capita of 2,136 kWh
- 1.4 billion people will not have access to electricity. Additional investment is needed of \$665 billion in order to reach 100 percent access (see Figure 1) and providing those people gaining access with 526 kWh/capita on average. Each person gaining access is at first going to use electricity only as a substitute for the traditional fuels (LPG, kerosene) used to cover basic needs. Most of the added supply will be required in Africa (437 TWh) and South Asia (377 TWh), or an increase of 25 percent and 18 percent respectively.

The IEA recommends the following to assure universal access to electricity (IEA, 2004):

- Renovation and modernization of conventional power plants, and transmission and distribution system with new energy efficient technology
- Demand side management: adoption and continuation of energy efficient technologies and usage practice
- Creating awareness amongst fellow energy users for adoption of energy saving measures and accepting new technologies when available.

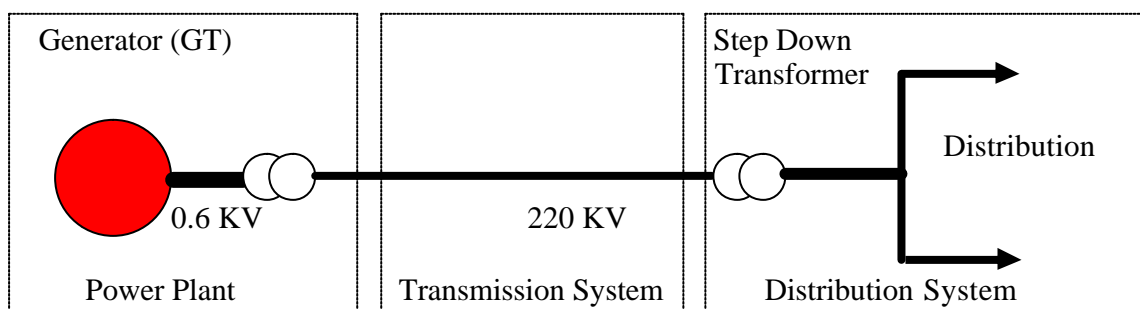
## 2. GENERATION & DISTRIBUTION OF ELECTRICITY

Figure 2 shows that electricity is mostly generated by power stations that use fossil fuels (coal, gas, oil) and nuclear facilities that use uranium. Due to environmental and safety concerns, and more recently energy security concerns as the oil supply is dependent on fewer and fewer countries, alternative sources of energy are being explored. Renewable energy provides 21 percent of the world energy needs, including hydropower (20 percent), solar, wind, geothermal, biomass, and tidal energy (approximately 1 percent but growing).



**Figure 2. World electricity generation**  
(US Energy Information Administration, 2004)

Figure 3 shows a simplified representation of an electrical system, which is explained below.



**Figure 3. Power generation, transmission and distribution**

## Electrical Energy Equipment: Electricity

Electricity is mostly generated by AC generators called “alternators” in thermal, hydro or nuclear power plants at 50 or 60 cycles per second. Electricity is typically generated at about 9 to 13 KV at the generator terminal. The power generated by one generator (also termed as UNIT) is in the range of 67.5 MW, 110 MW, 220 MW, and 500 MW, although 1000 MW generators also exist. Higher MW rating of generation capacity is preferred because of lower auxiliary power consumption and other operation and maintenance cost per MW generated.

Electricity must be generated when it is needed since electricity cannot be stored. The generated power is transmitted to the user through a transmission and distribution network, which consists of transformers, transmission lines and control equipment. All power stations have generating transformers (GTs) that increase the voltage to extra high voltages (EHV, e.g. 132 KV, 220 KV, 400 KV) prior to transmission. This reduces losses during transmission and because smaller and more economical transmission lines can be used. The benefits of transmitting power at higher voltage are shown in Table 1. Similarly, sub-stations have step-down transformers, which reduce the voltage for distribution to industrial, commercial and residential users through distribution lines.

There is no difference between a transmission line and a distribution line except for the voltage level and power handling capability. Transmission lines operate at EHV and are usually capable of transmitting large quantities of electric energy over great distances. Distribution lines carry limited quantities of power at a lower voltage over shorter distances.

**Table 1. Benefits of High Voltage Transmission**

Reasons	Explanation	Benefit
Less voltage drop	Voltage drops in transmission/distribution lines are dependent on the resistance, reactance and length of the line, and the current drawn. For the same quantity of power handled, a higher voltage results in a lower current drawn and lower voltage drop.	Good voltage regulation i.e. the difference between voltages sent and received at small.
Less power loss	The power loss in lines is proportional to the resistance (R) and the square of the current (I), i.e. $P_{Loss} = I^2R$ . A higher voltage results in lower currents and therefore lowers power losses.	High transmission efficiency
Smaller conductor	A higher voltage results in lower currents and therefore a smaller conductor is needed to handle the current.	Less capital and erection cost
<b>Example</b> If the voltage of the power distributed is raised from <u>11 kV</u> to <u>33 kV</u> , then the voltage drop would be reduced by <u>1/3</u> and the line loss would be lower by a factor <u>1/9</u> , i.e. $(1/3)^2$ .		

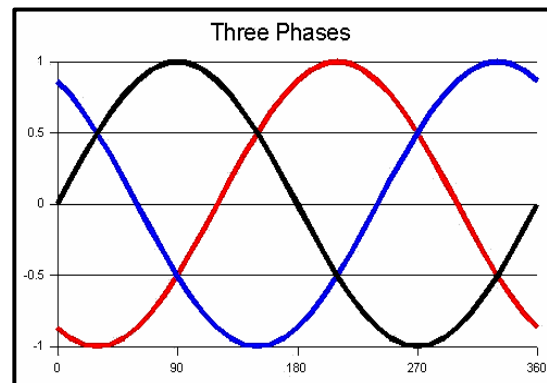
### 3. PHASE OF ELECTRICITY

There is one further major characteristic of an AC electricity supply that requires explanation: phases.

Basically the AC electric supply is divided into *single-phase* and *three-phase* circuits. A single-phase AC circuit has two wires connected to the source of electricity. However, unlike the DC circuit in which the direction of the electric current does not change, the direction of the current changes many times per second in the AC circuit depending upon the frequency of the supply. The 240 volt (V) electricity supplied to our homes is single-phase AC electricity and has two wires: 'active' and 'neutral'.

However, the distribution line may also be made up of four lines. Three lines carry electricity from three electrical circuits, and they share a common neutral line (i.e. three active lines and one common neutral line). Three-phase systems have 3 waveforms (usually carrying power) that are  $2/3\pi$  radians (120 degrees,  $1/3$  of a cycle) offset in time.

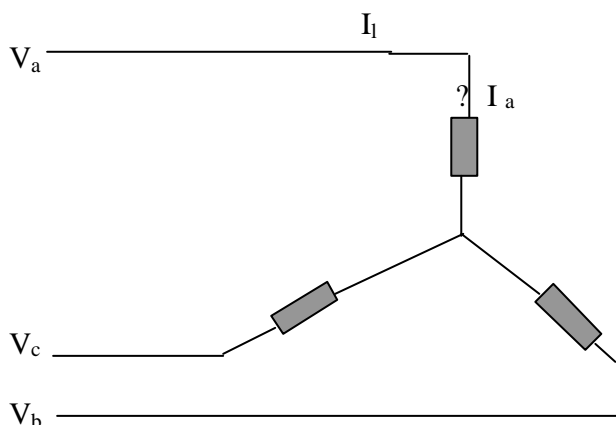
Figure 4 shows one cycle of a three-phase system, from 0 to 360 degrees ( $2\pi$  radians), along the time axis. The plotted line represents the variation of instantaneous voltage (or current) in time. This cycle will repeat 50 or 60 times per second depending on the power system frequency. The colors of the lines represent the American color code for three-phase systems: black= $V_{L1}$  red= $V_{L2}$  blue= $V_{L3}$ .



**Figure 4. A 3-phases of an electric system**

(Wikipedia contributors, 2005)

The three-phase supply system is further represented by *star and delta* connection as shown in Figure 5.



#### Star Connection

$I_L = \text{Line current} = I_a = \text{Phase current}$

$V_a = V_b = V_c = \text{Line voltage}$

$n = \text{Common neutral point}$

*Line voltage = 1.732 X Phase voltage*

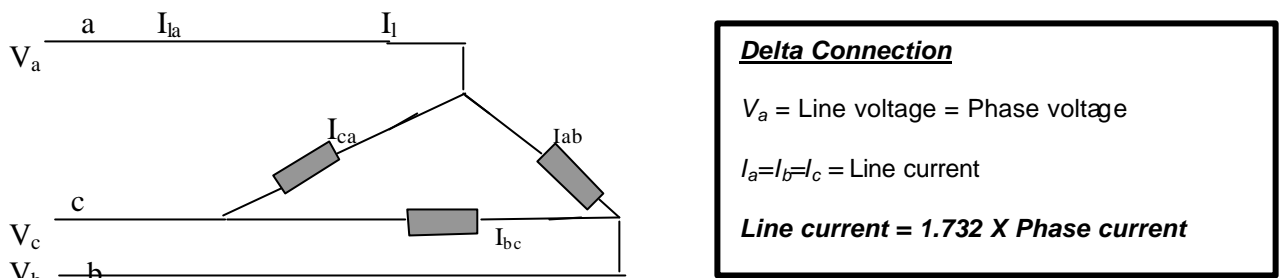


Figure 5. Star and delta connection in an electrical system

#### 4. ACTIVE & REACTIVE POWER

Active power, measured in kilowatt (kW), is the real power (shaft power, true power) used by a load to perform a certain task. However, there are certain loads like motors, which require another form of power called reactive power (kVAR) to establish the magnetic field. Although reactive power is virtual, it actually determines the load (demand) on an electrical system. The utility has to pay for total power (or demand) as depicted in Figure 6.

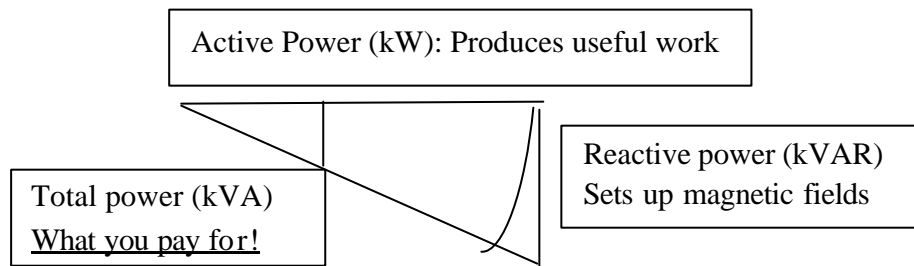


Figure 6. Representation of power triangle

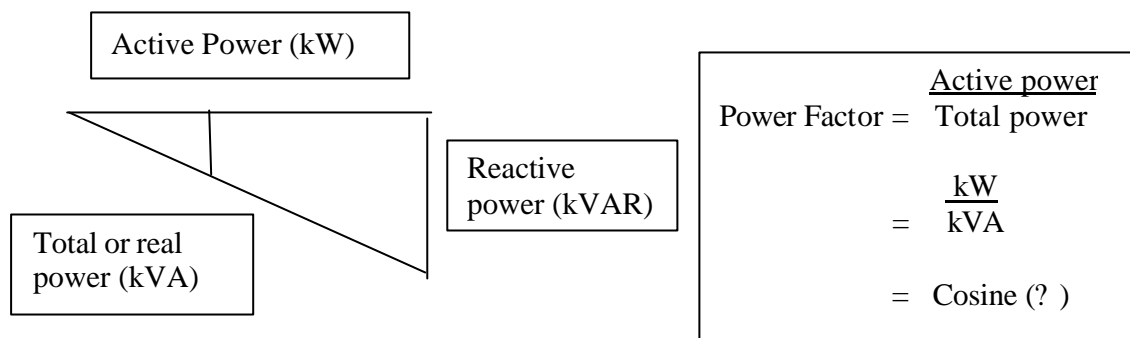
The vector sum of the active power and reactive power is the total (or apparent) power, measured in kVA (kilo Volts-Amperes). This is the power sent by the power company to customers. Mathematically it may be represented as:

$$kVA = \sqrt{(KW)^2 + (KVAR)^2}$$

#### 5. POWER FACTOR CORRECTION

##### 5.1 What is the Power Factor?

The power factor is the ratio between active power (kW) and total power (kVA), or the cosine of the angle between active and total power. A high reactive power, will increase this angle and as a result the power factor will be lower (See Figure 7).

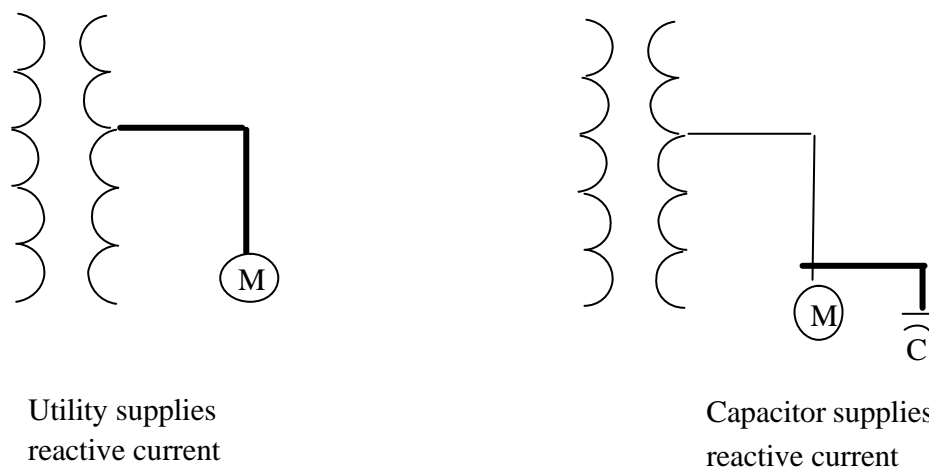


**Figure 7. Power Factor of electric circuit**

The power factor is always less than or equal to one. Theoretically, if all loads of the power supplied by electricity companies have a power factor of one, the maximum power transferred equals the distribution system capacity. However, as the loads are inductive and if power factors range from 0.2 to 0.3, the electrical distribution network’s capacity is stressed. Hence, the reactive power (kVAR) should be as low as possible for the same kW output in order to minimize the total power (kVA) demand.

### 5.2 Capacitors to Improve the Power Factor

The power factor can be improved by installing power factor correction capacitors (see Figure 8 and 9) to the plant’s power distribution system. They act as reactive power generators and therefore reduce the amount of reactive power, and thus total power, generated by the utilities.



Utility supplies reactive current

Capacitor supplies reactive current

**Figure 8. Capacitor as kVAR Current**



**Figure 9: Film type capacitor banks**  
(Copper Industries Inc. 2000)

An example showing the power factor improvement by capacitor installation is shown below.

<p><b>Example</b></p> <p>A chemical plant installed a 1500 kVA transformer. The initial demand of the plant was 1160 kVA with power factor of 0.70. The percentage loading of the transformer was about 78 percent (<math>1160/1500 = 77.3</math> percent). To improve the power factor and to avoid penalties charged by the electricity supplier, the plant added about 410 kVAR in motor load. This improved the power factor to 0.89, and reduced the required kVA to 913, which is the vector sum of kW and kVAR.</p>	
<p>The 1500 kVA transformer was now loaded only to 60 percent of its capacity. This will allow the plant to add more load to the transformer in the future. (NPC Field Study)</p>	

## 5.2 Advantages of Power Factor Improvement by Capacitor Addition

The advantages of an improved power factor through the installation of a capacitor are:

For the company:

- A one-off investment in purchasing and installing the capacitor is needed but there are no ongoing costs
- Reduced electricity costs for the company because (a) the reactive power (kVAR) is no longer supplied by the utility company and therefore the total demand (kVA) is reduced and (b) penalty charges imposed when operating with a low power factor are eliminated
- Reduced distribution losses (kWh) within the plant network
- Voltage level at the load end is increased resulting in improved performance of motors

For the utility supplying electricity

- Reactive component of the network and the total current in the system from the source end are reduced
- $I^2R$  power losses are reduced in the system because of reduction in current

- Available capacity of the electricity distribution network is increased, reducing the need to install additional capacity

## **6. ELECTRICAL LOAD MANAGEMENT**

At a macro level, growing electricity consumption and congestion of electricity demand during certain times during the day has led to shortfalls in capacity to meet demand. As capacity addition is costly and can only be installed over a longer timeframe (especially if a new power plant must be built), better load management at the user end helps to minimize peak demands on the utility infrastructure and improve the utilization of power plant capacity. Some of the techniques for effective load management are given in Table 2.

**Table 2: Peak Load Management Strategies** (Bureau of Energy Efficiency, 2004)

<i>Shifting Non-Critical and Non-Continuous Process Loads to Off-Peak time</i>	Rescheduling of large electric loads and equipment operations, in different shifts can be planned and implemented to minimize the simultaneous maximum demand. For this purpose, it is advisable to prepare an operation flow chart and a process chart. Analyzing these charts and with an integrated approach, it would be possible to reschedule the operations and running equipment in such a way as to improve the load factor which in turn reduces the maximum demand.
<i>Shedding of Non-Essential Loads during Peak Time</i>	When the maximum demand tends to reach a preset limit, shedding some of non-essential loads temporarily can help to reduce it. It is possible to install direct demand monitoring systems, which will switch off non-essential loads when a preset demand is reached. Simple systems give an alarm, and the loads are shed manually. Sophisticated microprocessor controlled systems are also available, which provide automatic load shedding options.
<i>Operating In-House Generation or Diesel Generator(DG) Sets during Peak Time</i>	When diesel generation (DG) sets are used to supplement the power supplied by the electric utilities, it is advisable to connect the DG sets for durations when demand reaches the peak value. This would reduce the load demand to a considerable extent and minimize the demand charges.
<i>Operating Air Conditioning units during off-peak times and utilizing cool thermal storage</i>	It is possible to reduce the maximum demand by building up storage capacity of products/ materials, water, chilled water / hot water, using electricity during off peak periods. Off peak hour operations also help to save energy due to favorable conditions such as lower ambient temperature etc.
<i>Installation of Power Factor Correction Equipments</i>	The maximum demand can also be reduced at the plant level by using capacitor banks and maintaining the optimum power factor. These systems switch on and off the capacitor banks to maintain the desired Power factor of system and optimize maximum demand thereby.

A presentation of the load demand of a consumer against time is known as a ‘Load Curve’. If load demand is plotted for the 24 hours of a single day, it is known as an ‘Hourly Load Curve’ (see Figure 10) and if daily demands plotted over a month, it is called ‘Daily Load Curve’.

Load curves are useful in predicting patterns of high a low power demand for a plant section, and entire plant, a distribution network etc.

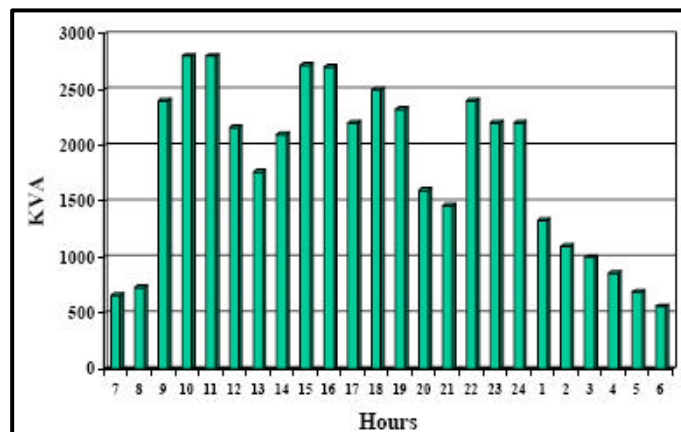


Figure 10: Daily load curve of an engineering industry (National Productivity Council, India)

## 7. ELECTRICITY BILLING MECHANISM

Utilities often apply a two-part tariff structure in their electricity bills for medium and large enterprises:

- *Energy Charges* - These charges relate to the actual energy or active power (kilowatt hours or kWh) consumed during a month / billing period. Some utilities now charge on the basis of apparent energy (kVAh), which is a vector sum of kWh and kVArh.
- *Maximum Demand Charges* - These charges relate to maximum demand registered during a month / billing period and corresponding rate of utility. The purpose of charging a penalty for the peak load is to encourage end users to reduce the peak load. Companies that manage their peak load (e.g. by reducing the power factor) therefore reduce the monthly electricity bill, without necessarily using less electricity.

Other components of electricity bills may include:

- *Power factor penalty or bonus rates*, as levied by most utilities, are to contain reactive power drawn from the grid.
- *Fuel cost*: adjustment charges as levied by some utilities are to adjust the increasing fuel expenses over a base reference value
- *Electricity duty charges*: additional charges based on electricity units consumed
- *Meter rentals*: a monthly fixed charge for the installed energy meter
- *Lighting and fan power consumption*: charges that are higher than normal electricity rates, which can be levied on a slab basis or on actual metering basis
- *Time Of Day (TOD) rates*: different rates for peak and non-peak hours
- *Penalty for exceeding contract demand*

The utility employs an electromagnetic or electronic trivector meter for billing purposes, which measures the following:

- Maximum demand registered during the month, which is measured in set time intervals (e.g. 30 minutes) and this is reset at the end of every billing cycle
- Active energy in kWh during billing cycle
- Reactive energy in kVArh during billing cycle and
- Apparent energy in kVAh during billing cycle

It is important to note that while maximum demand is recorded, it is not the instantaneous demand drawn, as is often misunderstood, but the time integrated demand over the predefined recording cycle (e.g. 30 minutes). For example:

In an industry, if the demand over a recording cycle of 30 minutes is is:

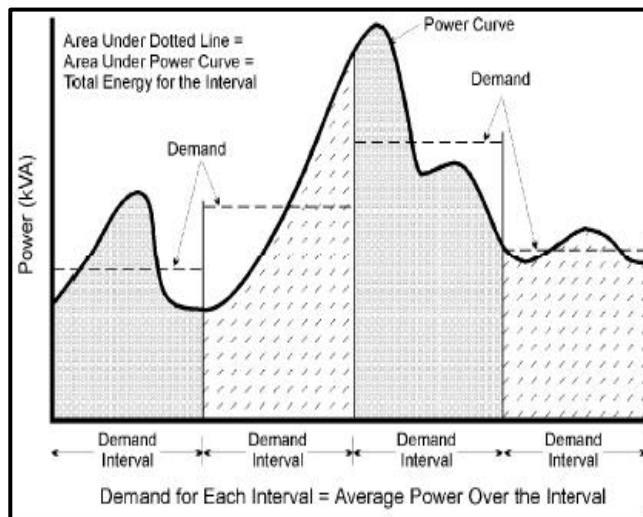
- 2000 kVA for 4 minutes
- 3600 kVA for 12 minutes
- 5000 kVA for 6 minutes
- 3500 kVA for 8 minutes

The MD recorder will be computing MD as:

$$[(2000 \times 4) + (3600 \times 12) + (5000 \times 6) + (3500 \times 8)] / 30 = 3640 \text{ KVA}$$

A typical demand curve is shown in Figure 11. The demand is measured over predetermined time intervals and averaged out for that interval as shown by the horizontal dotted line.

The maximum demand will be the highest of the demand values recorded in the billing month. The meter registers only if the value exceeds the previous maximum demand value and thus even if average maximum demand is low, the industry/facility is charged based on the highest maximum demand value measured.



**Figure 11: A Typical Demand Curve**  
(National Productivity Council)

Recently, most electricity boards have changed over from conventional electromechanical trivector meters to electronic meters, which have some excellent provisions that can help the utility as well as industry. These provisions include:

Substantial memory for logging and recording all relevant events

- High accuracy up to 0.2 class
- Amenability to time-of-day tariffs
- Tamper detection /recording
- Measurement of harmonics and total harmonic distortion (THD)
- Long service life due to absence of moving parts
- Amenability for remote data access/downloads

Trend analysis of purchased electricity and cost components can help the industry to identify areas where opportunities exist to reduce their bills within the utility tariff framework.

## **8. TRANSFORMERS**

### **8.1 What is a Transformer**

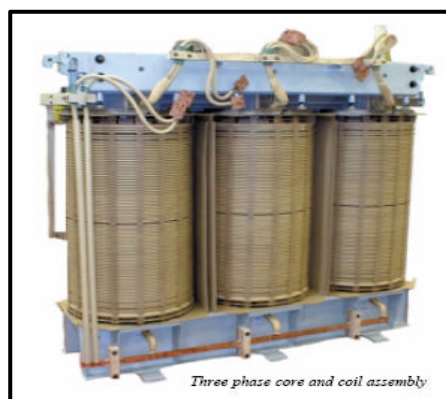
A transformer is a static electrical device, which transforms electrical energy from one voltage level to another voltage level. This permits electrical energy to be generated at relatively low voltages and transmitted at high voltages and low currents, thus reducing line losses, and to be used at safe voltages (see Figure 12).



**Figure 12: A view of a transformer**  
(Indiamart.com)

Transformers consist of two or more coils that are electrically insulated, but magnetically linked. The primary coil is connected to the power source and the secondary coil is connected to the load. Features of transformers are:

- Turn's ratio: the ratio between the number of turns on the secondary coil and the number of turns on the primary coil (see Figure 13).
- Secondary voltage: the primary voltage times the turn's ratio.
- Ampere-turns: calculated by multiplying the current in the coil times the number of turns. Primary ampere-turns are equal to secondary ampere-turns.
- Voltage regulation of a transformer: the percentage increase in voltage from full load to no load.



**Figure 13: Three phase core & coil assembly of a transformer**  
(Kuhlman Electric)

## 8.2 Type of Transformers

Table 3 lists different types of transformers.

**Table 3: Classification of Transformers** (Bureau of Energy Efficiency, 2004)

Criteria	Types	Comment
<b>Based on Input voltage</b>	Step Up	Transforms LV to HV
	Step Down	Transforms HV to LV
<b>Based on Operation</b>	Power Transformer	Located at power stations to Step up the voltage & handles large power. Typical voltage ratings are 400 kV, 220kV, 132KV, 66 kV, 33kV etc.
	Distribution Transformer	Located at sub-stations of a distribution network and handles low power. Typical voltage ratings are 11kV, 6.6 kV, 3.3 kV, 440V, 230V etc.
	Instrument Transformer	Used for measuring high voltage and current in measuring instruments
<b>Based on Location</b>	Outdoor	Located outside on a concrete structure or iron pole structure
	Indoor	Located inside a shed on concrete structure
<b>Based on Connection</b>	Three Phase	Input and output supply are of three phases (R/Y/B) with or without neutral
	Single Phase	Input and output supply are of single phase

## 8.3 Determining Transformer Losses and Efficiency

As there is no rotating part in a transformer, the efficiency remains in the range of 96 to 99 percent. Losses are mainly attributed to:

- Constant Loss: this is also called iron loss or core loss, which mainly depends upon the material of the core and magnetic circuit of the flux path. Hysteresis and Eddy current loss are two components of constant loss.
- Variable Loss: this is also called load loss or copper loss, which varies with the square of the load current.

**Note:** The best efficiency of a transformer occurs at a load when constant loss and variable loss are equal. Typical transformer losses as a percentage of the load current are shown in Figure 14.

Transformer manufacturers normally provide the no-load loss ( $P_{NO-LOAD}$ ) and full load loss ( $P_{LOAD}$ ). The following mathematical relations give the total loss ( $P_{TOTAL}$ ) at any load condition in a transformer.

$$P_{TOTAL} = P_{NO-LOAD} + (\% \text{ Load}/100)^2 \times P_{LOAD}$$

$$P_{TOTAL} = P_{NO-LOAD} + (\text{Load KVA}/\text{Rated KVA})^2 \times P_{LOAD}$$

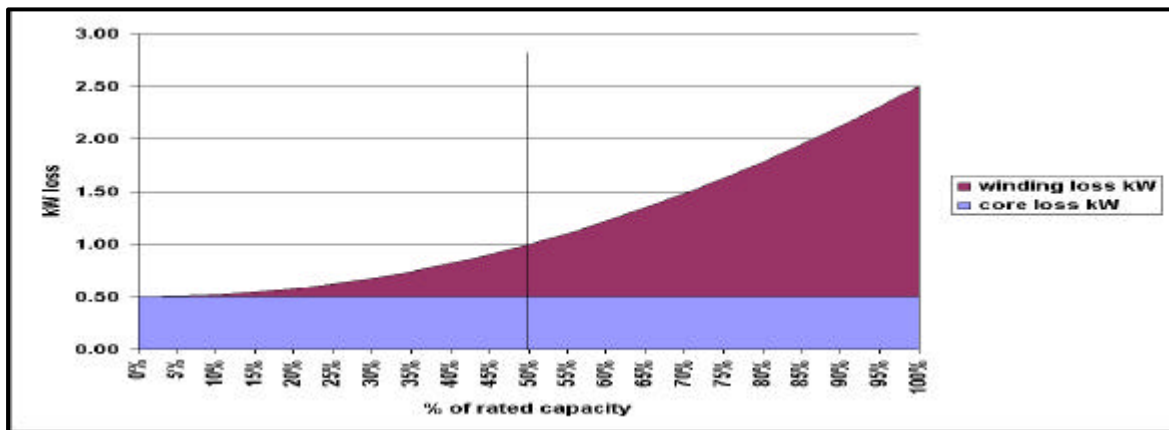


Figure 14: Transformer loss versus percent loading (Bureau of Energy Efficiency, 2004)

## 9. ELECTRICITY FORMULAE

Table 4 below lists the most important formulae for electric systems.

Table 4: Basic Formulae Associated with Electrical Systems (National Productivity Council, unpublished)

Term	Nomenclature & Unit	Empirical Relation	Remark
<b>Resistance</b>	R (Ohm)	$= S L / A$	S=Resistivity (Ohm-m) L=Length (m) A=Area of Cross Section(m <sup>2</sup> )
<b>Voltage</b>	V (Volt)	$= I R$	I=Current (Amp) R=Resistance (Ohm)
<b>Reactance</b>	X <sub>L</sub> (ohm) (inductive)	$= 2\pi FL$	$\pi = 3.142$ F = Supply Frequency (Hz) L = Inductance (Henry)
	X <sub>C</sub> (ohm) (Capacitive)	$= 1/(2\pi FC)$	$\pi = 3.142$ F = Supply Frequency (Hz) C = Capacitance (Faraday)
<b>Impedance</b>	Z (Ohm)	$= \sqrt{[R^2 + (X_L - X_C)^2]}$	
<b>Real Power</b>	P (Watt)	$= VI \cos \Phi$ (Single Phase) $= 1.732 VI \cos \Phi$ (Three Phase)	V=Voltage (Volt) I=Current (Amp) CosΦ=Power Factor V=Voltage (Volt) I=Current (Amp) CosΦ=Power Factor
<b>Reactive Power</b>	VAR	$= 1.732 VI \sin \Phi$ (Three Phase)	V=Voltage (Volt) I=Current (Amp) Φ=Power Factor Angle

Term	Nomenclature & Unit	Empirical Relation	Remark
<b>Apparent Power</b>	VA	$=\sqrt{[P^2+(VAR)^2]}$	P=Real Power (Watt) VAR=Reactive Power (VAR)
<b>Power Factor</b>	$\text{Cos}\Phi$	$= P/VA$	P=Real Power (Watt) KVA=Apparent Power (VA)
<b>Efficiency</b>	$\eta$	$= P_{\text{out}}/P_{\text{input}}$	$P_{\text{out}}$ = Output Power $P_{\text{input}}$ =Input Power
<b>Transformer Ratio</b>		$V_1/V_2 = N_1/N_2$	$V_1$ =Primary Voltage(Volt) $V_2$ =Secondary Voltage(Volt) $N_1$ =No. of Primary Turns $N_2$ =No. of Secondary Turns
<b>Voltage Drop in a Line</b>	$\Delta V$ (Volt)	$=IR$	I=Current in the Line(Amp) R=Resistance of Line(Ohm)
<b>Line Loss</b>	$P_{\text{Line}}$ (Watt)	$=I^2R$	I=Current in the Line(Amp) R=Resistance of Line(Ohm)
<b>Star Connection</b>		$V_{\text{line}}=1.732 V_{\text{phase}}$ $I_{\text{line}} = I_{\text{phase}}$	$V_{\text{line}}$ = Line Voltage (Volt) $I_{\text{line}}$ = Line Current
<b>Delta Connection</b>		$V_{\text{line}}=V_{\text{phase}}$ $I_{\text{line}} = 1.732 I_{\text{phase}}$	$V_{\text{phase}}$ = Phase Voltage(Volt) $I_{\text{phase}}$ = Phase Current (Amp)

## 9. REFERENCES

The content of this chapter was largely based on: Bureau of Energy Efficiency, Ministry of Power, Government of India. *Energy Efficiency in Electrical Utilities*. 2004.

Other references include:

Copper Industries Inc, Copper Power Systems , 2004

[www.cooperpower.com/Library/Literature/section.asp](http://www.cooperpower.com/Library/Literature/section.asp)

Indiamart. [www.indiamart.com/rowsons/index.html#oil-cooled-transformers](http://www.indiamart.com/rowsons/index.html#oil-cooled-transformers)

International Energy Agency. *World Energy Outlook 2004*.

[www.iea.org/textbase/nptoc/WEO2004.toc.pdf](http://www.iea.org/textbase/nptoc/WEO2004.toc.pdf)

Kuhlman Electric. *Kuhlman General Catalog*, p 7.

[www.kuhlman.com/clientdata/Kuhlman\\_General\\_Catalog1\\_1.pdf](http://www.kuhlman.com/clientdata/Kuhlman_General_Catalog1_1.pdf)

US Energy Information Administration. [www.eia.doe.gov/oiaf/ieo98/elect](http://www.eia.doe.gov/oiaf/ieo98/elect)

Wikipedia contributors. *Three-phase, Variable set up and basic definitions*. In: The Free Encyclopedia. 2005. <http://en.wikipedia.org/wiki/Three-phase>

## *Electrical Energy Equipment: Electricity*

### **Copyright:**

*Copyright © United Nations Environment Programme (year 2006)*

*This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder, provided acknowledgement of the source is made. UNEP would appreciate receiving a copy of any publication that uses this publication as a source. No use of this publication may be made for resale or any other commercial purpose whatsoever without prior permission from the United Nations Environment Programme.*

### **Disclaimer:**

*This energy equipment module was prepared as part of the project “ Greenhouse Gas Emission Reduction from Industry in Asia and the Pacific” (GERIAP) by the National Productivity Council, India. While reasonable efforts have been made to ensure that the contents of this publication are factually correct and properly referenced, UNEP does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.*