CH2356 Energy Engineering

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Electricity

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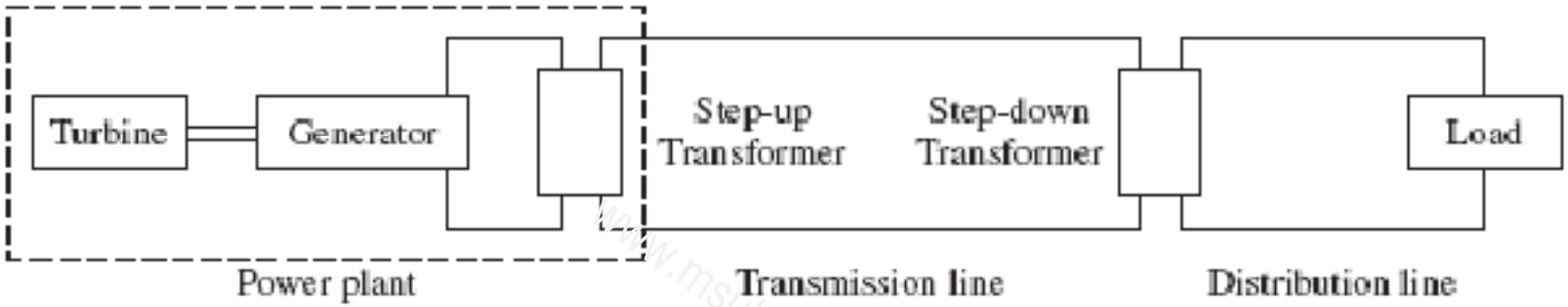


Figure 4.6 A sketch of the elements of an electric power system for generating, transmitting, and distributing power to end-users.

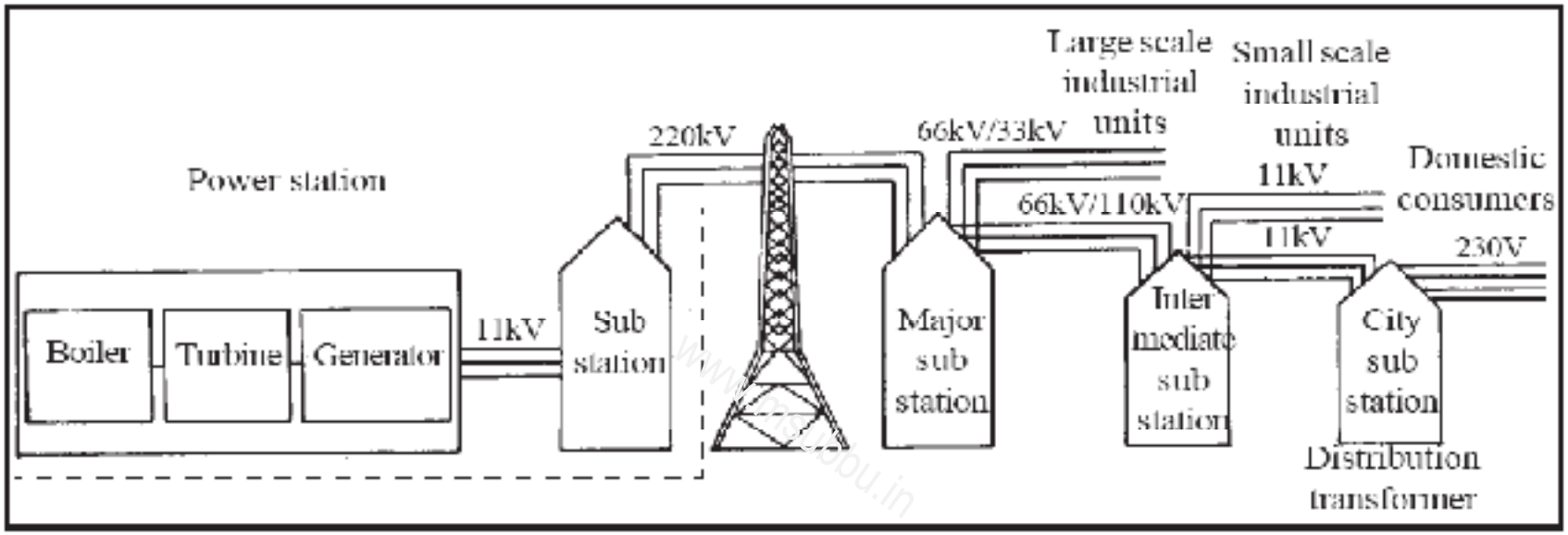


figure 1.6

The figure showing the different stages of the distribution of power

Electricity Transmission and Distribution

- A power transmission system is sometimes referred to as a "grid", which is a fully connected network of transmission lines.
- The grid consists of two infrastructures: the high-voltage transmission systems, which carry electricity from the power plants and transmit it hundreds of miles away, and the lower-voltage distribution systems, which draw electricity from the transmission lines and distribute it to individual customers.
- High voltage is used for transmission lines to minimize electrical losses; however, high voltage is impractical for distribution lines.
- Electric power is usually sent over long distances through overhead power transmission lines. Power is transmitted underground in densely populated areas, such as large cities, but is typically avoided due to the high capacitive and resistive losses incurred.

Electricity – Demand Curve

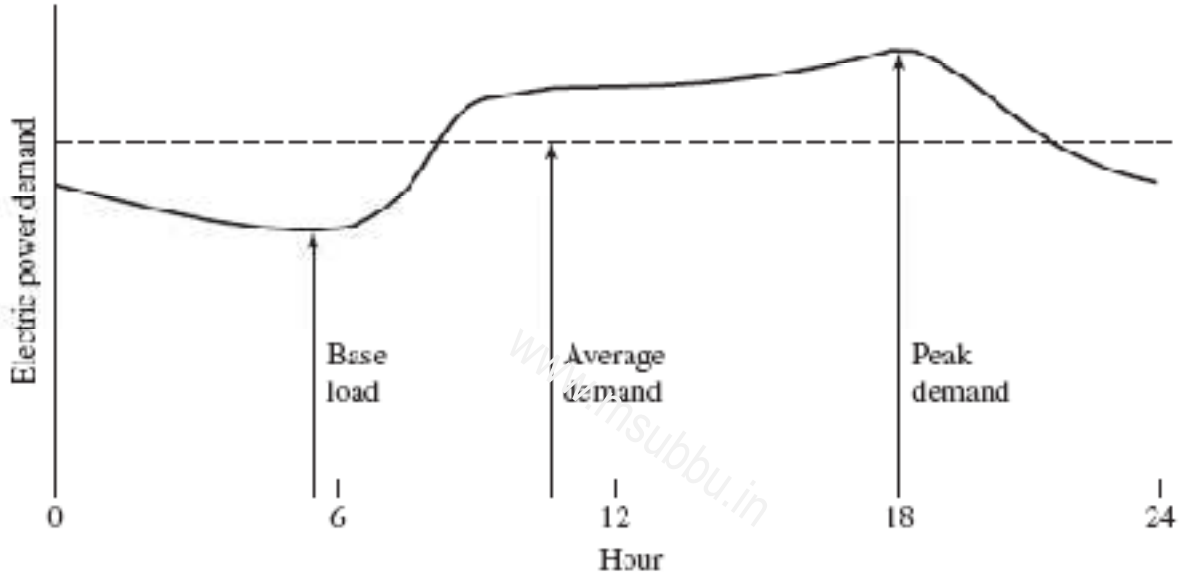
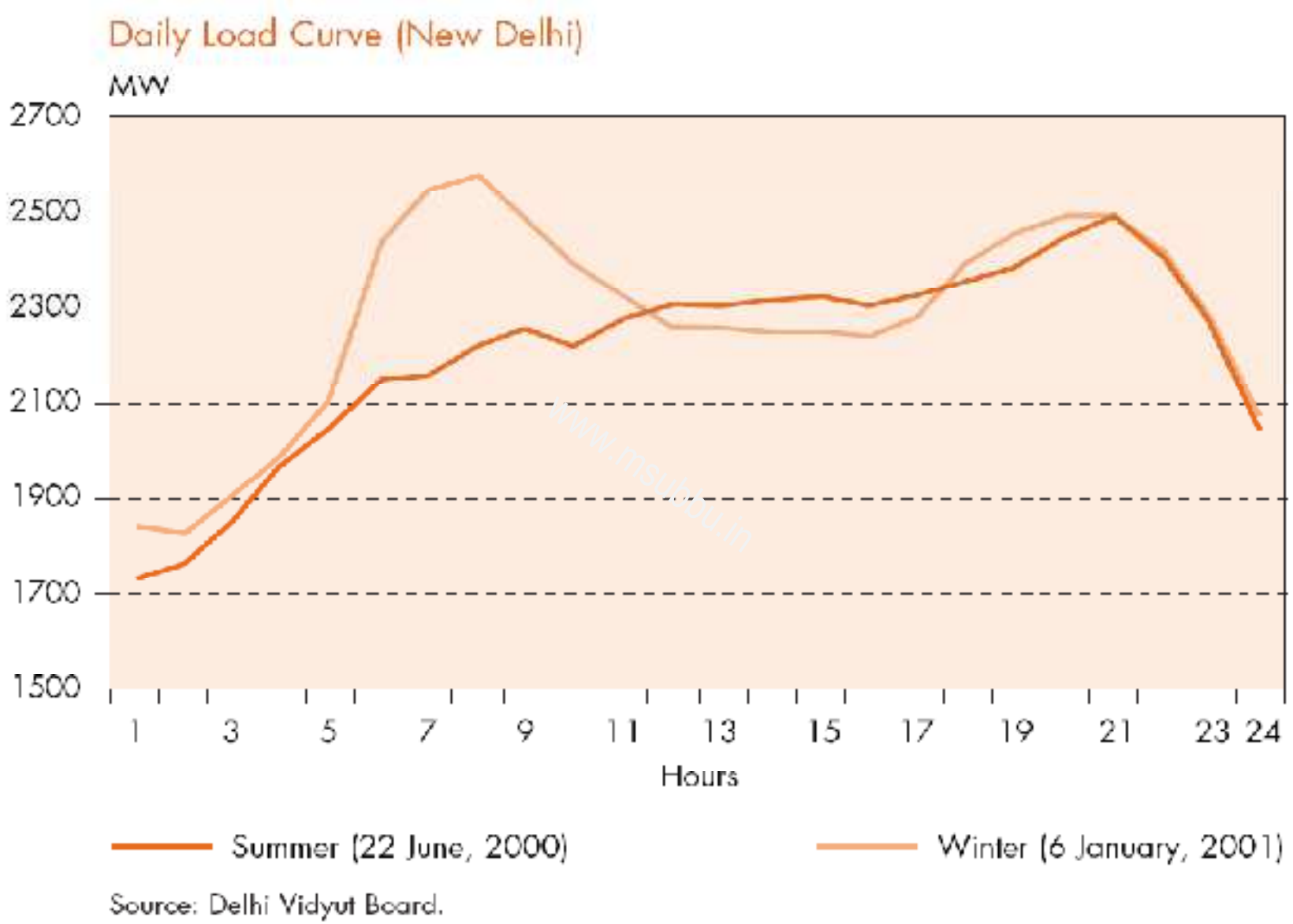
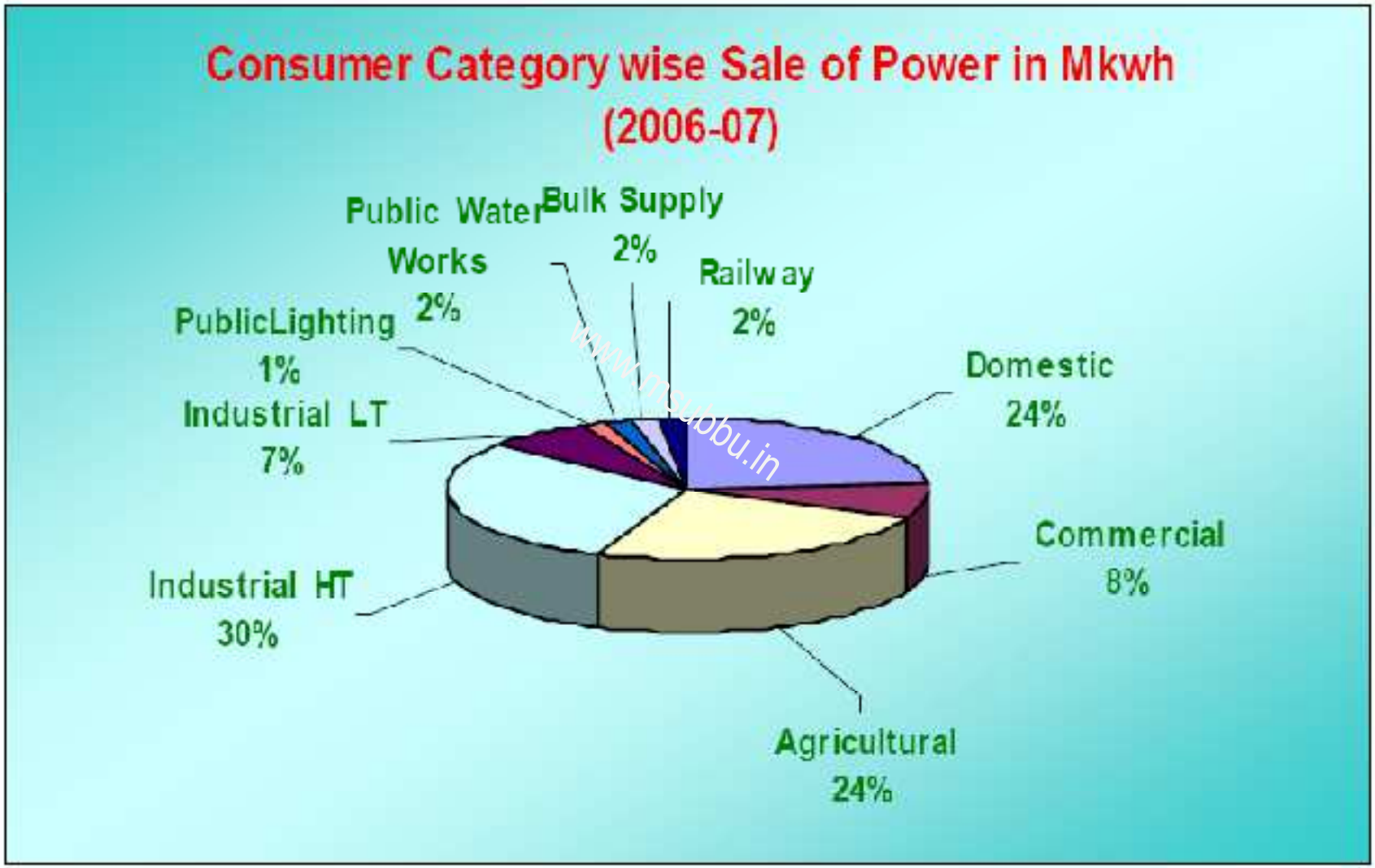


Figure 4.1 A typical diurnal demand for electric power has an early morning minimum and a late afternoon maximum, with the former defining the base load demand that is met by continuously operating plants.


Daily Load Curve (New Delhi)
MW
2700
2500
2300
2100
1900
1700
1500
1
3
5
7
9
11
13
15
17
19
21
23
24
Hours
Summer (22 June, 2000)
Winter (6 January, 2001)
Source: Delhi Vidyut Board.

Electricity Usage in India



Power Factor

- When a large number of inductive motors are used, the electrical system will operate with a low power factor.
- This means that the true power measured by the utility kilowatt-hour meter is much less than the power delivered by the utility.
- The utility may charge an additional fee for the power delivered, or demand a correction of the power factor.
- The power factor can be corrected by placing the correct value of capacitor in the line.

Electricity Bill

- Electric rate structures vary greatly from utility to utility, but they all have a series of common features. The most common components of rate schedules are described below:

  - **Energy charge**: this charge covers the actual amount of electricity consumed measured in kilowatt-hours

  - **Demand charge**: the demand charge is used to allocate the cost of the capital facilities which provide the electric service. The demand charge may be "hidden" in the energy charge or it may be a separate charge; for example it may be expressed as $6.25 per kW per month for all kW above 10 kW.

  - **Power factor penalty**: if a large customer has a poor power factor, the utility may impose another charge, assessed as a function of that power factor.

Understanding Energy Bills

Customer Class	Comments	Typical schedule bills for: Consumption (kWh)	Demand (kW)	Power factor (kVAR)
1. Residential	Small user but large numbers of them	√		
2. Commercial	Small to moderate user; relatively large numbers	√		
3. Small industrial	Small to moderate user; fewer customers	√	√	
4. Large industrial	Large user with low priority; typically, only a few customers in this class, but they consume a large percentage of the electricity produced.	√	√	√

Electricity Pricing in India

- Most of the problems of the Indian power sector arise from the present retail pricing system and from the fact that too little of it is actually paid for. Out of total electricity generated, only 55% is billed and 41% is regularly paid for. Electricity is either stolen, not billed, or electricity bills are not paid.

- Electricity prices are subsidised for domestic consumers and for farmers.

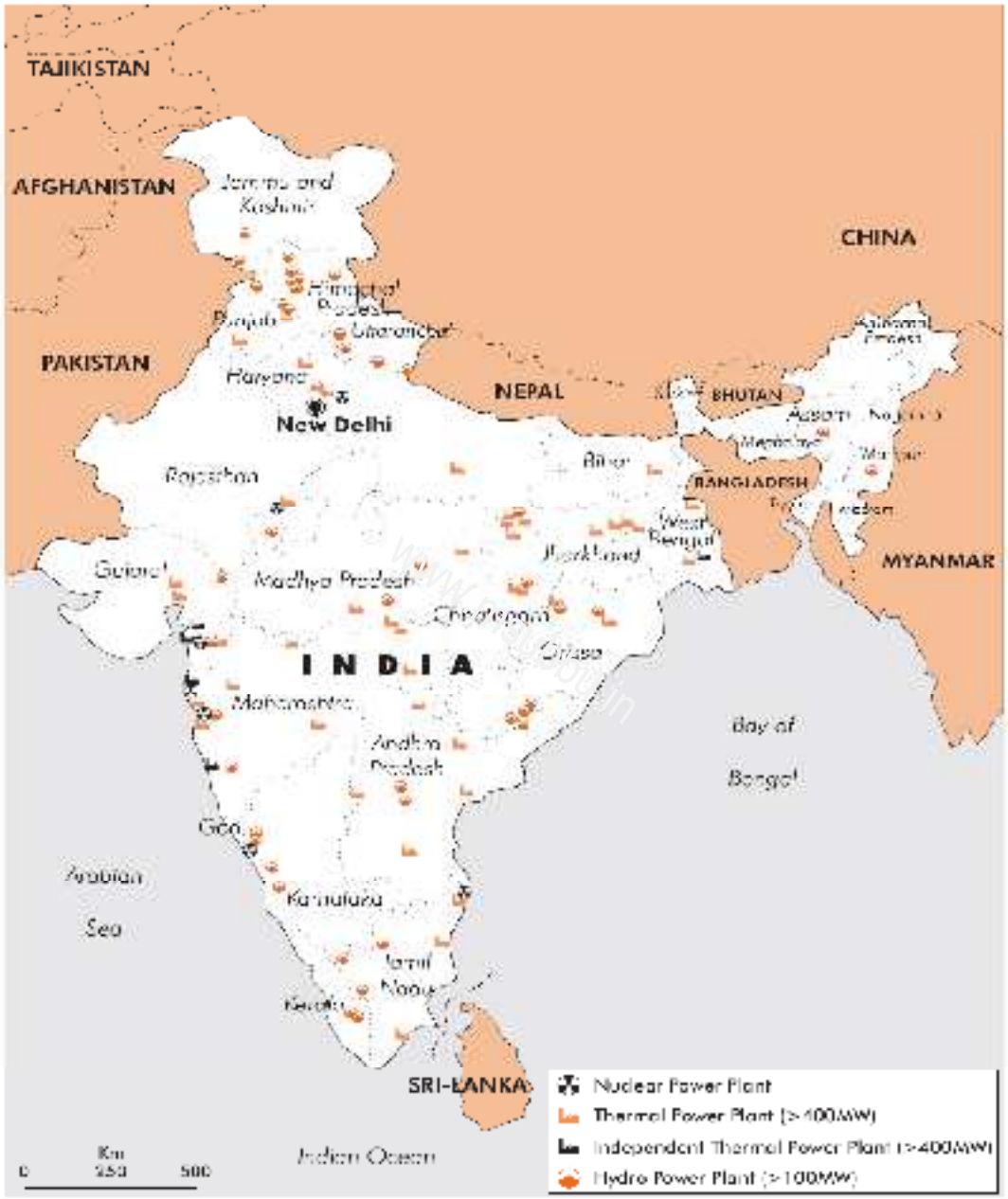
- Overpricing of industrial electricity hampers competitiveness. In other sectors, underpricing of electricity is a direct incentive to waste power.

- Confronted by high prices and unreliable supply from the network, big industrial consumers increasingly turn to "captive-power", which now represents more than one-third of their consumption.

Electricity Usage in India

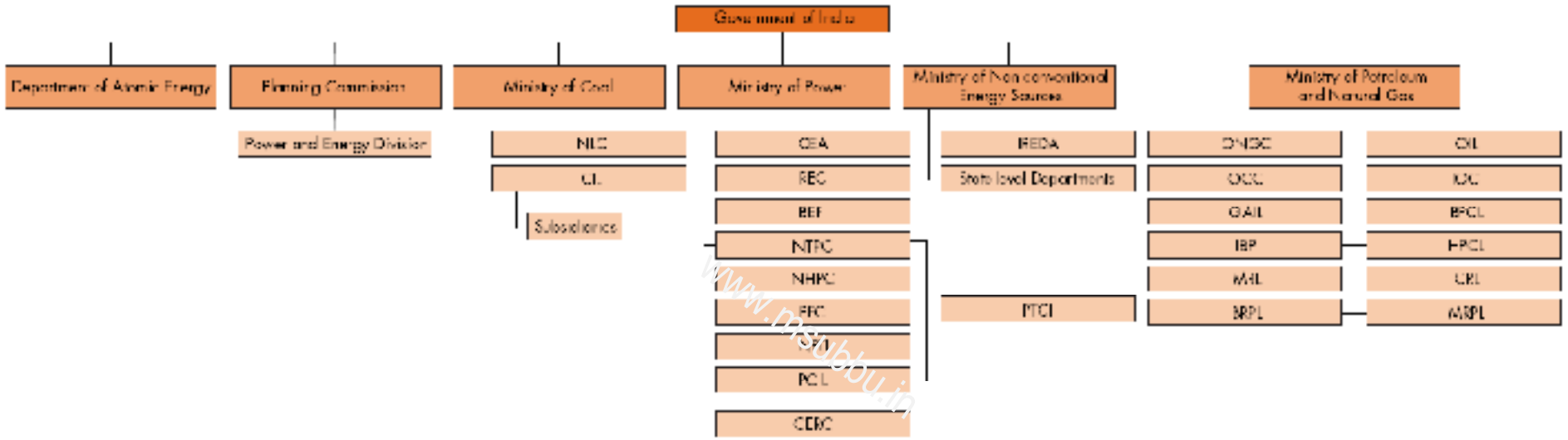
- Of total final sales of 332 TWh in 1999-2001 (rate of energy usage = 38 GW), industry accounted for just over one third, agriculture for 30%, and the household sector for 18%.

Map 2 Main Power Plants



Source: TEI, 2010

Figure 6 Organisation of the Power Sector in India



BPCL: Bharat Petroleum Corporation Ltd
BEE: Bureau of Energy Efficiency
BRPL: Bongaigaon Refinery and Petrochemicals Ltd
CEA: Central Electricity Authority
CERC: Central Electricity Regulatory Commission
CIL: Coal India Limited
CRL: Cochin Refineries Ltd
DAE: Department of Atomic Energy
GAIL: Gas Authority of India Ltd
HPCL: Hindustan Petroleum Corporation Ltd
IOC: Indian Oil Corporation Ltd
IREDA: India Renewable Energy Development Agency
IBP: IndianBurma Petroleum Company Ltd
MRL: Madras Refineries Ltd
MRPL: Mangalore Refinery and Petrochemicals Ltd
MNES: Ministry of Non-conventional Energy Sources
NHPC: National Hydroelectric Power Corporation
NLC: Neyveli Lignite Corporation
NPTI: National Power Training Institute
NTPC: National Thermal Power Corporation
OCC: Oil Coordination Committee
OIL: Oil India Limited
ONGC: Oil and Natural Gas Corporation
PGCIL: Powergrid Corporation of India Ltd
PFC: Power Finance Corporation
PTCI: Power Trading Corporation of India Ltd
REC: Rural Electrification Corporation

Source: TERI, 2000 and IEA.

TNEB - Tariff

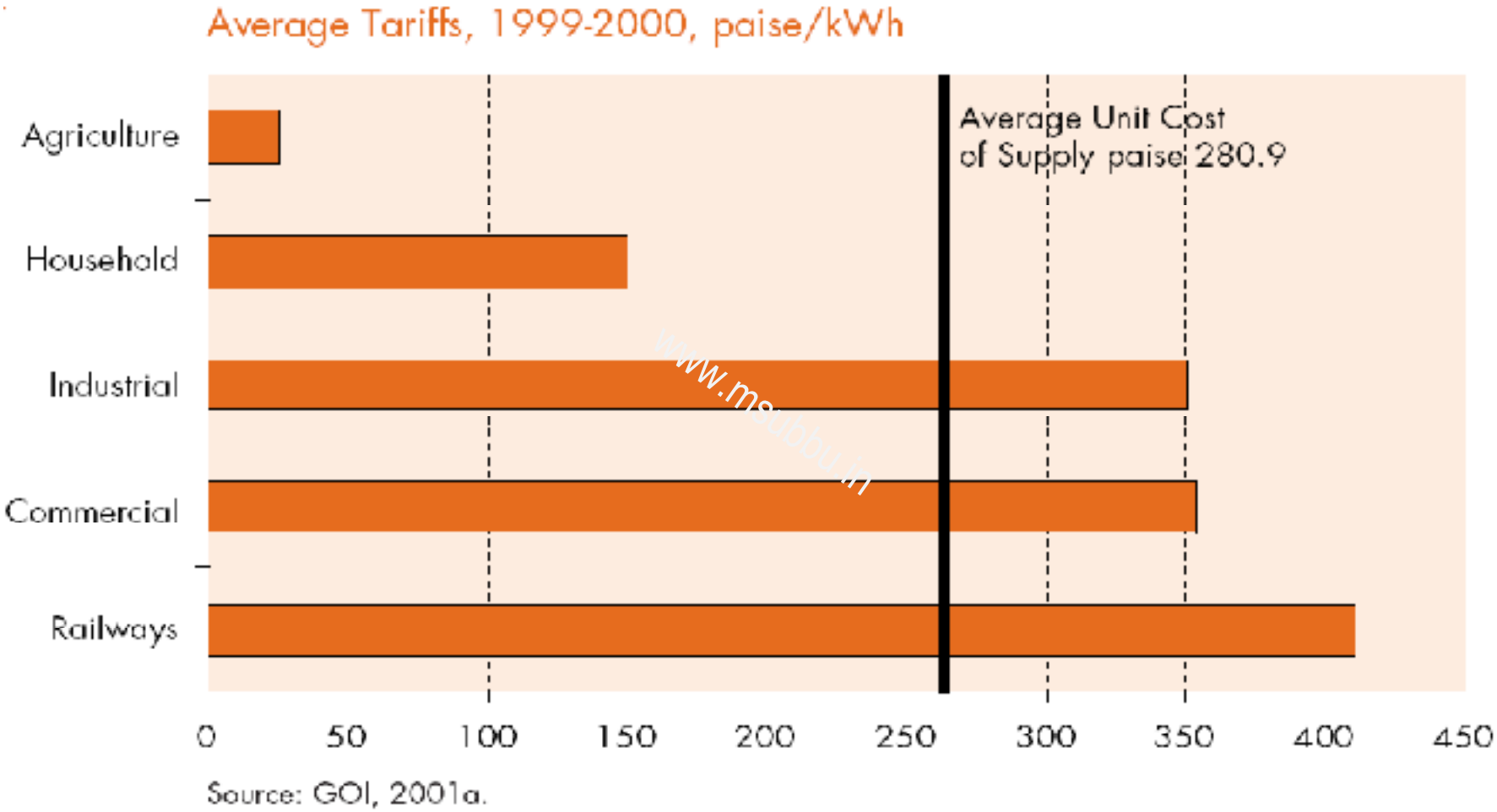
HIGH TENSION SUPPLY		
TARIFF	**Energy Charges - Paise per kWh (unit)**	**Demand charges - Rupees per kVA per month**
HT Tariff for HT Industries	400	300
Tariff IV Lift Irrigation, Cooperative Societies for Agriculture	50	

http://www.tneb.in/TariffDetailsNew.php

Tariff rates as approved by the T.N.E.R.C. with effect from 01-08-2010

LT Tariff IA Domestic

Tariff Description	Consumption Slab range in kWh (Units) and billing period (One or two months)	Fixed charges per service for two months	Energy Charges Paise/kWh (unit)	Monthly Minimum in Rupees
LT Tariff IA Domestic	Consumption up to 25 units per month or 50 units for two months	NIL	110	20 per month or 40 for two months
	Consumption from 26 units to 50 units per month/ from 51 units to 100 units for two months	NIL	130	
	Consumption from 51 units to 100 units per month/ from 101 units to 200 units for two months	Rs.10/-	260	
	Consumption from 101 units to 300 units per month/ from 201 units to 600 units for two months	Rs.10/-	350	
	Consumption from 301 units per month/601 units for two months	Rs.10/-	575	



Captive Power Generation

- Captive Power refers to generation from a unit set up by industry for its exclusive consumption.

- The industrial sector is the largest consumer of electricity. Besides purchasing power from the utilities, a number of industries, viz. aluminium, cement, fertilizer, iron, steel, paper, sugar etc. have their own captive power plants either to supplement the electricity supply from the utilities or for generating electricity as a by-product through co-generation.

- Captive power plants can be set up by industries to meet their own power requirements to enable them to tide over problems due to power shortages and poor quality of supply. They can use any easily available fuel - coal, gas, diesel, fuel oil - or any other conventional or non-conventional so long as they are able to generate stable power for their requirements all through the year without any interruption.

- Has adverse environmental impacts arising from types of fuels used and from higher emissions per unit of production, as compared to large power plants