



Fundamentals of Electricity

Power Distribution

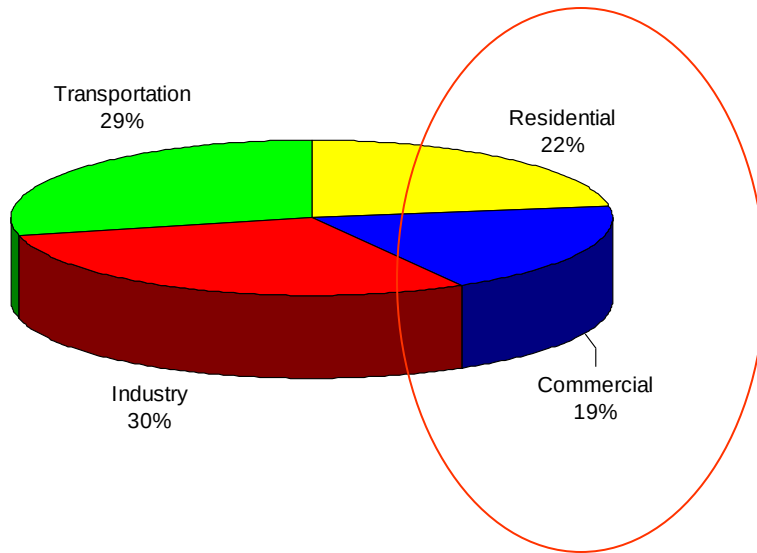


What you will Learn in this Lesson

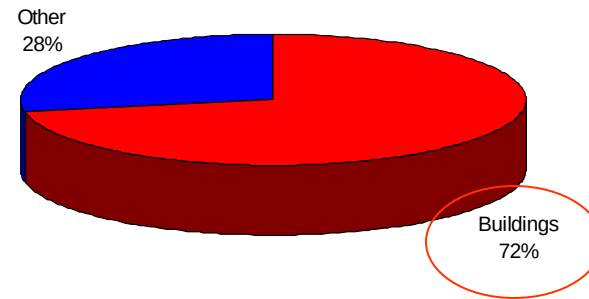
- Energy usage
- Electric power generation
- Distribution
- Common voltages
- Building distribution
- Codes and standards

Energy Usage

Energy Use by Sector

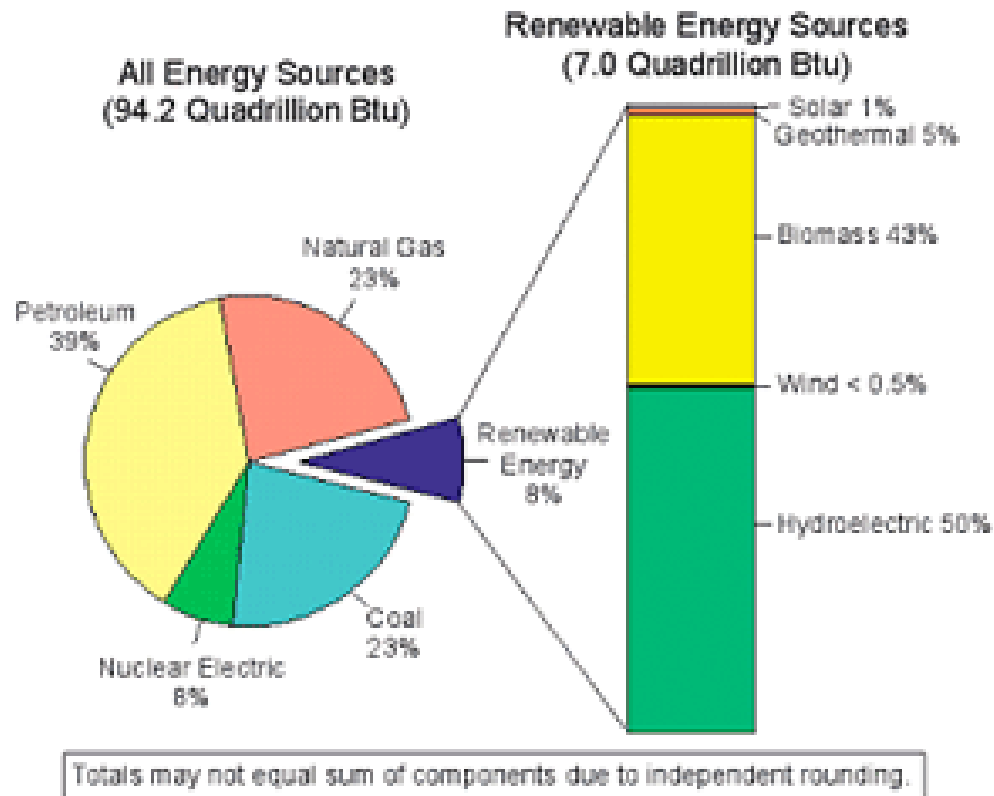


Electricity Use by Sector

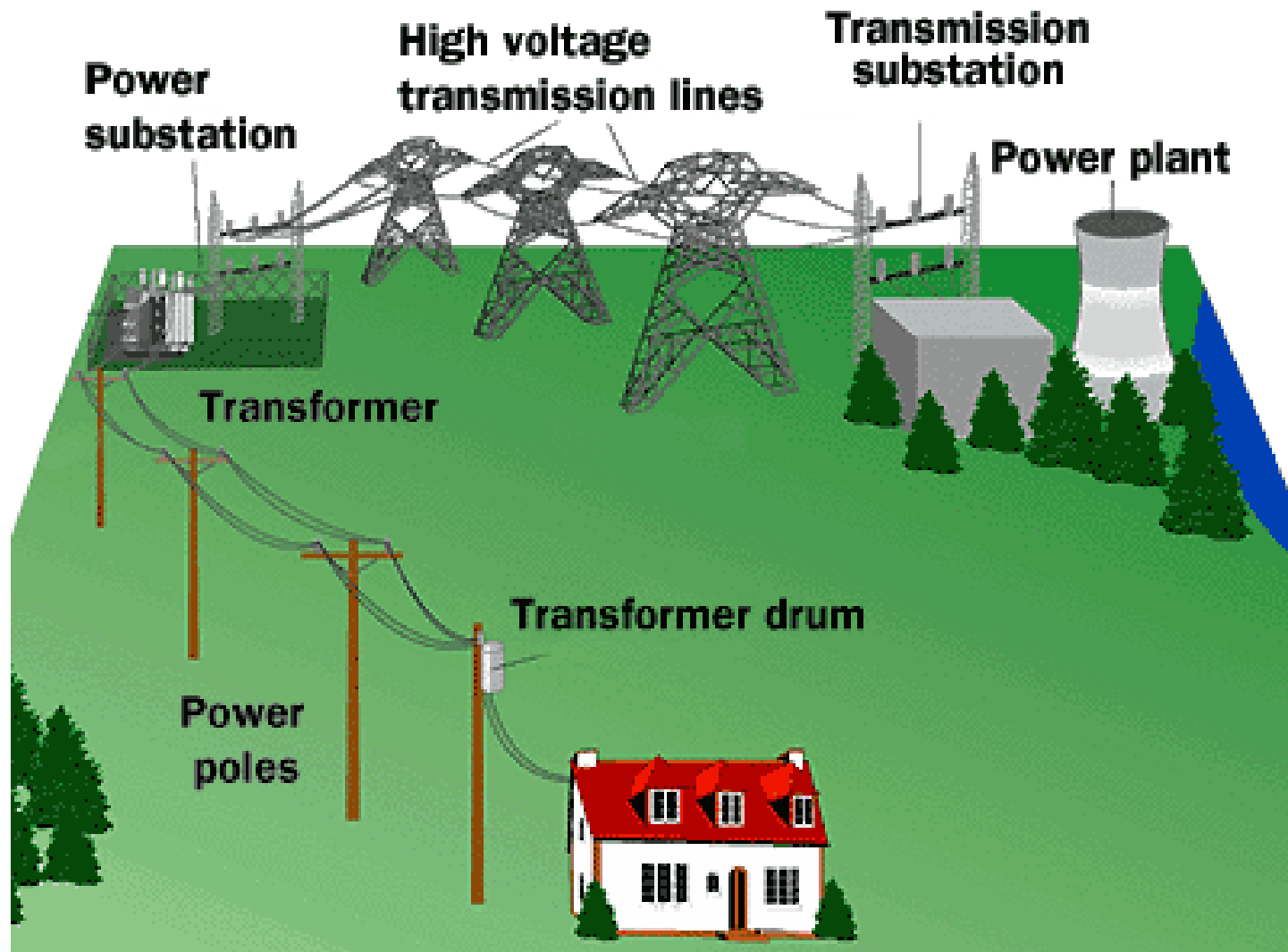


Source: Energy Information Administration 2009

Renewable Energy



Electric Grid



Electric Industry – Power Generation

- Hydro-electric, coal, natural gas, nuclear, wind, photovoltaic (PV), biomass etc.
 - Hoover Dam can produce 2.8 GW
- Produce 60 Hz (typically) AC current around 700,000 volts
 - Deliver to Grid
- Under a lot of pressure to manage CO₂ emissions
 - The order in which they turn generation on and off is called the “stack”
 - Nuclear is bottom of stack
 - Move low carbon generation to bottom of stack (not necessarily the cheapest)

Electric Industry – Power Generation

- Gas turbine peak shaving generating station
 - 500-1000 MW
- Hoover Dam hydro-electric
 - 2800 MW
- Pickering Nuclear Generating Station
 - 3100 MW
- Buffalo Ridge Wind Farm
 - 200 – 750 kW turbines

Electric Industry – Power Distribution

- Delivers electricity from source to cities and towns
 - 230,000 to 700,000 volt
- Most distribution is AC
 - There is some high voltage DC (HVDC) distribution
 - Lower line losses for long runs

Electric Industry – Local Distribution

- Local utility steps down high voltage for use within city
- Main distribution
 - 34,000, 13,800 volt, 4160 volt
- Residential
 - 220 volt Across two leads
 - 110 volt lead to neutral

Typical Voltages

- Low Voltage – under 1000 volts
 - 460/30/60 USA, 575/3/60 Canada, 380/3/50 rest of world
 - 208/3/60
 - 265/1/60 (277/1/60 in Canada) – one leg of 460(575) volt
 - 208/220/1/60
 - 120/1/60
- Medium Voltage – 1000 to 10,000 volts
 - 4160/3/60 USA and Canada
 - 3300/3/50 Rest of World
- High Voltage – above 10,000 volts
 - 13,800/3/60 USA
 - 10,000 to 11,000/3/50 rest of world

Building Distribution

- Most buildings operate off of 4160, 13,800 or 34,000 volt feeds
- They have a transformer vault to step voltage down
- Most HVAC equipment operates on 460/3/60
 - 575/3/60 in Canada
- Smaller transformers will step down to 220-120/1/60 panels for plug loads and lighting

Motor Control Centers (MCC)

- Used to deliver power to multiple motors
- Have a common bus providing power to all switch boxes
- Can include
 - Motor starters, disconnects, VFDs etc
- Common in larger projects and industrial applications

Distribution Panels

- Located throughout building in electrical rooms
- Provide local power for decentralized equipment, lighting, plug loads, etc.
- 208/3/60
- 220/1/60
- 120/1/60

Codes and Standards

- National Electric Code (NEC)
 - Safety code for electrical distribution
- IEEE
 - Provides specific standards
 - Harmonics, etc.
- UL
 - Provides safety standards for products using electricity
 - UL 990
- ASHRAE
 - Provides standards on building energy efficiency

End of Lesson

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