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} m^3 of fossil fuel.
- take the average energy density of fossil fuel to be about 10000Wh/lt or 10000 KWh/m^3

  (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 enviroment...

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

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

A case for enviroment...

- 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?

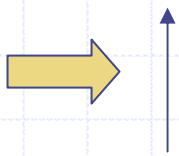
- Nuclear fuel – is it viable?
- What are its implications?
- Then what?

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