

LECTURE

ON

RENEWABLE ENERGY SOURCES

BY

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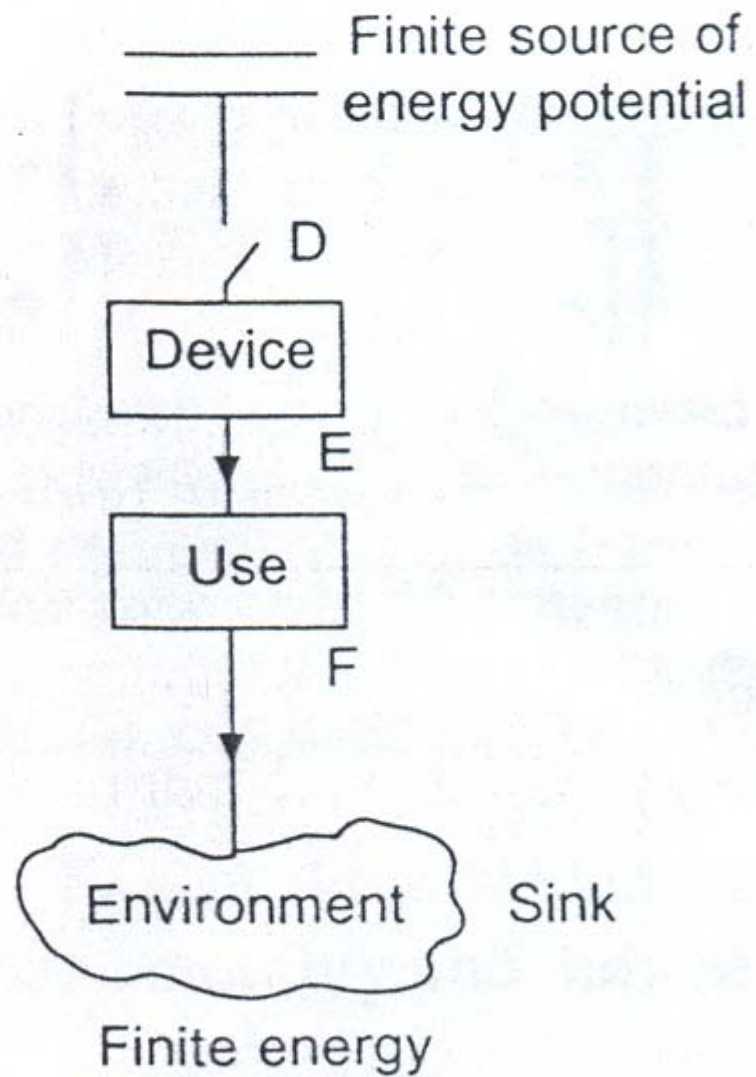
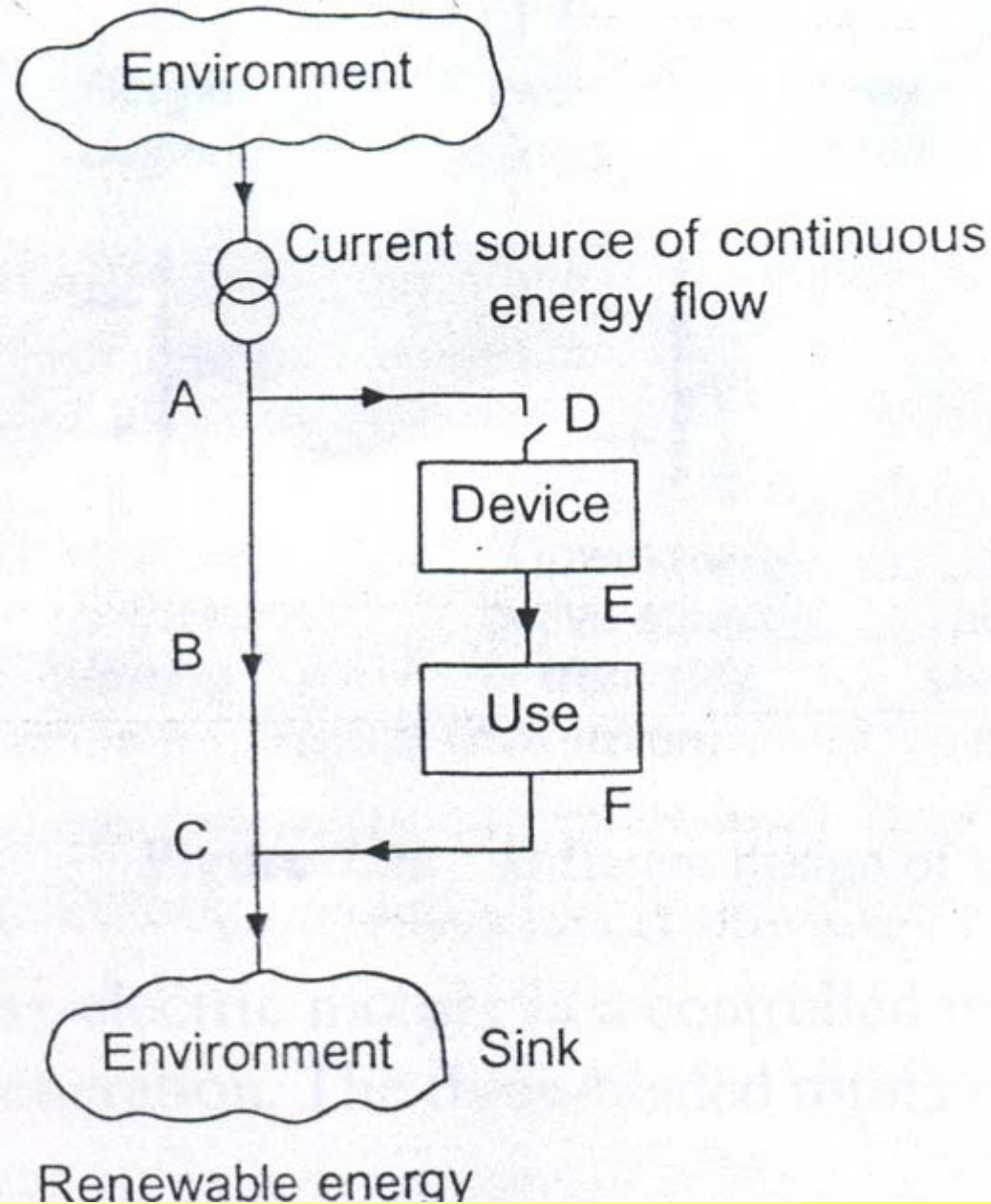
Roorkee

FORMS OF ENERGY

There is an important principle stating that the total amount of energy in a closed system remains constant. Energy may change from one form to another, but the total amount in any closed system remains constant. This principle, known as 'Conservation of energy' is extremely important for understanding a variety of phenomena various forms of energy are;

- (a) Kinetic energy
- (b) Potential energy
- (c) Chemical energy
- (d) Electrical energy
- (e) Heat energy
- (f) Radiant energy
- (g) Nuclear (Mass) energy

- a) **Renewable energy** is the energy obtained from regenerative or virtually inexhaustible sources of energy occurring in the natural environment like solar energy, wind energy etc. This is also referred as non-conventional sources of energy.
- b) **Nonrenewable energy** is the energy obtained from static stores of energy that remain bound unless released by human interaction. Examples are fossil fuels of coal, oil and natural gas and nuclear fuels. This type of energy is also called finite energy or conventional sources of energy.

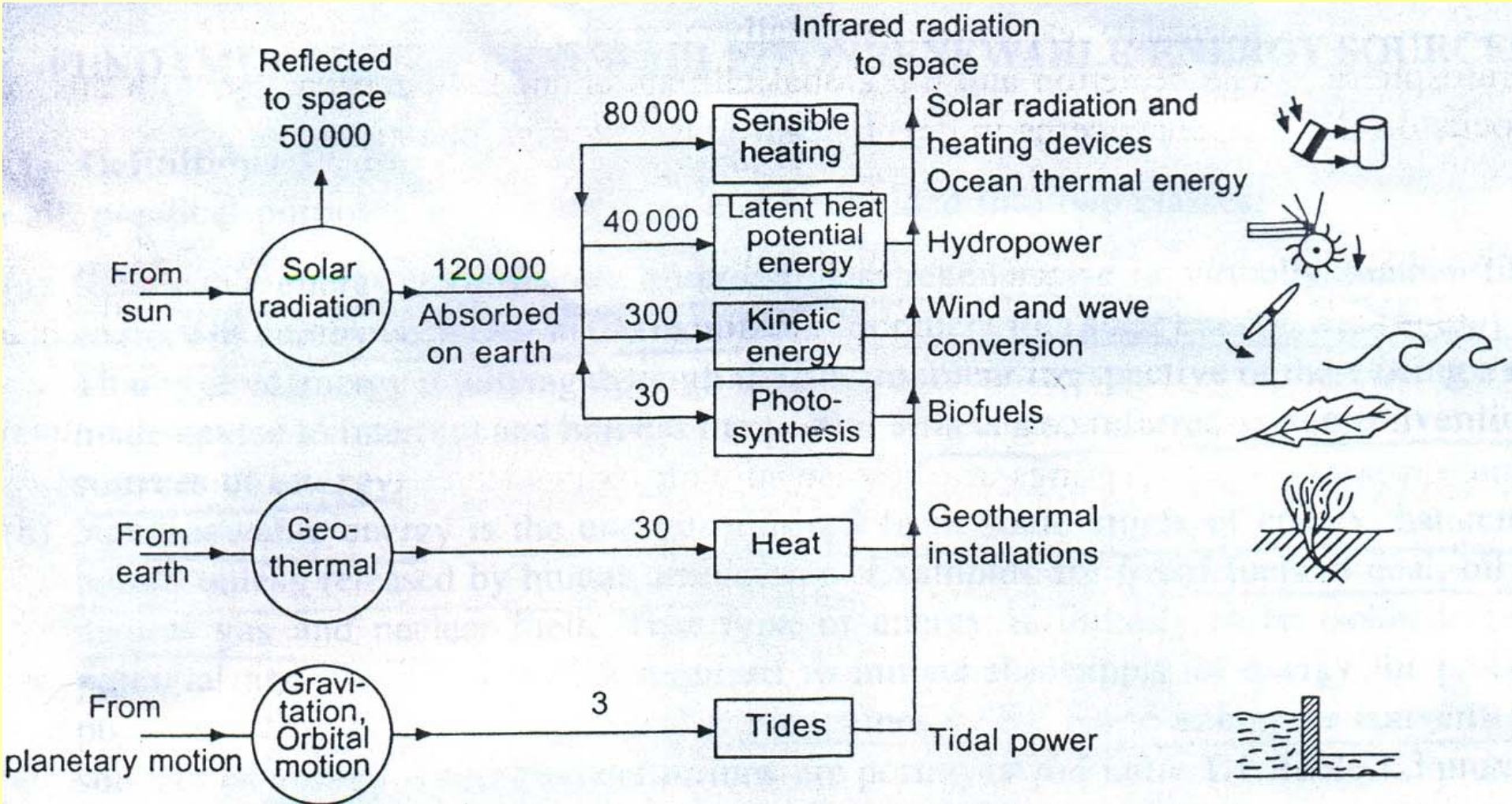


Comparison between renewable and finite energy supplies. Environmental energy flow ABC, harnessed energy flow DEF.

ENERGY SOURCES

There are six ultimate sources of useful energy:

- (1) The sun;
- (2) The motion and gravitational potential of the sun, moon and earth;
- (3) Geothermal energy, chemical reaction and the radioactive decay inside the earth;
- (4) Nuclear reactions on the earth;
- (5) Chemical reactions from mineral sources and
- (6) Fossil fuel (Petroleum product and gases).



Natural energy currents on earth, showing renewable energy systems. Units terawatts (TW) (10^{12} W)

Environmental and Social problems of fossil fuels

- (a) Water pollution.
- (b) Hazardous air pollutants
- (c) Ambient air quality.
- (d) Marine pollution
- (e) Solid waste disposal
- (f) Land use and siting impact.
- (g) Acid rain
- (h) Stratospheric ozone depletion
- (i) Global climate change(greenhouse effect)

POTENTIAL OF RENEWABLE ENERGY IN INDIA & ACHIEVEMENTS

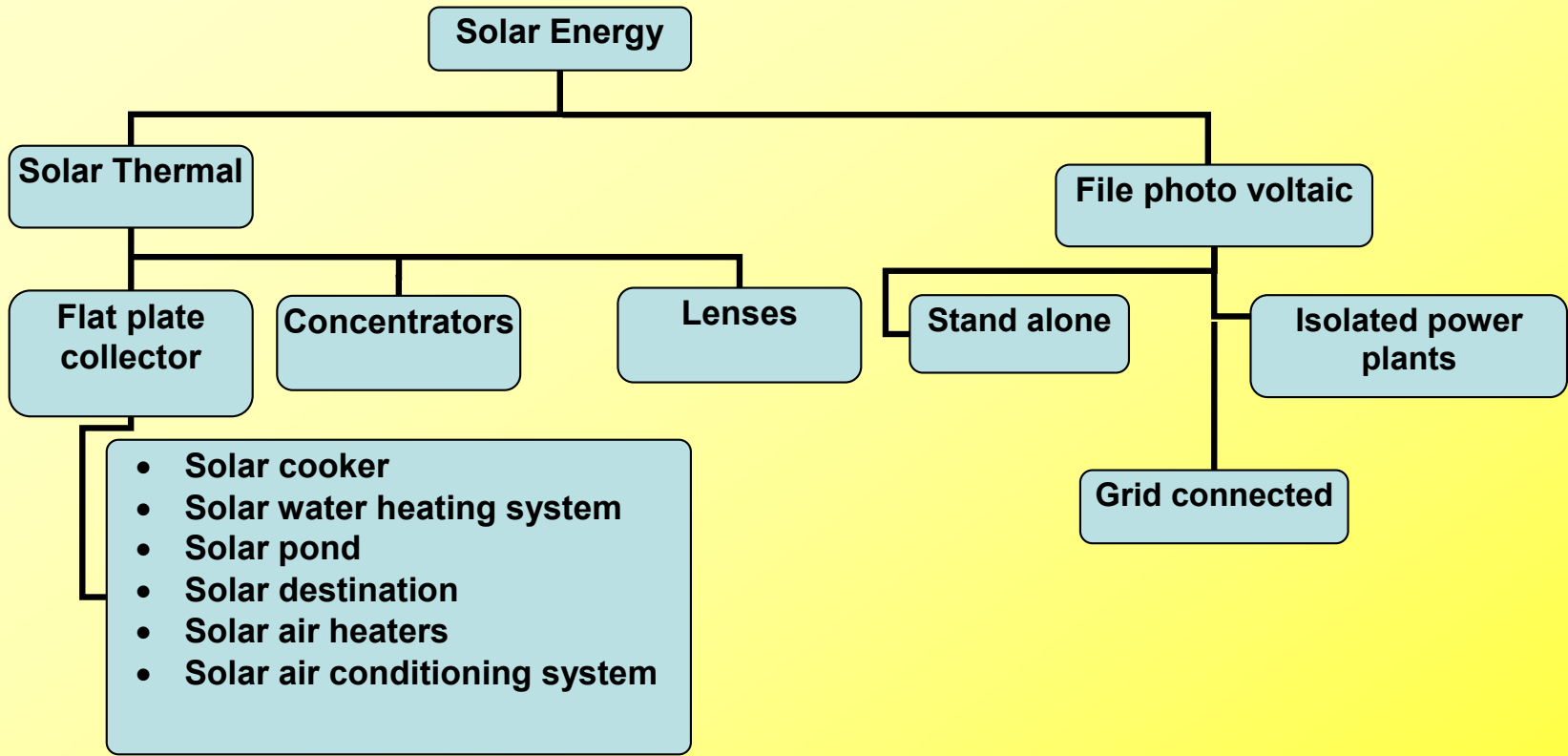
S. No.	Programmes	As on 12.10.1999	As on 12.10.2003
A	Grid Connected Systems (installed capacity in MW)		
1.	Wind power	1022.00	2002.00
2.	Small Hydro Power	1218.00	1530.00
3.	Biomass/Cogeneration Power	171.00	571.00
4.	Urban and industrial waste power	2.00	26.00
5.	Solar photovoltaic power	1.00	3.00
	Total	2414.00	4132.00
B.	Decentralized systems		
6.	Biogas plants (Nos. in lakh)	28.80	35.50
7.	Community/ Institutional/ Night-soil based biogas plants (Nos.)	2673.00	3902.00
8.	Improved chulha (Nos. in lakh)	250.00	350.00
9.	Solar home lighting systems (Nos.)	64000.00	260000.00
10.	Solar street lighting systems (Nos.)	32920.00	43470.00
11.	Solar lanterns (Nos. in lakh)	2.22	4.42
12.	SPV pumps (Nos.) (solar photovoltaic)	2160.00	6400.00
13.	Solar water heating systems (lakh sq. meter collector area)	5.70	7.00

Importance of Renewable Energy Resources and Technologies for Sustainable Development

- i) They have much less environmental impact compared to conventional sources of energy.
- ii) Renewable energy sources can not be depleted unlike fossil fuel and uranium resources.
- iii) They favour power system decentralization and locally applicable solutions more or less independent of the national network, thus, enhancing the flexibility of the system and the economic power supply to small isolated settlements.

Essential Factors for sustainable Developments

- i) Public awareness
- ii) Information
- iii) Environmental education and training
- iv) Innovative energy strategies
- v) Promoting renewable energy resources
- vi) Financing
- vii) Monitoring and evaluation tools



Forms of Solar Energy

Biomass Sources

New Plant growth

- Starch & sugar producing plant
- Latex producing plant
- Vegetable oil seed plants
- Agro-forestry
- Silvicultural forestry
- Urban forestry
- Rural forestry
- Social forestry

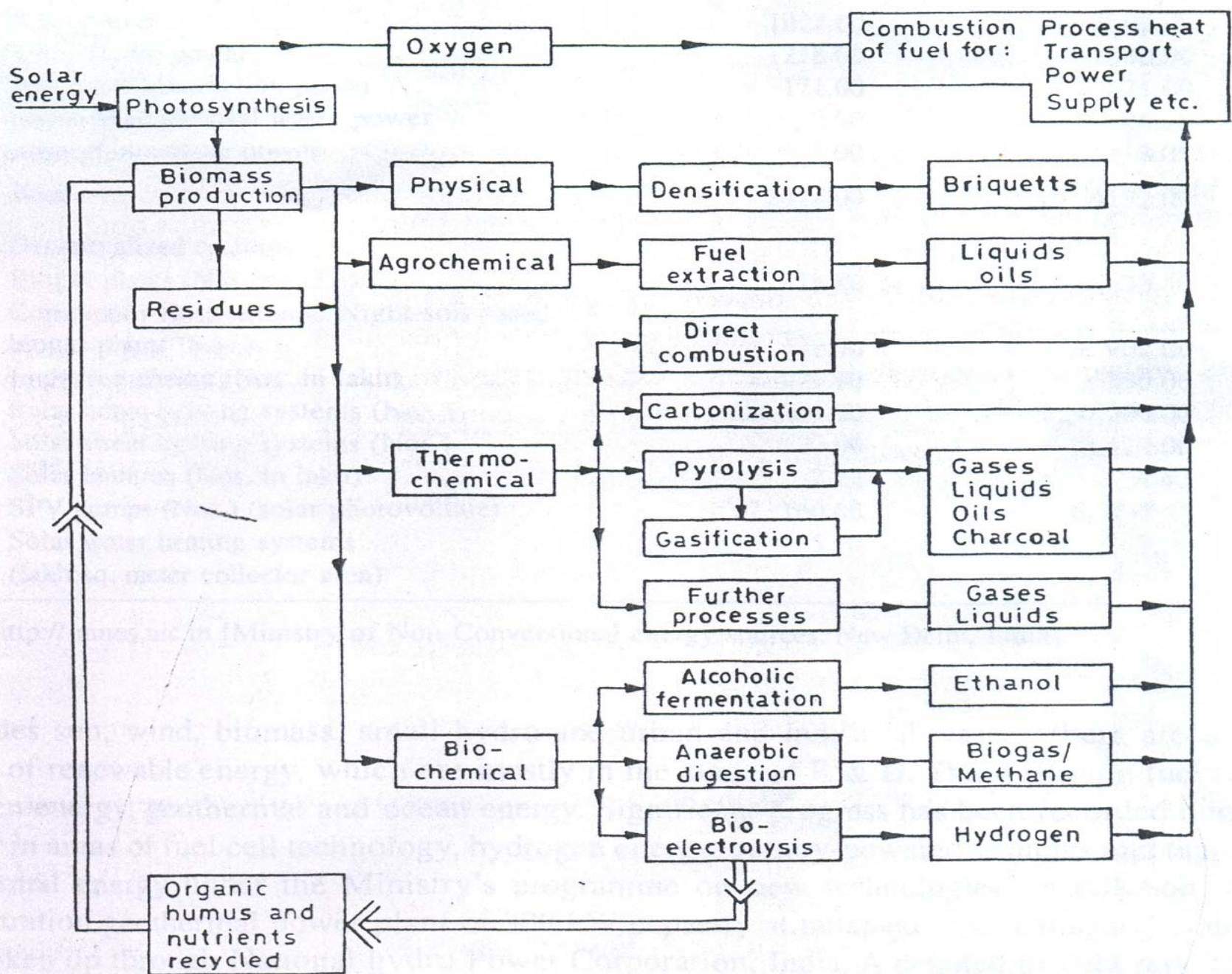
Biomass wastes

- Municipal wastes
- Industrial solid wastes
- Industrial effluents
- Sewage
- Agro-industrial wastes

Biomass residues

- Wheat straw
- Rice straw
- Rice straw
- Maize cubes
- Ground nut
- Jute sticks

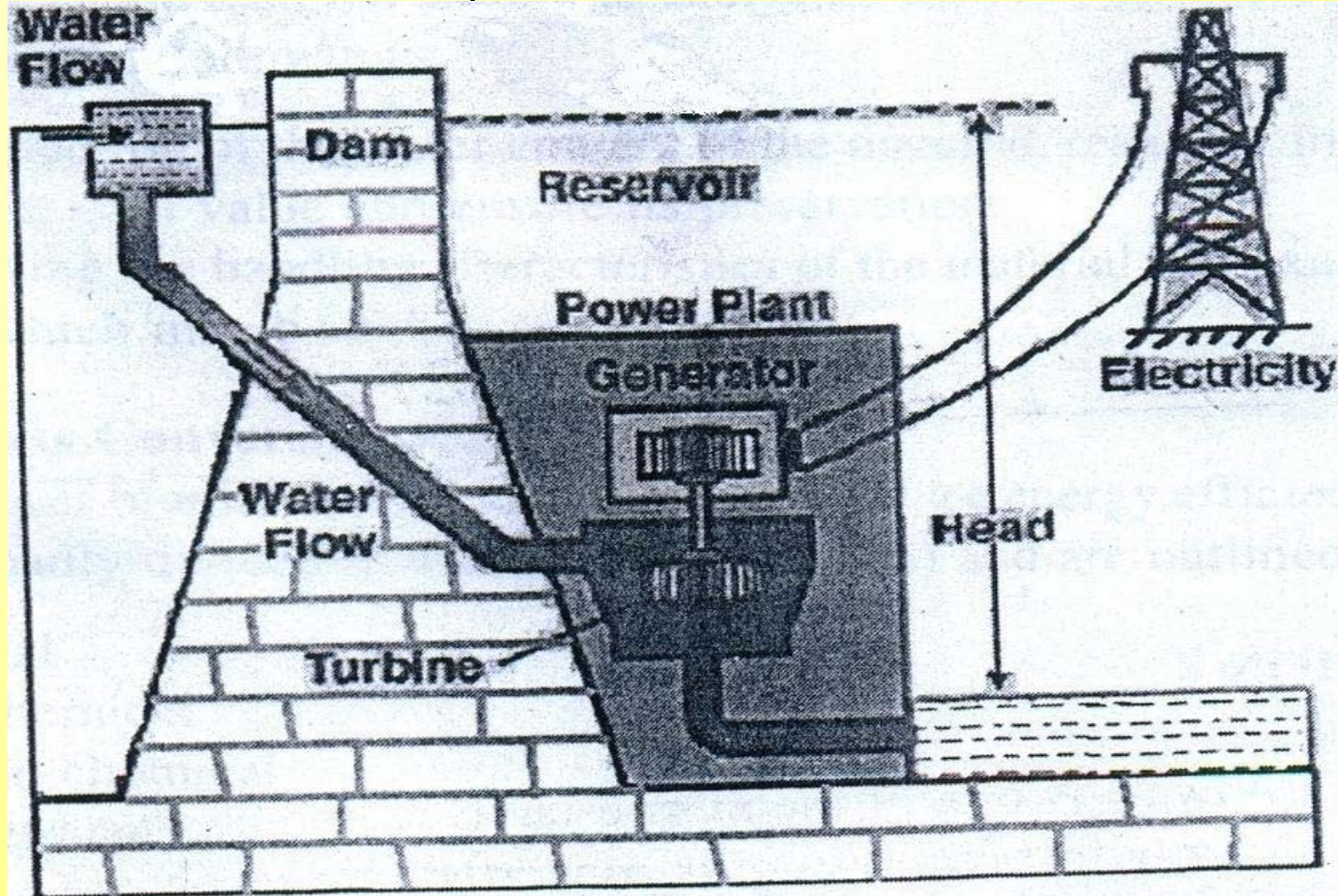
Biomass Energy Sources



Biofuel production process

HYDROPOWER

Hydropower (or water power) is one of the most established renewable sources of energy for electricity generation. Energy in falling water is converted into mechanical and then electrical energy to meet the energy requirements for a variety of tasks.



A general layout of hydroelectric plant

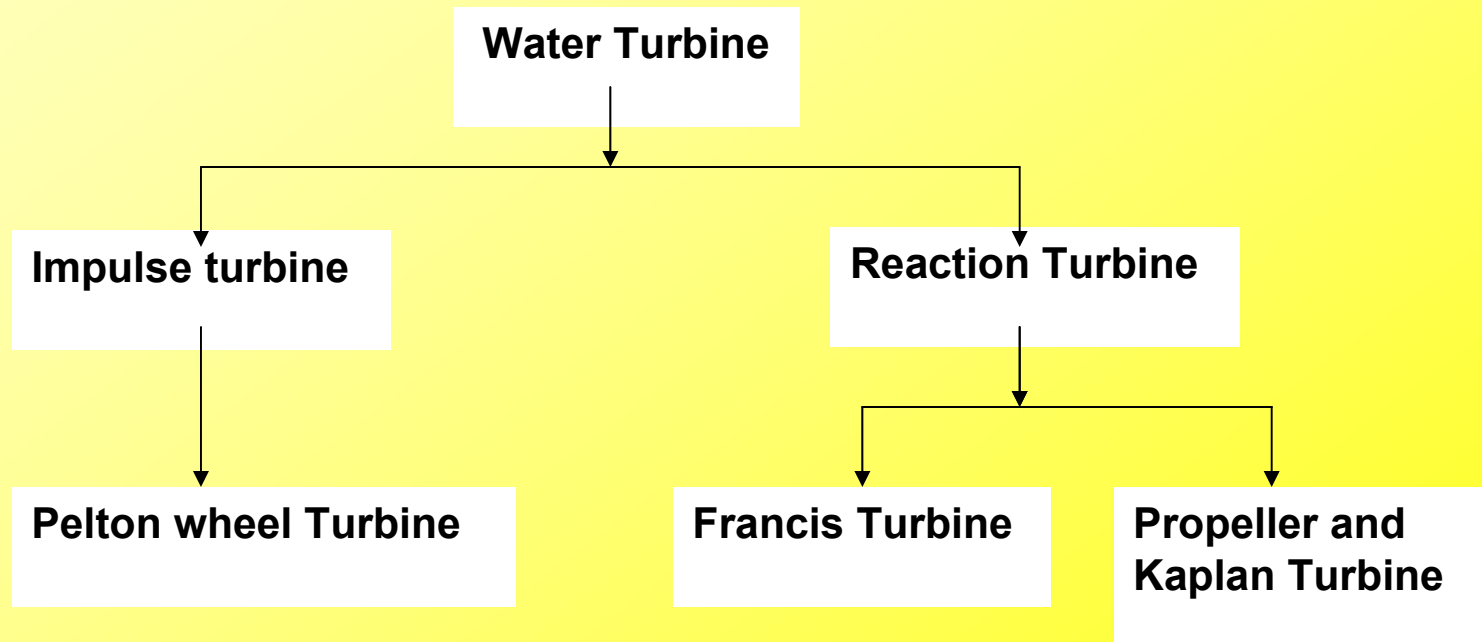
CLASSIFICATION OF WATER TURBINES

Water turbines can be classified according to the following considerations:

- (i) The action of flowing water on the turbine blades.
- (ii) The head and the quantity of water available
- (iii) The direction of flow of water in the turbine blades
- (iv) The disposition of turbine shaft
- (v) The name of the originator
- (vi) The specific speed of turbine

These are briefly described below:

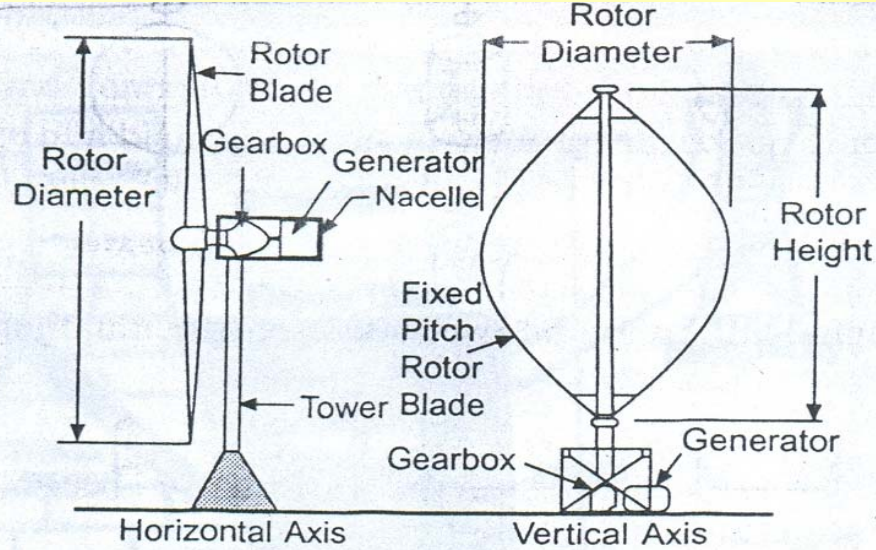
- (i) According to action of flowing water on the turbine blades, the classification is given below



WIND ENERGY CONVERSION SYSTEM

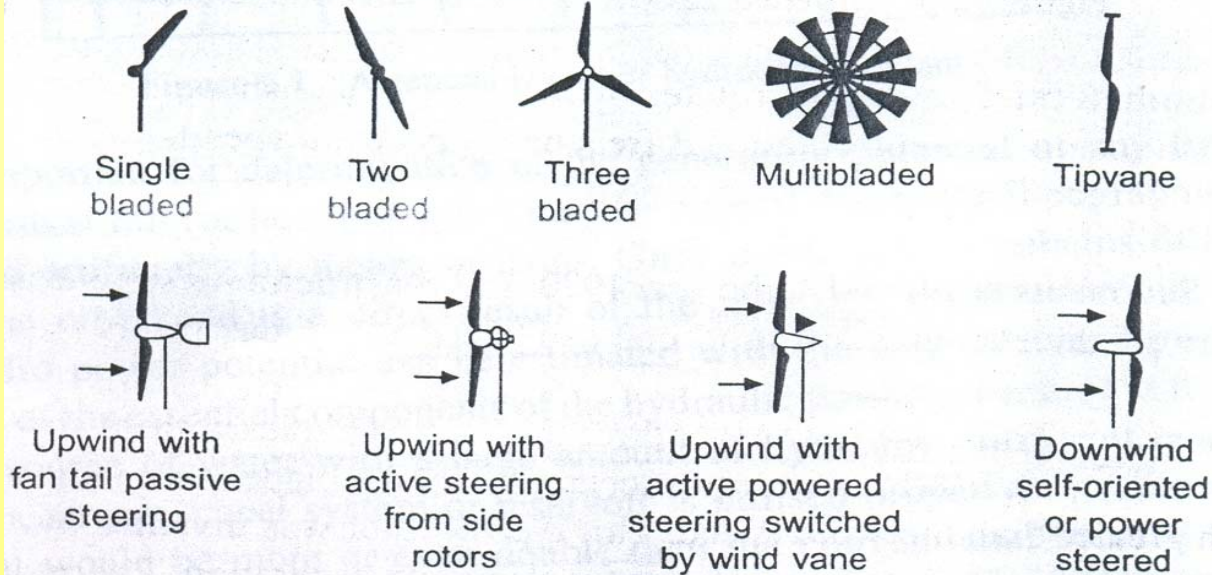
Wind generated electricity has been used in three different modes

- Below 4kW capacity is used as battery chargers.
- Wind electric generators in the range of 50 to 300 kW capacities have been used in grid connected wind farms
- Wind electric generators in the middle range of 50 to 300 KW capacities have been used in grid connected wind farms.
- Wind electric generators in the middle range of 20 to 100 kW have been used in stand alone model integrated with diesel-generator sets. Many such locations in India are Lakshawdip Bet-Dwarka, Leh etc. where small local grid operated by diesel generator and wind electric generators connected to this grid can be used in saving the consumption of diesel.



Wind Turbine Configurations

Configurations of horizontal axis and vertical axis wind turbine



Different design of horizontal axis wind turbine

Further Readings

Sno.	Author	Title	Publication	Year
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3.	M.S. Soha, S.S. Mathur, M.A.S. Malik	Reviews of Renewable Energy Resources	Wiley Eastern Limited	1983
4.	Chaman L. Gupta	Renewable Energy Basics & Technology	MNES	1998
5.		New Renewable Energy Resources: A Guide to the Future	WEC	1994
6.	T.C. Kandpal	Reviews of Renewable Energy Resources	Wiley Eastern Limited	1986

Thank
You



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