

Some Useful Terms

UNIT 1

ENERGY

- **Energy**
- In electrical industry it is generally expressed as **kilowatt hour (kWh)**. It is the amount of energy in spend in one hour. If one kilowatt electrical heater (which consumes one kilo-Joules per second) is turned for one hour it will consume one kWh.
- In electrical industry it is commonly called **unit**.
- Mechanical work done over a period of time is also a form of energy like heat.
- **Work done**
- It is applied force times distance covered ($N \times m$). Its unit is N.m. The thermal energy is also a form of work done. It's unit is **Joules** after the famous scientist Joule, who discovered that energy and work are equivalent. It is also at times expressed in the heat unit of **calorie**.
- 1 calorie = 4.186 Joules
- Electrical work is the product of voltage difference and the current that flows . $\text{Volt} \times \text{Amp} = \text{watt} = \text{Joule/sec}$

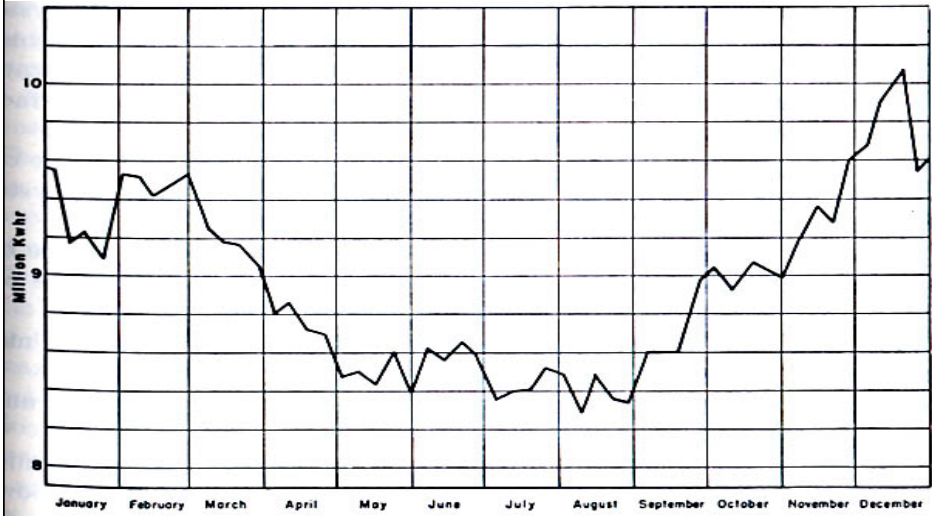
Power plant terms

- **Installed capacity**
- It is the designed power generation capacity of a plant. It is expressed in terms of energy generated per unit time. Megawatt electric (MW or MWe) is the most commonly used term for electricity generating plants. In case of process steam plant it is either expressed in amount of steam generated per unit time (t/h or kg/s) or in Megawatt thermal (MWth).
- **Power**
- It is the rate of work or work done per unit time. In the power industry it is generally expressed as Megajoules per second or MW. The basic unit is watt (Joules per second).
- **Base load Plant**
- It is a type of plant which caters to a constant load demand. Such plants run 100% of the time. Nuclear and Coal fired plants are suitable for this
- **Peak Load Plant**
- These plants helps tide over short term (15%) demand peak. Gas turbine, hydro plant can be used.

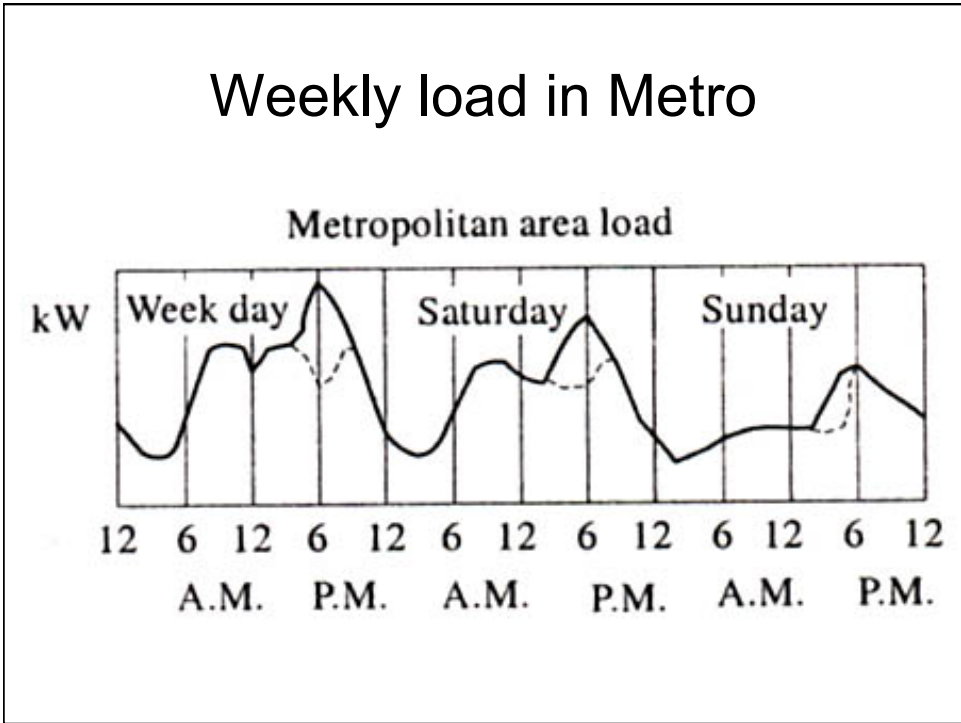
Efficiency

- **Heat rate:**
- It is the amount of energy (kJ) that the fuel must supply to produce unit amount of electrical energy (kWh). It is expressed as kJ/kWh or kCal./ kWh or BTU/kWh. This represents the overall efficiency of a power plant.
$$HR = (\text{KJ fuel burnt/kWh electricity produced})$$
- **Turbine Heat rate:**
- It is the amount of heat steam (kJ or BTU) must deliver to produce unit of heat (kWh). It gives the thermodynamic efficiency of the steam cycle, but it does not include the boiler efficiency.
- **Thermal efficiency**
- It is the amount of heat carried by the steam per unit amount of heat delivered through the fuel.
- **Combustion efficiency**
- It is the ratio of the amount of energy or heat released by the fuel and the energy contained in the fuel burnt

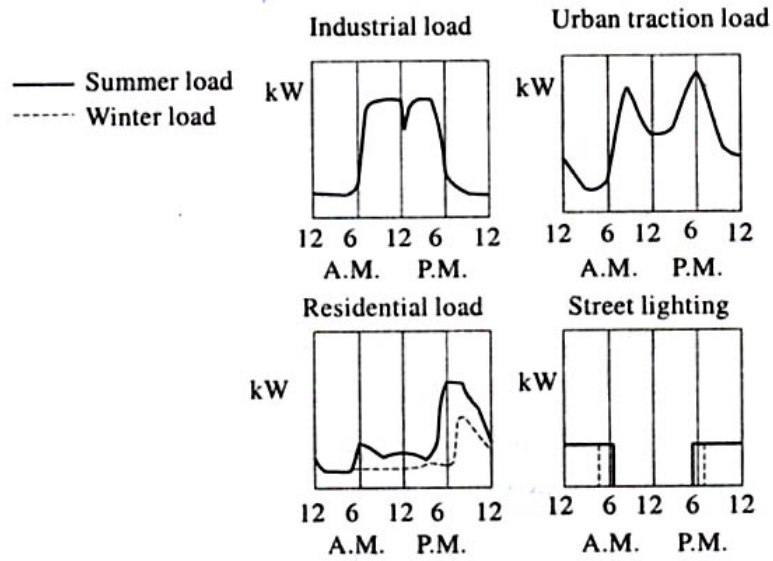
Yearly Load curve



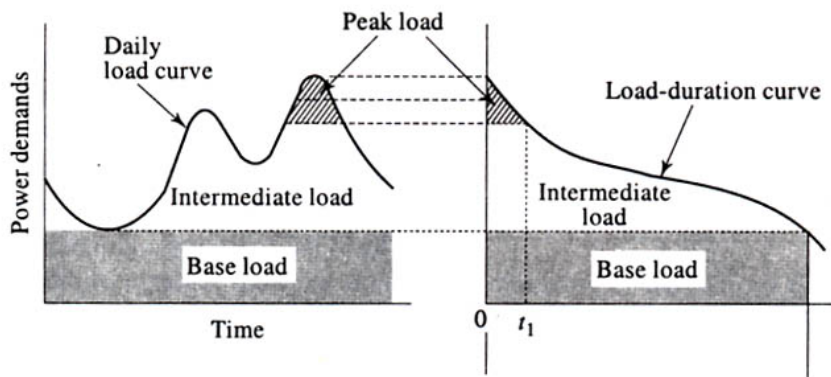
Weekly load in Metro



Load variation by sector



Base Load vs Peak Load



CAPACITY

- **Availability**

It is the fraction of **the time** a plant is available for generation.

Sometimes a plant may be partially available due to lack of operation of some components of the plant. It is called partial availability. This term, however, is not very commonly used.

- **Outage**

- It is another term for shut down of the plant either for planned maintenance (Planned outage) or due to unforeseen break down (forced outage).

- **Utilization factor**

It is the ratio of present maximum generation of the plant and the installed or the original design capacity of the plant.

$$\text{Utilization factor} = (\text{Maximum load}) / (\text{rated capacity of plant})$$

- **Capacity factor**

It is the ratio of total generation of the plant for a given period and that the plant is capable of delivering over the same period.

$$\text{Capacity Factor} = (\text{Average load}) / (\text{rated capacity of plant})$$

- **Average Load**

$$\text{Average load} = (\text{Area under load curve}) / (\text{duration of the load curve})$$

Load Factor

- Demand factor =
$$\frac{\text{Actual peak demand of the system}}{\text{Total connected load}}$$

- Diversity factor =
$$\frac{\text{Sum (Peak demands of individual subdivisions)}}{\text{Maximum demand of system}}$$

- Load factor (L_{avg}/L_{max}) =
$$\frac{\text{Average load over a period}}{\text{Peak load in that period}}$$

- Capacity factor (L_{avg}/Cap) =
$$\frac{\text{Average load}}{\text{rated capacity of plant}}$$

$$= \frac{\text{Total energy output in a period}}{\text{Rated capacity of the plant} \times \text{period}}$$

Utilization factor (L_{max}/Cap) =
$$\frac{\text{Peak output in a period}}{\text{Output if the plant operated in full rated capacity over the period}}$$

Also known as Plant load factor (PLF) or Use factor

$$\text{Reserve factor} = \frac{\text{Load factor}}{\text{Capacity factor}}$$