

USE OF NON-CONVENTIONAL ENERGY FOR SUSTAINABILITY TO FOSSIL FUEL

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ABSTRACT:

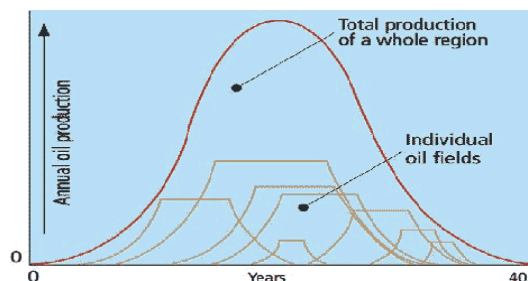
As civilization is growing, transport has become an essential part of life and technology has generally led to a greater use of hydrocarbon fuels and thereby generating high rate of emissions & making civilization vulnerable due to decrease in supply. The recent study made in the year 2004, predicts that if the oil is consumed at the current rates, then by 2020, we will be consuming 80% of the entire available resource and oil wells are going to dry within 30-40 years. The greater use of hydrocarbon is also causing severe pollution hazards affecting lives of mankind, creating worldwide environmental & ecological imbalances and raising Global heating due to reduction in ozone layer.

This necessitates the search for alternative to hydrocarbon oil as energy source as well as preserving it by tapping some other alternatives such as Non-conventional energy like photovoltaic cells, wind mills, hydrogen cells etc. and Renewable energy such as Bio-Diesel, Bio-mass etc, which may alternatively preserve oil source. Lot more researches have started to make sustainability to fossil fuel in recent years. Our President of India *Dr. APJ Kalam*^[1,0] has also dreamed and invited our researchers, inventors & industrialists to make India as Energy Independent by 2030 and developed country by 2020. This paper covers the use of Non- Conventional Energy sources to maintain the Sustainability to fossil fuel.

1.0 INTRODUCTION:

As per worldwide recent study, about 80 % of fossil fuel is being consumed in transport (e.g., Cars, Buses, Trucks, Trains, Power houses, Room heating devices etc.). It was predicted in 1956, by an US based Chief Consultant and Oil geologist **Marion King Hubbert**^[1,0] that if oil is consumed with high rate, US Oil production may peak in 1970 and thereafter decline. He also predicted that other countries may attain Peak Oil day within 20-30 Years and many more may suffer with oil crises within 40 years, when Oil wells are going to dry. He illustrated the projection with a bell shaped "Hubbert Curve" based on the availability & its consumptions of the fossil. Large fields are discovered first, small ones later, after exploration and initial growth in output, production plateaus and eventually declines to zero.

India's vehicular pollution is estimated to have increased eight times over the last two decades. This source alone is estimated to contribute about 70 per cent to the total air pollution.



With 243.3 million tons of carbon released from the consumption and combustion of fossil fuels in 1999, India is ranked fifth in the world behind the U.S., China, Russia and Japan. India's contribution to world carbon emissions is expected to increase in the coming years due to the rapid pace of urbanisation, shift from non-commercial to commercial fuels, increased vehicular usage and continued use of older and more inefficient coal-fired power-plants fuel.

Thus, peak oil is turning point for mankind and the 100 year of easy growth may end, if self-sufficiently & sustainability of energy is not maintained on priority. It may end up a better world^[1,0]. The study is going to cover Non-

Conventional Energy source to maintain sustainability

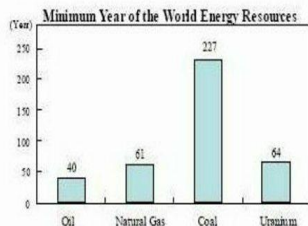
2.0 WHAT IS SUSTAINABILITY TO FOSSIL FUEL?

Sustainability is the extent to which the positive effects are likely to last after the intervention has terminated. In general *“Sustainability is meeting the needs of current and future generations through simultaneous environmental, social and economic improvement.”* [14.0]

The “Sustainability to fossil fuel” is nothing but to preserve the oil & make brighter future of mankind by adding alternative energy sources such as “Non-Conventional and or Renewable Energy” which is going to overcome current problem Now worldwide researchers, inventors are paying full attention towards this issue.

2.1 AVAILABILITY OF WORLD ENERGY RESOURCE [12.0]

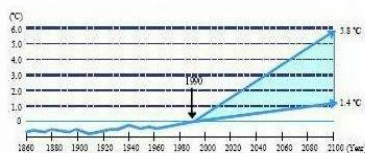
(1) Limits to Growth



Source: BP Statistical Review 2011
OPEC/IEA/IEA - TRANSFORMING 2009 Reserves, Production and Demand

2.2 INFLUENCE OF FOSSIL FUEL ON ENVIRONMENT & ECOLOGY [12.0]

(2) Global Warming Forecast



Source: Japan Environment Association, IEA, BP, Shell, "Coping with Global Warming: Intergovernmental Panel on Climate Change, IPCC, Third Assessment Report 2001"

2.1 Sustainability and Renewable Energy for fossil fuel:

From above it is evident that there are two distinct reasons to go for Sustainability and make alternative for fossil fuel: -

Greater use of Fossil fuel

2.1.0 Causing depletion of Oil resources

2.2.0 High rate of Emission

2.1.0 Depletion of Fossil fuel:

It is known fact that about 100 years ago our researches had gone towards hydrocarbon energy (i.e. petroleum product) as main energy source and now causing civilization vulnerable by its depletion in supply.

Why alternative to fossil fuel is sought? [3.0]

2.1.1. "We do not inherit the Earth from our parents; we borrow it from our children." Saint Exupery

2.1.2. When the wells run dry, we use more oil than we find, and if producers are fixing their figures the end could be closer than thought, by Adam Porter, The Guardian [2005 May 25]

"Predicting the end of the age of oil can be a sticky business. The Association for the Study of Peak Oil and Gas (Aspo), a collection of industry figures, politicians and academics, this week held its annual meeting at the Gulbenkian Museum in Lisbon..."

2.1.3. Expert says Saudi oil may have peaked, by Adam Porter [2005 February 22] : "As oil prices remain above \$45 a barrel, a major market mover has cast a worrying future prediction. Energy investment banker Matthew Simmons, of Simmons & Co International, has been outspoken in his warnings about peak oil before. His new statement is his strongest yet, 'we may have already passed peak oil.'"

2.1.4. Chinese demand set to push Opec to limit, by Javier Blas and Kevin Morrison in London [2005 February 16] "The Organisation of Petroleum Exporting Countries signaled a significant tightening of oil markets towards the end of this year, warning on Wednesday it would have to pump close to its maximum capacity next winter to meet rising demand from China against the backdrop of slowing Russian production."

2.1.5. New Oil Projects Cannot Meet World Needs This Decade, by Oil Depletion Analysis Centre [2004 November 16] "World oil supplies are all but certain to remain tight through the rest of this decade, unless there is a precipitous drop in demand, according to the results of a study by the London-based Oil Depletion Analysis Centre (ODAC). "The study found that all of the major new oil-recovery projects scheduled to come on stream over the next six years are unlikely to boost supplies enough to meet the world's growing needs."

2.1.6. Over a Barrel, by Paul Roberts in Mother Jones [2004 November]: "Experts say we're about to run out of oil. But we're nowhere near having another technology ready to take its place." Sir Charles Galton Darwin, 1952

We are consuming oil at an incredible pace. Sooner or later we will run out. It is really only a question of when. The answer is that it will be sooner than the authorities would like us to believe. And they know it! Just consider the following.

"...by 2010 we will need on the order of an additional fifty million barrels a day. So where is the oil going to come from?" - Vice President Dick Cheney in a speech at the London Institute of Petroleum Autumn lunch in 1999 (when he was chairman of Halliburton).

2.2.0 Influence of fossil fuel on environment and ecology:^[2.0]

It is observed that with increasing pace of civilization, uses of transport have become essential part of life and increasing in geometrical progression. This is leading to very hazardous condition due to high rate of pollution.

2.2.1 Automobile Emission: Emissions from an individual car are generally low, relative to the smokestack image many people associate with air pollution. But in numerous cities across the country, the personal automobile is the single greatest polluter, as emissions from millions of vehicles on the road add up. Driving a private car is probably a typical citizen's most "polluting" daily activity. Gasoline and diesel fuels are mixtures of hydrocarbons, compounds that contain hydrogen and carbon atoms. In a "perfect" engine, oxygen in the air would convert all the hydrogen in the fuel to water and all the carbon in the fuel to carbon dioxide. Nitrogen in the air would remain unaffected. In reality, the combustion process cannot be "perfect," and

automotive engines emit several types of pollutions.

2.2.2 Automobiles & Ozone: Ozone in the upper atmosphere (the "ozone layer") occurs naturally and protects life on earth by filtering out ultraviolet radiation from the sun. But Ozone at ground level is a noxious pollutant. Ozone is not emitted directly but is formed in the atmosphere through a complex set of chemical reactions involving hydrocarbons, oxides of nitrogen, and sunlight. The rate at which the reactions proceed is related to both temperature and intensity of the sunlight. Because of this, problematic ozone levels occur most frequently on hot summer afternoons. Hydrocarbons and nitrogen oxides come from a great variety of industrial and combustion processes. In typical urban areas, at least half of those pollutants come from cars, buses, trucks, and off-highway mobile sources such as construction vehicles and boats.

2.2.3 Automobiles and Carbon Monoxide: Carbon monoxide (CO) is a colorless, odorless, poisonous gas. A product of incomplete burning of hydrocarbon-based fuels, carbon monoxide consists of a carbon atom and an oxygen atom linked together. Carbon Monoxide creates Public Health Problem & enters the bloodstream through the lungs and forms carboxyhemoglobin, a compound that inhibits the blood's capacity to carry oxygen to organs and tissues. Carbon monoxide results from incomplete combustion of fuel and is emitted directly from vehicle tailpipes. Incomplete combustion is most likely to occur at low air-to-fuel ratios in the engine

2.2.4 Auto Emission Control Act: Air pollution and cars were first linked in the early 1950's by a California researcher who determined that traffic was to blame for the smoggy skies over Los Angeles. At the time, typical new cars were emitting nearly **13 grams per mile hydrocarbons (HC), 3.6 grams per mile nitrogen oxides (NOx), and 87 grams per mile carbon monoxide (CO)**. Since then, the Federal Government in 1995 has set standards to bring down levels of these pollutants, and the auto industry has responded by developing new emission control technologies. The current Federal certification standards for exhaust emissions from cars are **0.25 gram per mile HC, 0.4 gram per mile NOx, and 3.4 grams per mile CO**. The standard for evaporative HC emissions is 2 grams per test.

2.2.5 Wasteful Uses of Fossil fuel: It is essential to reduce carbon emissivity due to higher rate of utilization of transport and to increase thermodynamic efficiency of energy usage. For this, the ecological tax reform should be advanced, harmonized internationally step by step, and be a part of the WTO treaty.

Energy prices should be sufficiently high to punish wasteful behavior while honoring efficient energy use across the board, and especially in the road transport sector.

3.0 NON-CONVENTIONAL ENERGY SOURCE:

Many research works are being carried out to find the alternative to fossil fuel. Apart from the non-conventional energy such as Photocell battery operated vehicles, hydrogen cell, windmill operated power-generating device and its storage capacitors, Compressed air operated vehicle, Bio diesel and Di-methyl Ether are also being used as an alternative to fossil fuel.

3.1 Use of Wind Energy:

Windmills are being used very effectively for irrigation as well as power generation, where high velocity air is running in atmosphere, due to geological conditions.



Wind power is the kinetic energy of wind, or the extraction of this energy by wind turbines. In 2004, wind power became the least expensive form of new power generation, dipping below the cost per kilowatt-hour of coal-fired plants. Wind power is growing faster than any other form of electrical generation, at about 37%, up from 25% growth in 2002. In the late-1990s, the cost of wind power was about five times what it is in 2005, and that downward trend is expected to continue as larger multi-megawatt turbines are mass-produced.^[11.0]

3.2 Bio-Diesel: Biodiesel is a renewable fuel obtained from vegetable oils, animal fats, and recycled cooking oils. Biodiesel offers many^[4.0] advantages:



- It is renewable.
- It is energy efficient.
- It displaces petroleum derived diesel fuel.
- It can be used in most diesel equipment with no or only minor modifications.
- It can reduce global warming gas emissions.
- It can reduce tailpipe emissions, including air toxics.
- It is nontoxic, biodegradable, and suitable for sensitive environments.
- It is made in the United States from either agricultural or recycled resources.
- It can be easy to use if you follow these guidelines.

Biodiesel can be used in several different ways such as use 1% to 2% Biodiesel as a lubricity additive, which could be especially important for ultra low sulfur diesel fuels (ULSD, less than 15 ppm sulfur), which may have poor lubricating properties. It can blend 20% Biodiesel with 80% diesel fuel (B20) for use in most applications that use diesel fuel. It can even use it in its pure form (B100) with take proper precautions. The word Biodiesel in this report refers to the pure fuel—B100—that meets the specific Biodiesel definition and standards approved by ASTM International. A number following the “B” indicates the percentage of Biodiesel in a gallon of fuel, where the remainder of the gallon can be No. 1 or No. 2 diesel, kerosene, jet A, JP8, heating oil, or any other distillate fuel. The use of Bio diesel are tested for various parameters and blending of Bio Diesel up to 18-20 % is found most efficient for the running of the vehicle and also pollution limits due to hydrocarbon (HC), Carbon-mono oxide (CO) and nitrogen (NOx)

are found well within the emission limits prescribed by EPA in 1995.^[4.0]

3.3 Dimethyl Ether: Demonstration on Dimethyl Ether while carried out it was found that CO emission is lower than Propane and n-butane over a broad range. No production from DME is less than or similar to Propane & n-butane. DME burns with a non-luminous flame & flame is much compact. It is also noticed that oxygen blending 4 % wt in the fuel blend and it is observed that the emissions can be reduced by as much as 28 % when compared with premium diesel.

3.4 Hydrogen Cell Vehicle: Hydrogen gas does not occur naturally in the Earth's atmosphere and the gas must be artificially produced. Currently hydrogen used in the manufacture of ammonia is produced by reacting steam with methane. Hydrogen may also be extracted from fossil fuels by using fuel 'reformers'. Both these processes produce pollutants. They cannot be used to generate the gas for storing electrical energy. Therefore the most practical method of generating hydrogen is the electrolysis of water. This process is about 65% efficient and because of this hydrogen will always be more expensive than the energy used to produce it.

One of the main problems of using hydrogen in vehicles is storing the gas. Hydrogen is highly flammable and this raises many safety issues. However, hydrogen is less hazardous than petrol as the gas dissipates quickly and will not cause prolonged fires.

The simplest method of storing hydrogen gas is by compressing the gas and storing it in cylinders. However, cylinders are bulky and make transporting the gas costly.

Hydrogen can be bound to solid metals, and because the process is reversible, it can be used to store the gas. Certain metals absorb hydrogen and can be used to transport it. Unfortunately, the mass of hydrogen stored is very small compared to the mass of the metal. As the **metals used are expensive this method is also very costly.**

The recent development in Hydrogen cell car was done by USA based inventor who has demonstrated the car.

"E.J. Honton" an US based inventor in April 2004 presented the Hydrogen Fuel Cell Car at 15th Annual US Conference & Hydrogen Expo, USA and projected the scope of its market in different country.^[9.0]

3.5 Photovoltaic Cell: Non-conventional energy is the source available in nature and do not effect imbalance in atmospheric ecology. Worldwide uses are being made for electric photocell to generate electric power and power so generated are utilized to be stored in batteries, which finally gives power to use for light, run small electric motors and in US photo Cell car has also been developed to run on roads emission free. A research works are also going on to make cluster of photocell operated device to generate power, which can be utilized in many ways.



Solar Cell Spectral Response Setup

Solar PV, or photovoltaic -- panels on roofs -- are what most people think of when they think of solar power. The largest PV array in the world, located in Germany, produces 10 megawatts of electricity. But Nevada Solar One will produce 64 megawatts -- enough to power 40,000 homes in the Las Vegas area during the hottest part of the day.

3.6 Solar Thermal Power Generation:

When the price of oil is high, talk turns to alternative forms of energy, including wind, biofuels and solar. One kind of solar energy isn't getting much publicity. But solar thermal power is quietly becoming a significant source of electricity in the Southwest. In the desert south of Las Vegas, crews working on a project called Nevada Solar One are assembling a parabolic trough of curved mirrors connected in a huge array.



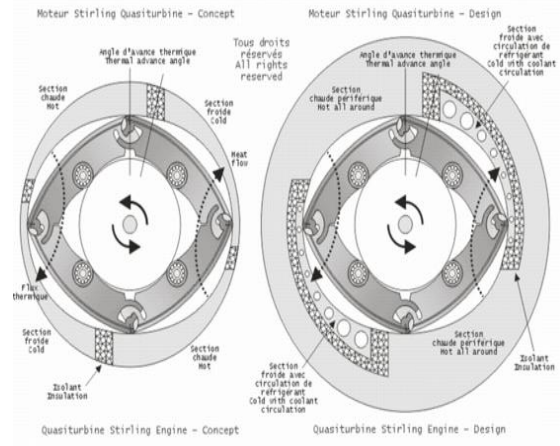
At the center, a closed-loop tube will be filled with oil that will be heated by the sun. The hot oil will flow around the 400-acre project and into a building where it will turn water into steam. It, in turn, will turn a steam turbine, which will make electricity.

3.7 Compressed Air:

Sterling air engine was developed in 1790-1810, but due to its limitation much work was not carried out. Keeping in view of fire problems in Coalmines and other volatile places where high flammable fuel like fossil fuel vehicles are not advisable, compressed air engine operated vehicle are normally started to use. Thus in 1979 to 1998 much work was not carried out, with limitation.

3.7.1 Rotary Hot air Motor (Quasiturbine):

How it Works: The Quasiturbine engine, the four strokes of a typical cycle de Beau de Rochas (Otto) cycle is arranged sequentially around a near oval, unlike the reciprocating motion of a piston engine. In the basic single rotor Quasiturbine engine, an oval housing surrounds a four-sided articulated rotor, which turns and moves within the housing. The sides of the rotor seal against the sides of the housing, and the corners of rotor seal against the inner periphery, dividing it into four chambers.



Korean inventor “Beau de Rocha” (Otto) developed zero pollution cars using Quasiturbine with a set of 14- engines parameters and disclosed on Sept’2005 using gasoline. [8.0]

3.7.2 Other Developments in Compressed Air Engine:

“Guy Negre”, a French Scientist, in 1998 developed compressed air- 4- cylinders engine run on air and gasoline, claims zero pollution cars and got 52- patents registered since 1998 to 2004. The car was demonstrated in Oct.’2004 publically. [7.0]

4.0 INDIAN SCENARIO OF NON CONVENTIONAL ENERGY:

4.1 Solar Power Station: A 50 KW prototype level solar thermal power plant, utilising parabolic trough collectors is being maintained as an educational, R&D and training facility. [10.0]

- Indigenisation & standardization of various components used for solar thermal power generation.
- Field assessment of various solar thermal power generation technologies in Indian context.

4.2 Biodiesel: India has 60 Million hectares un-utilized land and if 50 % of land is used for Jatropha cultivation, major problem will be over. We may get production of 60 Million Tonnes of Biodiesel. [6.0]

4.3 Total Indian Non-Conventional Energy Plan:

[Ministry of Non- Conventional Energy Sources (MNES)] ^[13.0]

Statement of Outlays and Outcomes / Targets: Annual Plan 2005-06

Sl. No.	Name of the Scheme/ Programme	Objective / Outcome	Outlay 2005-06	Target 2005-06 (MW)	Deliverables (MW / Rs.1 cr.)	Processes / Timelines	Remarks / Risk Factors
1	Power from Renewables	Setting up of grid interactive renewable power			For every Rs.1 crore of MNES subsidy the capacity in MW of grid interactive renewable electricity to be Installed.		
2	Wind power	To promote commercial wind power projects	5.00	450.00	90.00	By March 2006	
3	Small Hydro (upto 25 MW)	Setting of SHP projects	50.00	130.00	2.60	By March 2006	
4	Biomass Power / Cogeneration	Setting up of grid interactive renewable power in sugar mills and other industries	16.00	160.00	10.00	By March 2006	

(Rs.in crores)

5.0 CONCLUSIONS:

In view of fast depleting fossil fuel reserves and growing energy requirements, it has become inevitable to look into for alternative sources of energy. Biodiesel, Solar Energy, Wind Energy, Photovoltaic Cell, has immense potential for being used as an alternative to fossil fuel. Following conclusion drawn from present study:-

5.1 Peak oil is turning point for mankind and the 100 year of easy growth may end, if self-sufficiently & sustainability of energy is not maintained on priority.

5.2 India has 60 Million hectares un-utilized land and if 50 % of land is used for Jatropha cultivation, major problem will be over. We may

get production of 60 Million Tonnes of Biodiesel. But it must commensurate with farming for food grain to feed rising population of India in 30 Years, which may likely to reach 110 to 140 Crores. *Constraint: Use of Pure Biodiesel as Vehicle fuel is not possible.*

5.3 Future technological developments are aggressively being done to develop Photo voltaic electric powered, hybrid powered, fuel cell operated, compressed air engines and Biodiesel renewable energy for automobile vehicles.

5.4 Solar Energy Power Stations, Wind Power Stations and Nuclear Power Stations will also become future Power generation source in big way.

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