

EEE 3352

Electromechanics & Electrical Machines



Lecture 7a: Introduction to power systems



7. Introduction to Power Systems

- Energy
- Transmission systems
- Three phase power systems
- Measurement of power in three phase systems



Introduction to Power Systems

ENERGY



Energy: System Viewpoint

- Introduction
- Types of Energy
- Sources of Energy
- Conversion of Energy & Power
- Storage of Energy
- Transmission of Energy
- Role of Electric Power
- Competitive Uses of Natural Sources



Introduction

- Energy is essential for life
- Energy also determines quality of life

- There many sources of energy
- There many uses of energy

- thus NEEDS/REQUIREMENTS vs SOURCES



Types of Energy & Power

- “Capacity to do work”
- Energy \gg Power

- Energy: term relevant for storage
 - *oil tanker, coal mine, water reservoir etc*
- Power: term relevant for flow of energy
 - *rotating shaft, electric cable, gas pipe-line etc*



Types of Energy & Power

- Chemical & nuclear energy
- thermal energy
- potential & kinetic energy
- strain & pressure energy
- electric & magnetic energy
- mechanical power
- electric power



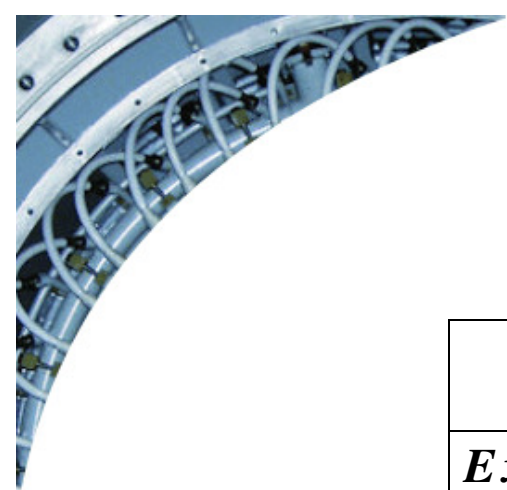
Sources of Energy

- Renewable

- wood
- solar
- hydropower
- wind power
- specific
 - biomass
 - geothermal
 - tidal

- Non-renewable

- coal
- oil
- natural gas
- nuclear fuel



	Renewable	Non Renewable
<i>Examples</i>	Solar, biomass, wood, hydro, wind, tidal, geothermal.	Coal, oil, gas
Location	Natural local environment	Relatively concentrated regions
Availability	A given average power	A given amount of stored energy
Life time of supply	No limit	Coal: 100-1000 years; oil: 10-100 years
Cost	High capital, but low running costs	Oderate to high capital; moderate running costs



Energy Conversion

- “law of conservation of energy”
- Examples
 - *chemical to thermal*
 - *thermal to mechanical*
 - *potential to kinetic to mechanical*
 - *mechanical to electrical to mechanical*
 - *electrical to thermal to electrical*
 - *electrical to chemical to electrical*

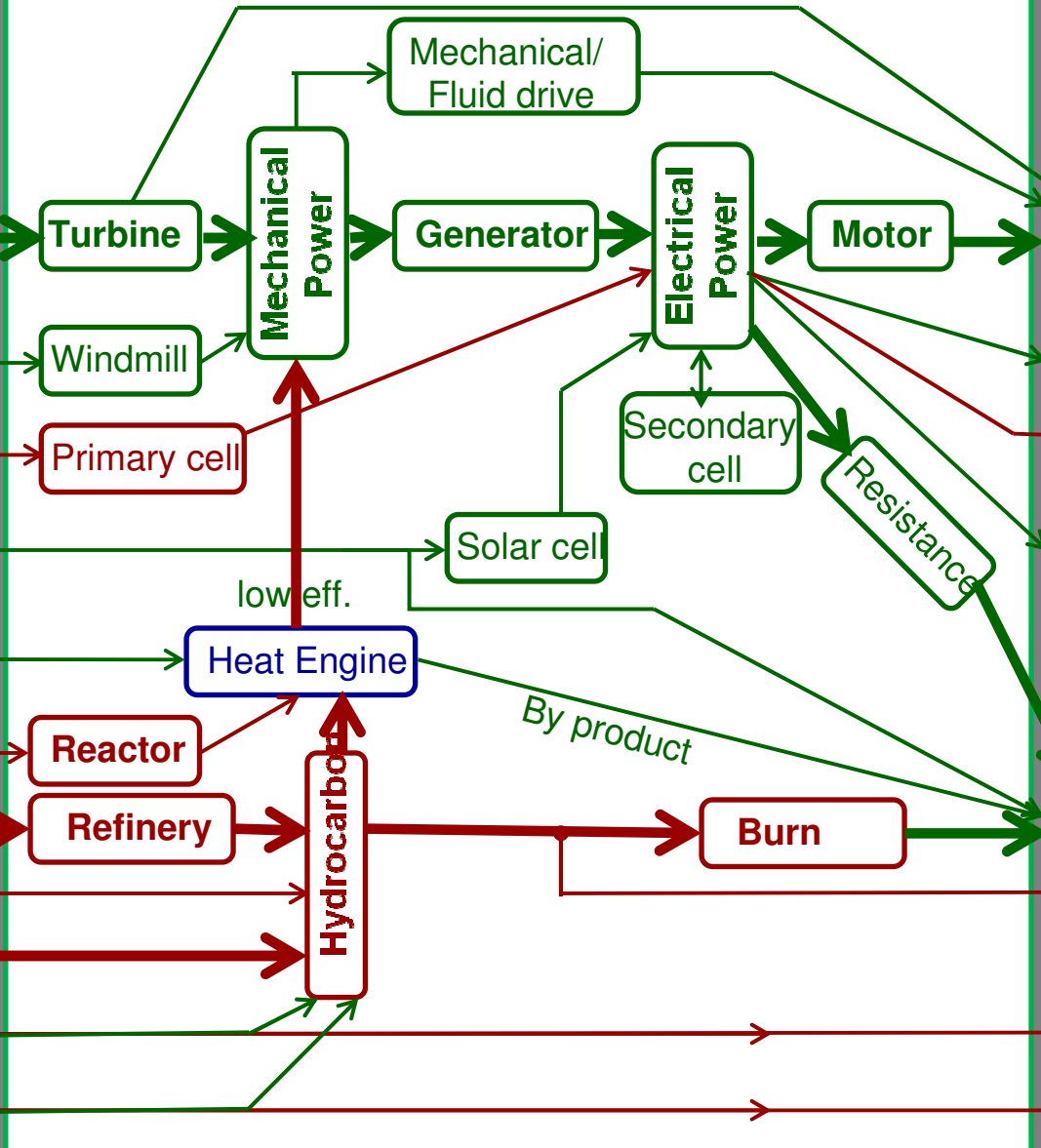
Energy Conversion

Energy Sources Renewable?

No	Yes
Chemical	Hydro
Nuclear	Wind
Oil	Solar
Gas	Waste Heat
Coal	Biomass
	Wood

Man's Needs

Energy	Other
Mechanical	Irrigation
Electrolysis	ICT
Lighting	
Heat	Chemical
	Food
	Construction





Storage of Energy

- **Intermittent Supply**

- solar -charge batteries
- wind -fill up water resv
- river - lake
- petrol eng.-flywheel
- dc - capacitors/induct
- oil tankers
- mech spring

- **Intermittent Demand**

- pneumatic drill
- starter motor-battery
- “pumped storage”
- steam pressure in boiler
- capacitors - high spark discharge

. **Emergency Use: examples**



Transmission of Energy

⇒ Geographical & geological features of the earth determine the **sources** of energy [oil, coal, hydro power etc].

⇒ Other different features influence where energy is **needed** [in towns, mining, industry, farming]

⇒ Usually **sources** and places of **utilization** are separate.
So, **transmission** of energy becomes important



Transmission of Energy

- Continuous transmission
- batch transmission
- economic factors



Transmission of Energy

Distance	Continuous	Batch
Long (over 1000 km)	Oil pipeline, gas pipeline, HVAC, HVDC	Oil tanker, coal ships
Medium (1-1000 km)	Oil & gas pipeline, Medium to high voltage	Oil in vehicle, tank, coal in trains, biomass in truck
Short (10m-1km)	Gas pipe, elec(low, high Voltage) conveyor, flues	Biomass in truck, wood
Same building (under 30m)	As in Short	Solid fuel by hand or truck



Role of Electrical Power

- Disadvantages

- it does not occur naturally
- not required as end-product (except in electrolysis, communication & computing)
- Cannot be directly stored

- Advantages

- high conversion efficiency
- ease of transmission
- high transmission efficiency
- flexible distribution



Competitive Uses of Sources

- Best balance of alternative sources and competitive needs
- Environmental issues
 - extra carbon dioxide & global warming
 - nuclear waste
 - non-renewable resources