

Introduction to Non- Conventional Energy Systems

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Why Fossil Fuel Base?

- ◆ Applications need concentrated energy i.e. high energy densities.
- ◆ Extraction, storage, distribution and service infrastructure is well established and stable
- ◆ Large scale production results in affordable running cost.

Why fossil fuel base?

	Fuel	Wh/kg	density Kg/m ³	Wh/m ³	Wh/lt.
1	Gasoline	12300	~700	9348000	9348
2	Natural Gas	9350	~800	7480000	7480
3	Methanol	6200	791	4904200	4904
5	Kerosene	12300	870	10701000	10701
6	Coal	8200	1250-1550	10250000	10250
7	Battery (lead- acid)	35	-	-	80
8	Flywheel	15	-	-	-
9	Solar thermal**	-	-	900/day	0.9/day
10	Solar PV*	-	-	500/day	0.5/day

*Efficiency is assumed as 10% and 1m height is required for installation with appropriate inclination.

**Efficiency is assumed as 18% and 1m height is required for installation with appropriate inclination.

Why fossil fuel base?

◆ COSTS

- Cost of petrol Rs.40/lt > Rs.4.27/KWh
- Cost of kerosene Rs.15/lt > Rs.1.4/KWh
- Cost of PV Rs.200/W > *Rs.40000/KWh of capital investment*

Why fossil fuel base?

- ◆ Petrol/diesel fuel stations infrastructure is available
- ◆ LPG gas is distributed at your doorstep
- ◆ LPG and CNG service infrastructure is also well established
- ◆ Customer need not bother about storage and service infrastructure costs. Payment is only for running cost of fuel.

Then why move away from fossil fuel base?

- ◆ Depletion of fossil fuels
- ◆ Environmental hazards
- ◆ Health hazards
- ◆ Life Cycle costs versus running costs

How long will fossil fuel last?

- ◆ Let the earth be made of a thin shell that is filled entirely with fossil fuels.
- ◆ Consider the earth as a sphere of radius $R=6378.137$ kms.
- ◆ This amounts to about 1.1×10^{21} m³ of fossil fuel.
- ◆ take the average energy density of fossil fuel to be about 10000Wh/lt or 10000 KWh/m³
(refer table on energy densities – slide 03)

How long will fossil fuel last?

- ◆ the amount of stored energy within the earth is 1.1×10^{25} KWh
- ◆ The current annual world energy consumption is about 55×10^{12} KWh
- ◆ Considering a 7% growth in energy consumption annually

How long will fossil fuel last?

◆ in 372 years with an annual energy consumption growth rate of 7%, all the fossil fuel is emptied within the earth even though we started with earth being full of fossil fuel. However, earth is not composed fully of fossil fuel. Only a fraction of its volume is stored as fossil fuel.

How long will fossil fuel last?

- ◆ The pinnacle of fossil fuel usage is passed. Its usage will now decay exponential and in the next 100 years will gradually die.

So now a Paradigm shift...

“Concentrated usage of energy to
Distributed usage of energy”

A case for environment...

.....rush hour pictures.....

1. Majestic railway station
2. MGRoad
3. Shivajinagar bus station

A case for environment...

- ◆ Green house effects
- ◆ Climate change
- ◆ Depletion of stratospheric ozone layer

Green house effect

- ◆ Green house gases – carbon dioxide, nitrous oxide, methane, chloro fluoro carbons.
- ◆ Green house gases are the temperature stabilisers of the earth's atmosphere.
- ◆ Temperature stabilisation is by trapping radiated heat from the earth's surface by these green house gases.

Global warming

- ◆ Due to emissions from the fossil fuel based systems, the green house gases in the atmosphere increases.
- ◆ As a result, the average temperature of the earth is becoming higher.

Effects of Global warming

- ◆ changes in rainfall patterns
- ◆ rise in sea level
- ◆ impacts on flora and fauna
- ◆ impacts on human health

Health is an issue!

- ◆ CO poisoning.
- ◆ Asthma.
- ◆ Skin diseases and cancer due to depletion of stratospheric ozone.

Cost in the long run...

- ◆ Life cycle costing gives more realistic estimates.
- ◆ This gives a much better correlation of cost to energy used.

What are the alternatives?

- ◆ Nuclear fuel – is it viable?
- ◆ What are its implications?
- ◆ Then what?

Non-conventional fuel base

- ◆ Muscular
- ◆ Solar thermal
- ◆ Solar PV
- ◆ Wind
- ◆ Hydro
- ◆ Biomass
- ◆ Wave
- ◆ Hybrids

Scope for alternative energies...

- 75% of energy comes from fossil fuels such as crude oils, coal and natural gas
- 12% from bio fuels such as methane
- 9% from hydro based
- 3% from nuclear
- 1% from windmills and photovoltaic put together

→ ↑ Scope to increase