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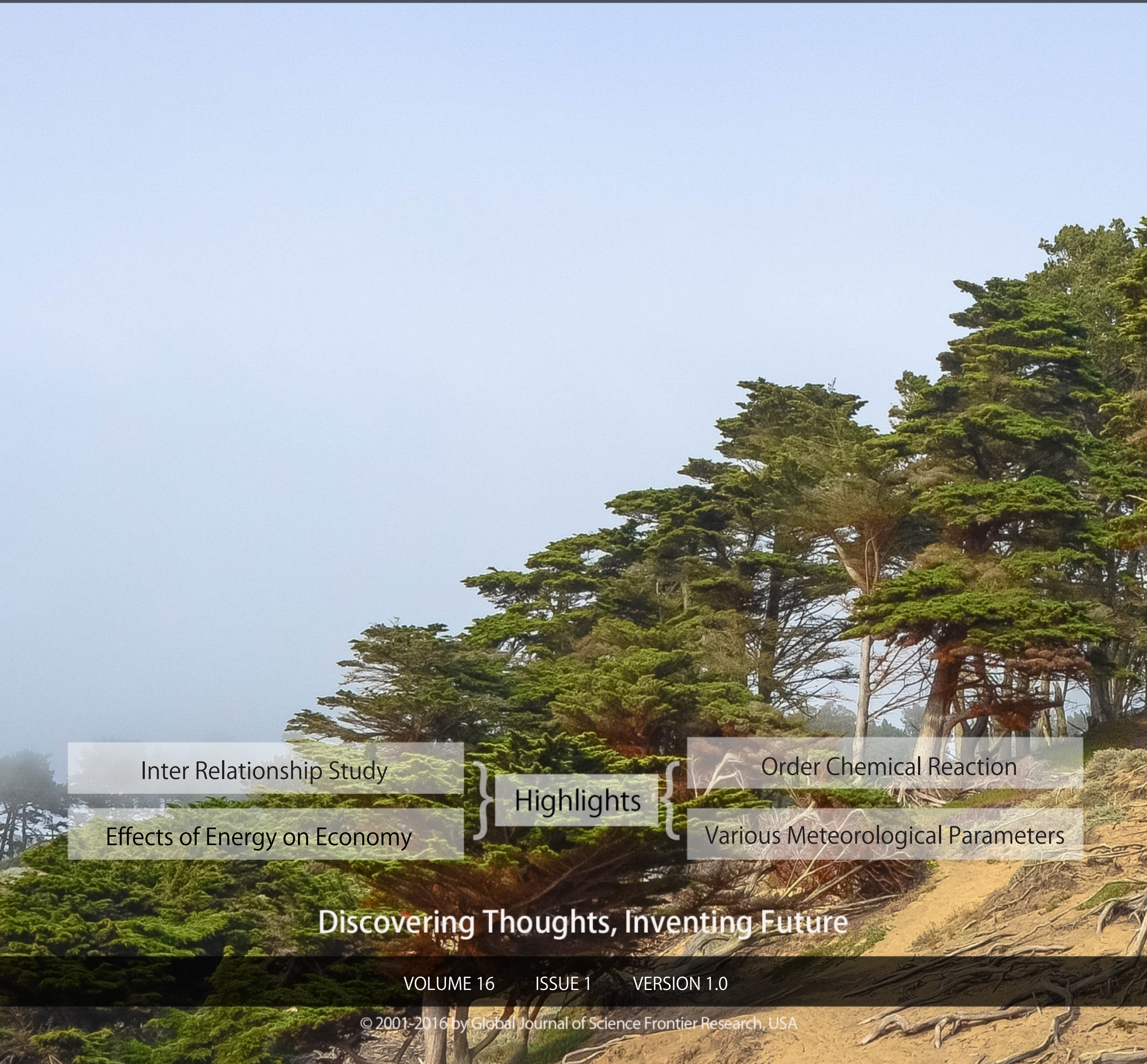

Inter Relationship Study

Effects of Energy on Economy

Highlights

Order Chemical Reaction

Various Meteorological Parameters

Discovering Thoughts, Inventing Future

VOLUME 16 ISSUE 1 VERSION 1.0

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Effects of Energy on Economy, Health and Environment

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Abstract- Life is but a continuous process of energy conversion, transformation and use. The quantity of energy, forms and the sources used for conversion from one form to other are closely linked with economy and quality of life. But the energy conversion, transformation and use always produce effects on the surrounding environment. Some of these effects are detrimental to human health and the environment. Environmental pollution, particularly global warming is the talk of the day. Burning of fossil fuels produce smokes (COx, NOx, SOx and undesirable particulates) or flue gas, ash and other wastes. The wastes, flue gas, particulates and radiation produced in the energy system, cause health hazards. The SOx and the NOx are responsible for acid rain.

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EFFECTSOFENERGYONECONOMYHEALTHANDENVIRONMENT

Strictly as per the compliance and regulations of :

Effects of Energy on Economy, Health and Environment

Md. Nasir Uddin [α], MM Rashid [σ], MG Mostafa [ρ], Belayet H [Ѡ], SM Salam [¥], NA Nithe [§] & MW Rahman [χ]

Abstract- Life is but a continuous process of energy conversion, transformation and use. The quantity of energy, forms and the sources used for conversion from one form to other are closely linked with economy and quality of life. But the energy conversion, transformation and use always produce effects on the surrounding environment. Some of these effects are detrimental to human health and the environment. Environmental pollution, particularly global warming is the talk of the day. Burning of fossil fuels produce smokes (COx, NOx, SOx and undesirable particulates) or flue gas, ash and other wastes. The wastes, flue gas, particulates and radiation produced in the energy system, cause health hazards. The SOx and the NOx are responsible for acid rain.

The energy mix and the consumption rate should be planned and executed in commensurate with sustainable development. The energy chain accordingly is required to be managed in a way so that the health hazards remain with in acceptable limits and that the ecological balance is not unduly disturbed to the extent that our posterity is put to too much risk.

Comprehensive environmental assessment of all large energy related industries are essential before the start of the project to limit the emissions within acceptable limits. The findings of the assessment report have to be reassessed during and routinely after the commissioning of the industry. Appropriate law to this end has to be enacted and effectively enforced. The paper tries to focus on energy related economy, health and environmental issues and discuss possible remedies.

I. Introduction

Economic opportunities, among other things, depend on the availability of different forms of energy at an affordable price. Economic development of a country is closely linked with energy. Most of the global energy these days is produced out of fossil fuels: coal, oil and gas. Burning of the sources produce greenhouse gas, NOx and SOx and particulates. The green house gas cause global warming. NOx and SOx produce acid rains. Particulates cause health hazards. Nuclear power produces ionizing radiation and radioactive wastes. These are harmful for human health. The exploration and processing of the primary energy sources also cause health hazards and affects ecosystem.

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Hydro power plant submerges large areas causing dislocation of people and communities. It also either destroys or threatens existence of many rare bio-species. Other renewable energy sources like wind, solar photovoltaic, tide, geothermal, hydrogen fuels etc are yet to be cost effective for large-scale applications. These sources also cause adverse effects of different degrees and nature.

The global environment and ecosystem has changed (in some case irreversibly) and is changing due to human actions [1]. The rate of change is increasing. World community is now becoming more and more conscious on the issue of sustainable development so that the posterity is not put to too much risk. The risk benefit analyses of the different energy sources are essential to determine optimum future energy development strategy for attaining sustainable development.

Wide economic disparities exist among nations and communities. Attentions are also required to address the energy accessibility and affordability issues of the about 2 billion poor and deprived people of the earth.

Concerted wisdom and ethics based efforts of all parties at stakes including states, UN Agencies, scientists, engineers, civil societies, media will be required to achieve sustainable development without putting human health and environment to unacceptable risk.

II. Energy and Economy

Economy is related to demand and supply dynamics of the unending and unlimited quantities and types of human centered goods and services. The dynamics of economy depend on many factors. The status of economy is measured by Gross Domestic/National Product (GDP/GNP) in terms of money, usually USA dollar ($) or currency of the state under consideration. Money is again defined as the purchasing power for the goods and services. The concept of dollar on purchasing power parity (PPP) basis is now also used for comparison of economic status among states. The United Nations Development Programme (UNDP) uses PPP criterion for economic status in determining Human Development Index (HDI).

Energy of different forms particularly electricity creates opportunities for human activities. The production of goods and services depends on the

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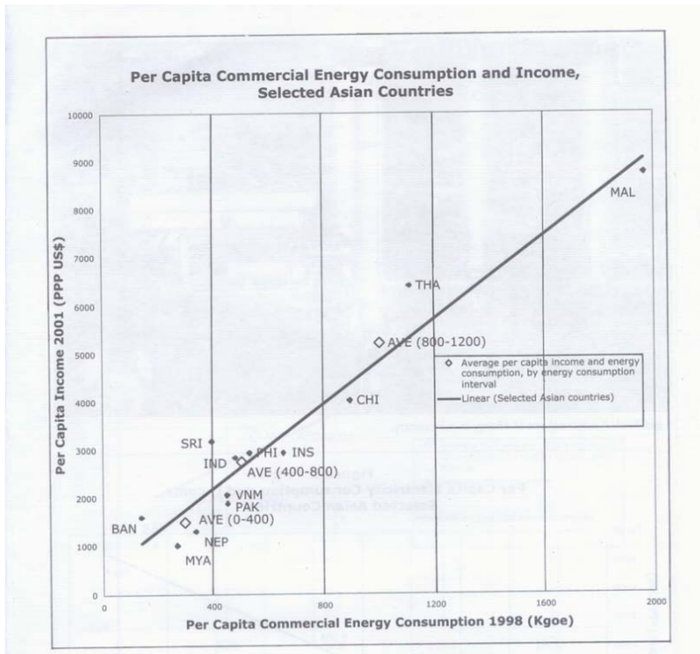
energy. The economic growth of a country, therefore, largely depends on the availability, accessibility and affordability of different forms of energy of sufficient quantity. The supply assurance of energy sources for a reasonable future period or energy security is also important for healthy and uninterrupted economic growth.

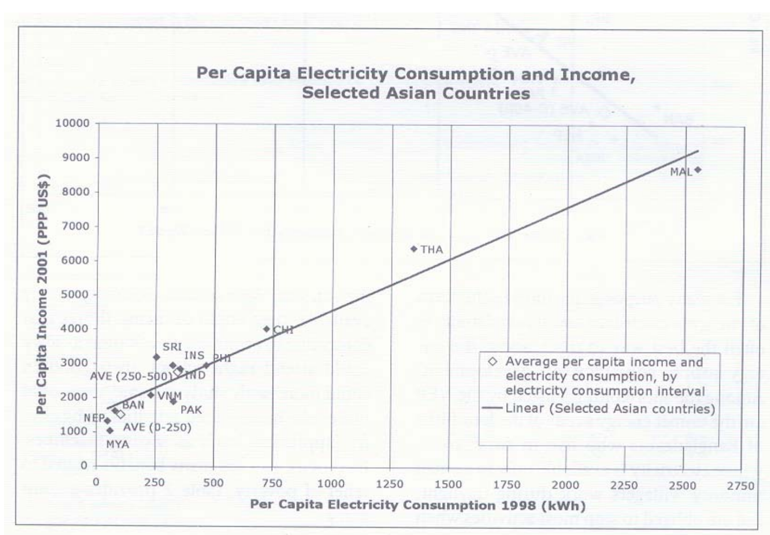
The economy or the energy consumption level reflects the quality of life of people of a country. The UNDP introduced the HDI method for comparison of quality of life status among the states of the world. The HDI was developed by Dr. Mahbubul Haque and Nobel laureate Prof. Amartya Sen. The higher the economy the better, in general, is the human development index (HDI). The HDI index is determined on a scale of 1 considering the economy, life expectancy and literary rate of the people of a country [2].

The **Fig.1** shows per capita commercial energy consumption and income, **Fig.2** shows per capita electricity and income; and **Fig.3** shows per capita commercial energy consumption and human development index of a number of selected Asian countries [3].



Source: [3]

Fig.1 : Per Capita Commercial Energy Consumption and Income of Selected Countries



Source: [3]

Fig.2 : Per Capita Electricity Consumption and Income of Selected Asian Countries

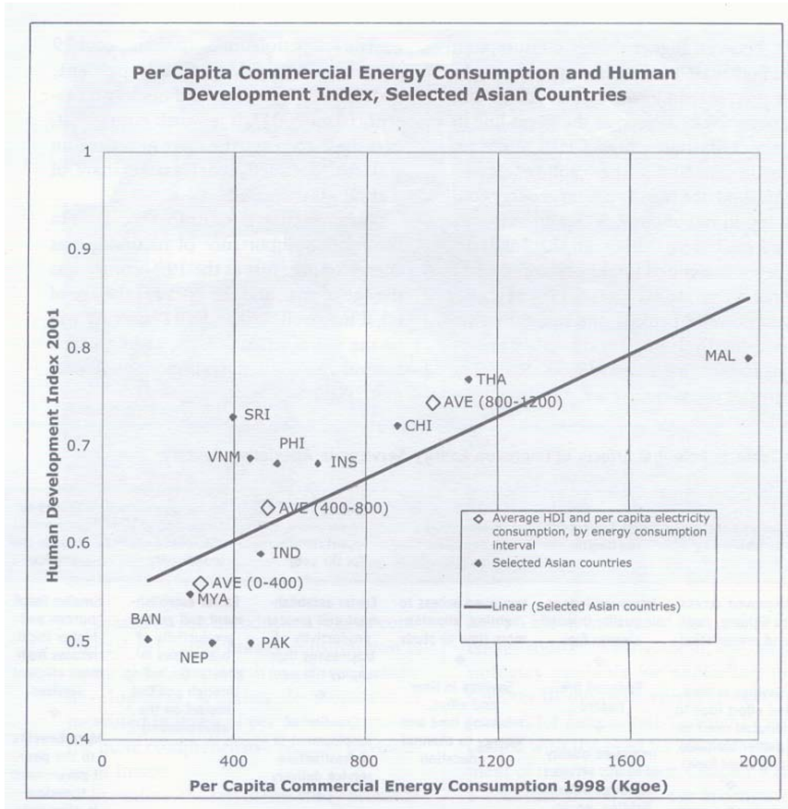


Fig. 3 : Per Capita Commercial Energy Consumption and Human Development Index of Selected Countries

The three figures presented above show the importance of energy for the economic development and improving quality life of the people of a country.

It is the responsibility of the national government and the policymakers to ensure smooth accessibility, availability and affordability of energy for the rapid economic development as well as for improving quality life of people of the country.

III. Energy and Pollution

Energy system includes all activities consisting of exploration, production, processing, transportation, conversion, distribution of the energy sources for different end uses: cooking, lighting, heating, cooling, motive power for transportation, communication etc.

Each step of the energy system needs activities of different types and magnitude. Undesirable wastes of different forms and quantities are also produced at different steps of different type of the sources.

The pollutant may be categorized into the following principal groups: *(a) greenhouse gases (COx) which cause global warming, (b) acid rain inducers (SOx, NOx), (c) particulates (d) toxic wastes and (e) radioactive wastes. Besides, thermal pollution and ionizing radiation are also produced particularly during the process of energy conversion.*

These wastes and the pollution need proper handling and effective management. Energy consumption is generally proportional to the level of economy of a country- so is the release of greenhouse. This may be seen at Table-1.

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Table 1 : Economic Status and Greenhouse Gas Release of Selected Countries & Regions

Sl / No	Country and Regions	HDI Ranking	Traditional Fuel Consumption (% of Total Energy Requirements)	Electricity consumption per capita (kilowatt-hours)		MDG GDP per Unit of Energy Use (2000 PPP US$ per kg of Oil Equivalent)		MDG Carbon Dioxide (CO_2) Emissions		
								Per Capita (metric tons)		Share of World Total (%)
	Years		2002	1980	2002	1980	2002	1980	2002	2000
1	Norway	1		22400	26640	4.6	6.1	10.6	12.2	0.2
2	United States	10	3.6	10,336	13,456	2.8	4.4	20	20.1	24.4
3	Japan	11	0.2	4,944	8,612	5.7	6.4	7.9	9.4	5.2
4	United Kingdom	15	0.5	5,022	6,614	4.5	6.6	10.5	9.2	2.5
5	France	16	4.7[d]	4,633[d]	8,123[d]	5.0	5.8	9.0	6.2	1.6[d]
6	Germany	20			6,989	3.9	6.2		9.8	3.4
7	Korea	28		1,051	7,058	4.2	3.9	3.3	9.4	1.9
8	Malaysia	61	1.5	740	3,234	4.6	4.1	2.0	6.3	0.6
9	Thailand	73	13.6	340	1,860	5.1	5.0	0.9	3.7	0.9
10	China	85	5.3	307	1,484	1.2	4.6	1.5	2.7	12.1
11	Sri Lanka	93	41.6	113	366	5.5	8.0	0.2	0.5	-
12	Maldives	96	0.0	25	448			0.3	3.4	-
13	Iran	99	0.1	570	2,075	4.9	3.1	3.0	5.3	1.4
14	Indonesia	110	17.6	94	463	3.9	4.1	0.6	1.4	1.2
15	India	127	20.0	173	569	3.3	5.0	0.5	1.2	4.7
16	Pakistan	135		176	469	3.5	4.3	0.4	0.7	0.5
17	Bangladesh	139	61.6	30	119	11.1	10.5	0.1	0.3	0.1
18	Developing Countries	NA	24.5	388	1,155	3.7	4.6	1.3	2.0	36.9
19	Least developed countries	NA	75.9	83	106		4.0	0.1	0.2	0.4
20	OECD	NA	4.1	5,761	8,615	3.9	5.1	11.0	11.2	51.0
21	High Income	NA	2.9	6,616	10,198	3.9	5.1	12.1	13.0	47.8
22	Middle Income	NA	9.2	623	1,653	3.7	4.1	2.1	2.9	38.9
23	Low Income	NA	42.2	174	399	2.3	2.0	0.5	0.8	7.3
24	World	NA	7.6[h]	1,573	2,465	3.8	4.6	3.4	3.6	100.0

Source: Human Development Report, UNDP, 2005

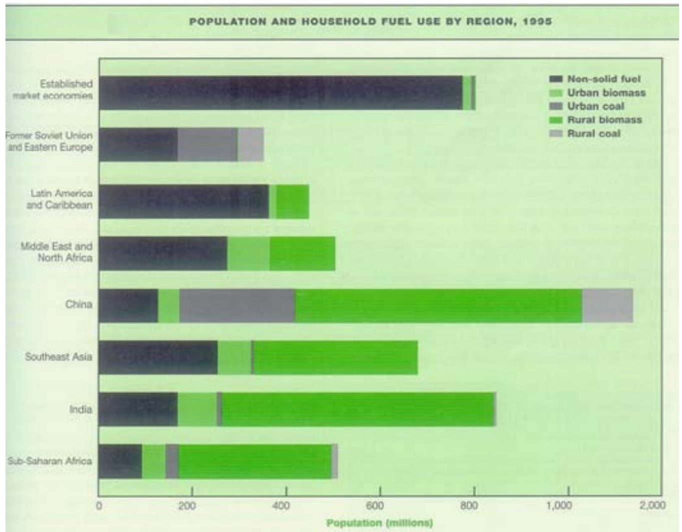
The energy systems affect surrounding environment and ecosystem. The harvesting of traditional fuels and exploration, processing till end uses of energy insult the natural environmental process. The affects include: major land use changes, due to fuel cycles such as coal, biomass and hydropower. “The activities disperse a wide variety of biologically and climatologically active elements and compounds into atmosphere, surface waters, and soil at rates far beyond the natural flows of these substances. The results include a 10 fold increase in the acidity of rain water…” [4].

The particulates and different type of toxic materials and chemicals are released in the atmosphere during mining and processing of the fuels. The chemicals and toxic materials *degrade* the ecosystem particularly water.

The efficiency of the power plants varies from 25 to 55% depending the type and size of the power plants. The remaining amount is released to the water system or environment causing *thermal pollution*.

The proportions of various pollutants released are shown in Table-2.

Table 2 : Proportions of Various Pollutants Released out of Household Fuels



Source: [4]

The energy system also produces particulates. The Fig.4 shows the global distribution of urban particulates.

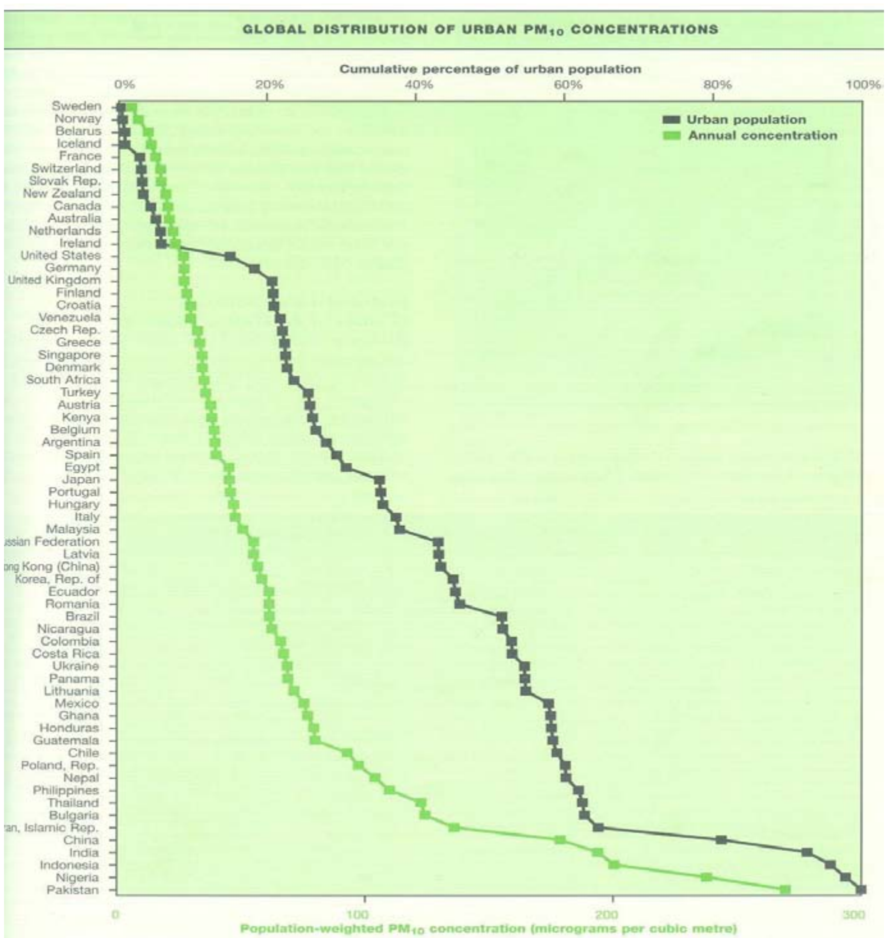


Fig. 4 : Global Distribution of Urban Particulates, Source: [4]

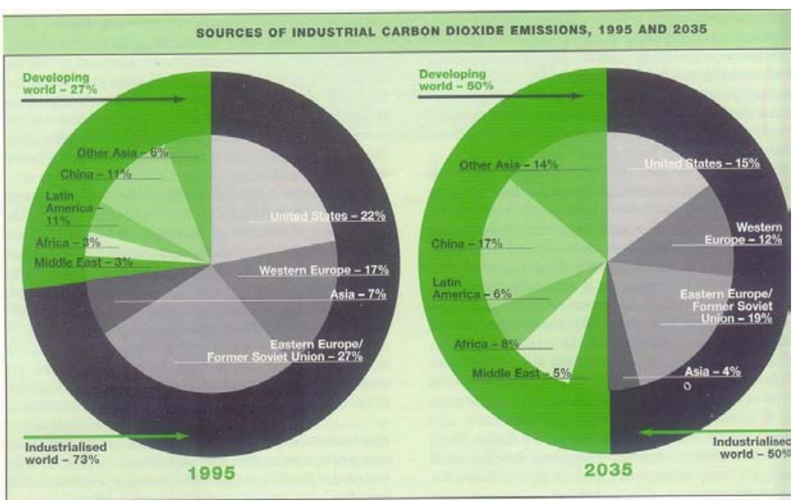
The ecological impacts of large dam associated with hydro plant are shown in Table-3.

Table 3 : Ecological Impacts of Large Hydro-Plant

ECOLOGICAL INSULTS AND IMPACTS OF LARGE DAMS			
Insult caused by dam	Impacts seen	Severity of impact	Example of impact
Changes in the chemical properties of release water	Deterioration of downstream ecosystem cased by inability to process the increased dissolved minerals	Depends on the sensitivity of the affected ecosystem (tropical ecosystems are especially sensitive)	Enhanced algae growth in the reservoir consumes the oxygen in the epilimnion and, as it decays, the mass sinks to the already oxygen-deficient hypolimnion, where decay processes reduce the oxygen concentration even further, resulting in acid conditions at lower levels and the dissolution of minerals from the reservoir bed.
Changes in the thermal properties of release water	Thermal pollution often results in species diversity reduction, species extinction, and productivity changes in the reservoir	Diversity, biomass, distribution, and density of fish stocks can be affected, disrupting breeding cycles	Productivity levels in the surface waters of new reservoirs often increase before long-term declines occur (Horne, 1994). China's Three Gorges Dam may be the final critical factor for driving to extinction the Yangtze River dolphin.
Changes in the flow rate and timing of release water	Erosion increases downstream of dam. Settling of sediments in the reservoir causes high sediment loads to be picked up in the area immediately below the dam	Erosion of natural riverbeds can disturb the nurseries and spawning of many aquatic organisms, disturbing their breeding cycles	Changes in the downstream river morphology and ecosystem productivity.
Changes in the sediment load of the river	High trap efficiencies of dams prevent the natural processes of sediments and associated nutrients refreshing downstream soils	Effects often noticed most severely in high-productivity areas downstream from the dam that no longer receive annual fertilisation	Before the Aswan High Dam was constructed, the Nile carried about 124 million tonnes of sediment to the sea each year, depositing nearly 10 million tonnes on the floodplain and the delta. Today 98 percent of the sediment remains behind the dam, resulting in a drop in soil productivity and depth, among other serious changes to Egypt's floodplain agriculture (Pottinger, 1997).
Changes in the dynamics of downstream riverbeds	Increased likelihood of lower water tables, which can create problems in areas near the dam where groundwater is a major source	Reduced access to potable water is a huge problem in many developing countries	Within nine years of the closure opening of the Hoover Dam, 110 million cubic metres of material had been washed away from the first 145 kilometres of riverbed below the dam (McCully, 1996).
Changes in the coastal area morphology	The loss of sediment in the rivers flowing through deltas and into the sea often results in a gradual process of delta and coastal degradation	Financially expensive for many areas where there is a large population living near the coastal zone.	Over the past 80 years dams have reduced by four-fifths the sediment reaching the coasts of southern California. This has reduced the beach cover at the base of cliffs along these shorelines, causing cliffs to collapse (Jenkins and others, 1988).

Source: [4]

The system produces very large quantity of CO_2 gas, which is main contributor of global warming. The **Fig.5**. shows the global generators or distribution of the emissions.



Source: [4]

Fig 5 : Global Generators or Distribution of the Emissions

IV. Energy and Health

No human action is absolutely risk free. Each action has certain elements of risks associated with it. The activities of energy system also cause health risks. As human knowledge is expanding and as the consumption rate of energy is also increasing the people are becoming more and more aware of the health risks associated with different forms of energy use.

The flue gas and the particulates released during the energy system cause health hazards.

About 50% of the global population particularly living rural areas use biomass or coal for cooking and heating in simple ovens or devices. The process cause large air pollution (in addition to CO_2): carbon monoxide, benzene, butadiene, formaldehyde and particulates-responsible for 4-5% of global burden of diseases [4].

The principal types of health hazards that are caused due to household use of biomass and coal are-

- Infectious respiratory diseases such as acute respiratory infections and tuberculosis.
- Chronic respiratory diseases such as chronic bronchitis and lung cancer

- Adverse pregnancy outcomes such as stillbirth and low birth weight in babies born to women exposed during pregnancy.
- Blindness, asthma, and heart disease.

The findings of national survey carried out in India [Annex-I] on burden of disease from household solid fuel use indicates that about 500,000 premature deaths occur in a year in women and children under 5. The death rates are unacceptable and as such the health risks shall have to be minimized to an acceptable level.

Accidents do take place in all the the energy systems. The Table –4 shows the fatalities rate due to severe accidents in electricity production cycle based on: coal, oil, gas, hydro and nuclear.

Table 4 : Normalized Fatality Rate for Severe Accidents (1969 – 1986)

Energy Option	No. of Events	Immediate Fatalities / Events	Total Immediate Fatalities	Energy Produced (TWa)	Immediate Fatalities/ Energy (Fat /Gwa)
Coal Mine disaster	62	10 – 434	3600	10	0.34
Oil Capsizing Refinery fire During transportation	6 15 42	6 – 123 5 – 145 5 – 500	N A 450 1620	21	 0.02 0.08
Natural gas fire/ explosion	24	6 - 452	1440	8.6	0.17
Hydropower	8	11 – 2500	3839	2.7	1.41
Nuclear	1	31	31	1.1	0.03

Source : After A. F. Fritzche, " The Health Risks of Energy Production" Risk Analysis 9, No. 4 (1989), Page 19, IAEA BULLETIN, 3/1991.

V. Energy and Environment

a) *Human Assault on Environment*

The concept of environment is complex. It may however be defined as, "The combination of external physical conditions that affect and influence the growth, development, and survival of organisms". Nature maintains a delicate balance of the environment and the constituting ecosystem.

Human actions as well as the natural causes e.g. volcanic eruptions, earthquakes, soil erosions, forest fire etc pollute the environment, particularly the biosphere which surrounds this 4.5 billion year old earth like a peel on an orange. About 10 million biospecies have been evolving in it for the last 6 to 7 million years. Human actions in the recent times caused alarming pollution and biodegradation. In a period of two decades between two world summit (held in Stockholm in 1972 and Rio in 1992) the earth has lost two hundred million hectors of forest land and 500 millions of top soil [6]. Besides thousands of biospecies simply vanished.

Acid rain, ozone layer depletion, global warming and climatic change, deterioration of air, water and soil quality is now issues of concern. Ozone layer depletion is a result of CFC and aerosol emissions. This is now more and less controlled. Global warming is linked with CO_2 emissions. This main global concern and the solution are yet to be foreseen or agreed. Acid rain is linked with SOx and NOx. This is also under control

The energy systems had caused irreversible degradation of the global environment and ecosystem. The United Nations sponsored Millennium Ecosystem Assessment (MA) Synthesis Report, conducted by 1,300 experts from 95 countries in March 2005 is a comprehensive study on environment. The UN spent $24 million for the study [7]. The report states that the ongoing degradation of ecosystem services is a roadblock to the Millennium Development Goals agreed to by the world leaders at the United Nations in 2000. "The highlights of the findings of the report are presented below: -

- Humans have changed ecosystems more rapidly and extensively in the last 50 years than in any other period. This was done largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel. More land was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850.[*] More than half of all the synthetic nitrogen fertilizers, first made in 1913, ever used on the planet have been used since 1985. Experts say that this resulted in a substantial and largely irreversible loss in diversity of life on Earth, with some 10 to 30 percent of the mammal, bird and amphibian species currently threatened with extinction.
- Ecosystem changes that have contributed substantial net gains in human well being and economic development have been achieved at growing costs in the form of degradation of other services. Only four ecosystem services have been enhanced in the last 50 years: increases in crop, livestock and aquaculture production, and increased carbon sequestration

for global climate regulation. Two services – capture fisheries and fresh water – are now well beyond levels that can sustain current, much less future, demands. Experts say that these problems will substantially diminish the benefits for future generations.

- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the UN Millennium Development Goals. In all the four plausible futures explored by the scientists, they project progress in eliminating hunger, but at far slower rates than needed to halve number of people suffering from hunger by 2015. Experts warn that changes in ecosystems such as deforestation influence the abundance of human pathogens such as malaria and cholera, as well as the risk of emergence of new diseases. Malaria, for example, accounts for 11 percent of the disease burden in Africa and had it been eliminated 35 years ago, the continent's gross domestic product would have increased by $100 billion.
- The challenge of reversing the degradation of ecosystems while meeting increasing demands can be met under some scenarios involving significant policy and institutional changes. However, these changes will be large and are not currently under way. The report mentions options that exist to conserve or enhance ecosystem services that reduce negative trade-offs or that will positively impact other services. Protection of natural forests, for example, not only conserves wildlife but also supplies fresh water and reduces carbon emissions"[1].

b) Global Warming

The global warming is causing climatic changes and melting of polar and other permanent icecaps. The "poor countries like Bangladesh will experience more flooding, declining food production, more disease and the deterioration or extinction of entire ecosystem or extinction of entire ecosystems upon which many of the world's poorest people depend"[8].

The status of the global warming and the future trend may be assessed from the Summary Report prepared by the UN sponsored Working Group-I of the Intergovernmental Panel on Climate Change has recently been prepared for the Policymakers. The principal conclusions of report are presented below: -

- The global average surface temperature has increased over the 20th century by about 0.6°C.
- Global average sea level has risen and ocean heat content has increased.
- Changes have also occurred in other important aspects of climate.
- Emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate.
- Concentrations of atmospheric greenhouse gases and their radiative forcing have continued to increase as a result of human activities.

The variations of earth's surface temperature as found in the summary report for the policy makers are shown in Fig.6. The Fig.7 indicates human influence on the atmosphere during the industrial era and Fig.8 shows the global climate of the 21st century under different scenarios [8]. The basis for the different scenarios are given in Annex-II. The summary report is provided in the CD.

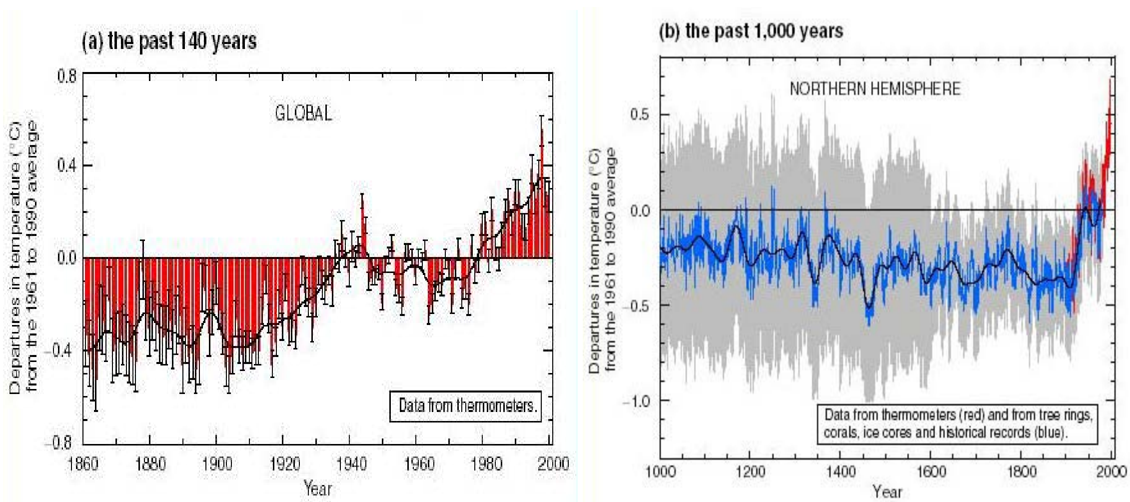


Fig 6 : Change in Earth Surface Temperature

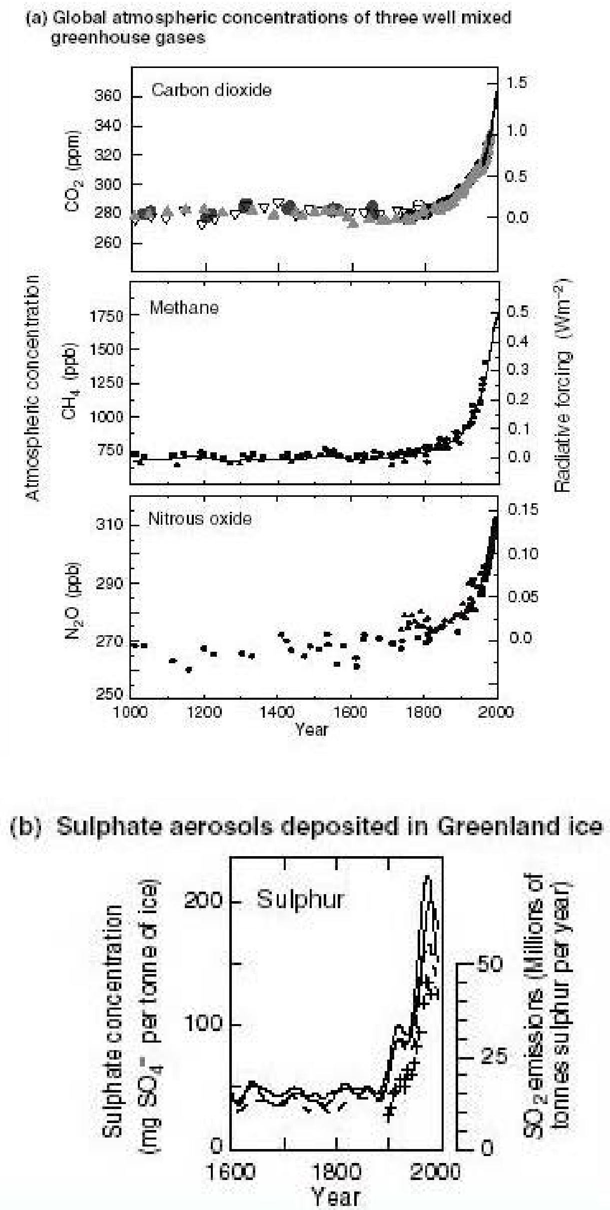


Fig 7 : Effects of Human Influence on the Atmosphere during the Industrial Era

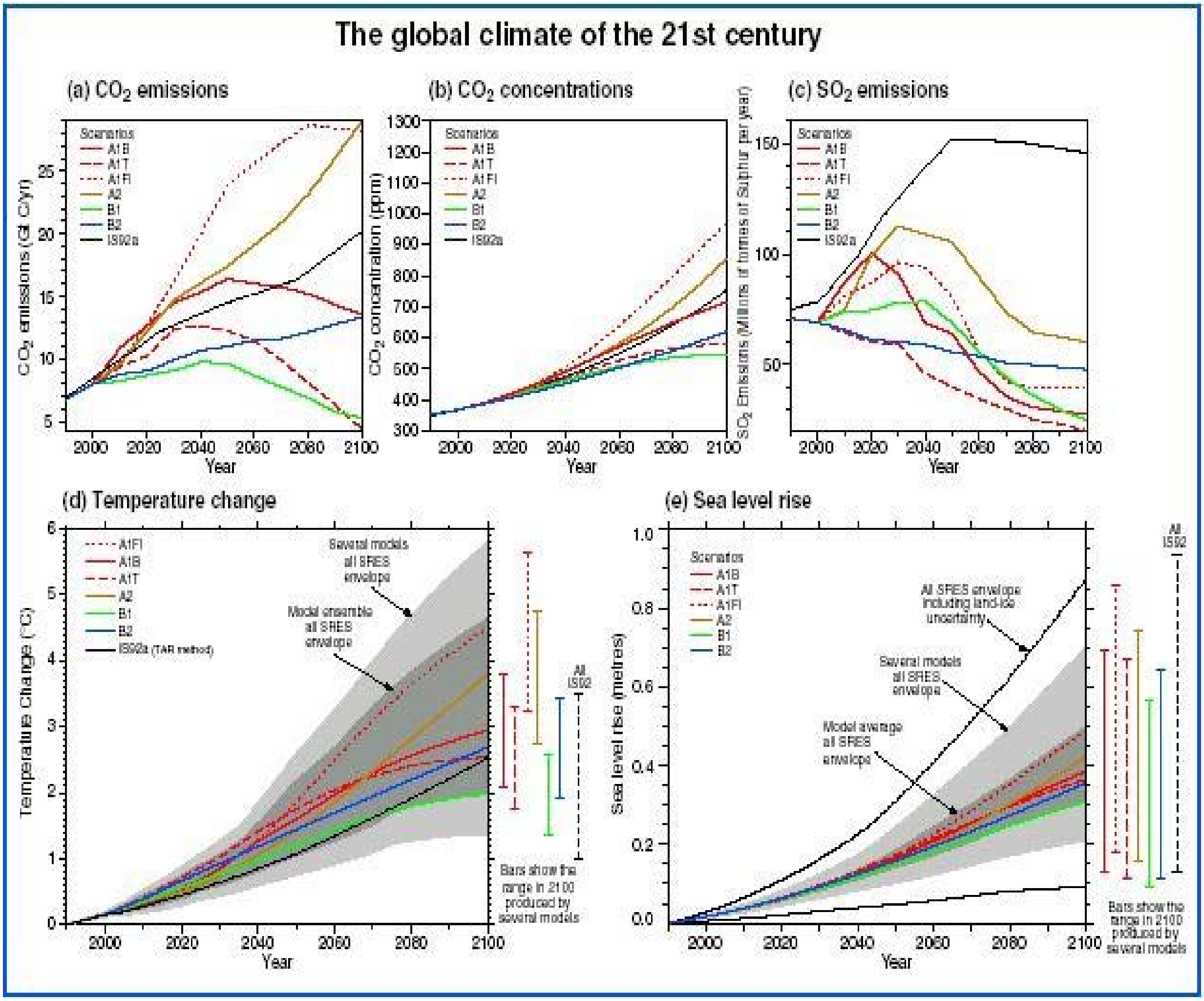


Fig 8 : World Climate Scenarios for the 21st Century

"Until recently, campanologists thought that it would take thousands of years of warming to melt the vast ice sheets of Greenland and Antarctica. Now many think they could collapse within centuries."[16].

The Fig.9 shows the range of total greenhouse gas emissions from electricity production chains [5]. The rate of growth of electricity is the highest among all forms of energy. The trend will remain in the coming years of the century. As such the findings of the Fig.9 must have to be considered seriously for effective control of the greenhouse gas.

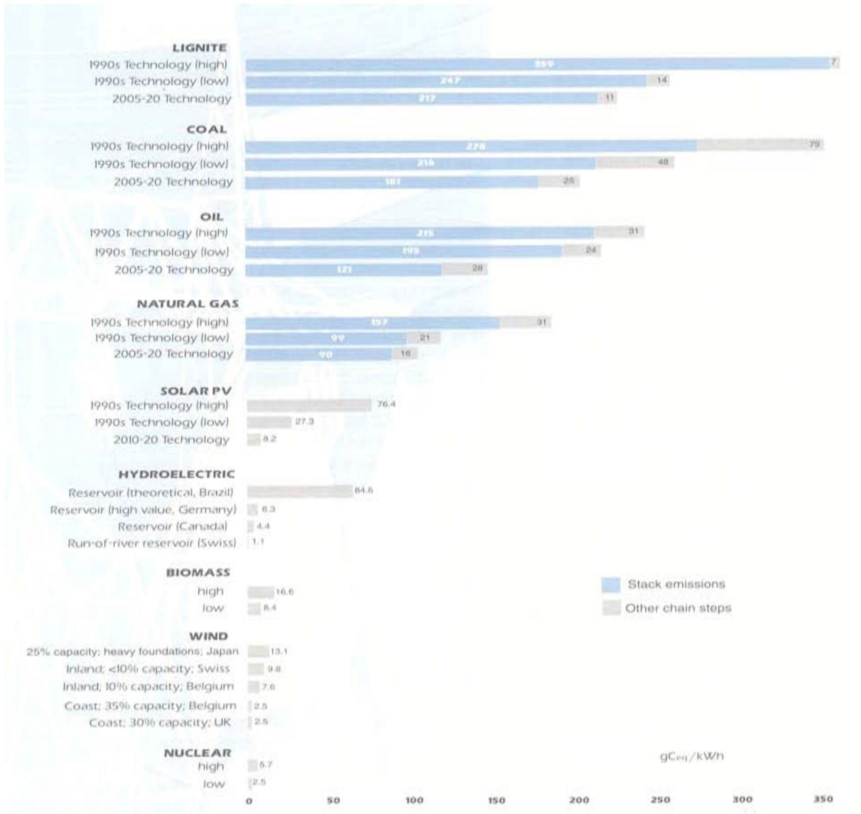


Fig 9 : Greenhouse Emissions by Different Energy Sources for Generation of Electricity

The control of green house gases is the most difficult challenge before the human beings to be addressed.

c) Acid Rain

The increase of atmospheric concentration of SOx and NOx cause acid rain. Acid rain destroys forests and soil. It also affects civil structures. Although the emission of these gases is more and less controlled in developed countries by the use of scrubbers yet the concentration is increasing (Fig.7).

d) Others

The energy system also produce particulates which depend on the type of the sources. Toxic materials are released in the process. Thermal pollutions do occur during energy conversion particularly from the large thermal power stations. These pollutants are relatively easier to control compared to the control of greenhouse gases.

VI. Possible Course of Actions/Remedies

a) Awareness

Sustenance of nature is must for quality life. The awareness of environmental assault is very important. Artaxeres-I first attempted to restrict cutting of Lebanese cedar as early as 450 BC [9]. The Rajah (king) of Nilumber alerted the governor of Bombay in 1830 about the serious consequences of felling trees in 1830. The USA enacted Environmental Protection Act in 1969 and established Environment Protection Agency.

The national scientific bodies, UN Agencies and civil societies are now getting more and more conscious and concerned about the health risks. The regulatory measures are being initiated in all most all the states to keep these health risks with in nationally/internationally acceptable limits. Public at large also has to made environment conscious through education and with the help of media.

b) Optimum Energy Mix

The energy system cause global warming with resulting climatic change and destroys bio-species. Present day techniques and devices can reduce the emissions of SOx, NOx and particulates substantially. What is still beyond control is the emission of CO_2. All energy sources produce different level of the greenhouse gas.

It may be seen that the renewable energy is not a reasonable option to stop global warming as their contribution to total global electricity production will be limited due to economic and technical reasons.

Larger use of nuclear energy appears to be critical to check against runway global warming, which would have potential catastrophic consequences.

Optimum energy mix has to be found out and pursued for sustainable development.

c) Kyoto Protocol

The Kyoto Protocol was negotiated during the world summit held in Kyoto, Japan in 1997 to limit the emission of CO_2 and other greenhouse gas that contribute global warming. The protocol requires participating states to reduce the emission of the gases on an average by 5.2% by 212 compared to 1990 emission level. The protocol is now on force. More than 145 countries are now parties to the protocol. But the USA has still reservations. Yet affective actions are to be seen.

d) Regulatory Control

Comprehensive environmental assessment of all large energy related (to be defined in the rules) industries is a must before the start of the project to limit the emissions within acceptable limits. All energy industries accordingly must prepare an *Environmental Report/Environmental Assessment Report* for the review and approval of *competent regulatory body.* The findings of the assessment report have to be reassessed during and the commissioning of the industry and routinely after the commissioning as per the regulatory requirements. Appropriate law to this end has to be enacted and effectively enforced. The law has to be backed by suitable *rules/regulations* and comprehensive *codes and standards and guides. Competent Regulatory Authority* has to be established *and manpower has to be groomed.*

"The climate will probably change no matter what we now do, but we should, at the very least make every effort to slow it down so as to permit the world to adapt. Nuclear energy is critical element of that process" [10].

"Global warming is a threat to the mother Earth and its inhabitants. It is a global problem and it has to be addressed globally. The slogan is: "Think globally but act locally." This generation must make decisions so that future generations will live within healthy environment. All countries must act together to reduce the greenhouse gases protecting the Earth, now and into the future, backpedaling the single-minded pursuit of profit and growth by emission of greenhouse gases."[12]

VII. Conclusion

Quality life is a natural human instinct. It is primarily dependent on economic status of a country. Economic status in turn, among others, depends on energy.

The quantity and forms of energy use adversely affects human health and environment. Human actions in the recent past have already caused irreversible damages to delicate ecosystem. The global temperature is rising with consequent climatic change, which is sometimes causing havoc.

The need and importance of proper forms and quality of energy for sustainable development can hardly be overemphasized. The world community has already agreed for the up-liftmen of the poor and the deprived global population (MDGs) and the issues of health and environmental (Kyoto Protocol).

Out of the different forms of pollutants, still no viable solution is foreseeable at this stage for the greenhouse gases. Comparatively easier solutions are available for other forms of pollutants.

Environmental assessment of all energy industries is a must. Effective regulatory control is essential. Competent regulatory authority accordingly has to be established and qualified manpower has to be groomed.

Global warming and environmental pollution issues are a major concern now. The solutions to these problems, most experts think, are possible and that the future is much more a matter of choice than destiny. It's a global issue and must be addressed globally.

But this will require global consensus among the states, UN agencies, scientific organizations, leaders of the private sectors, civil societies and their cooperation and active support, particularly of the developed states followed by wisdom and ethics based global actions.

VIII. Annex

Annex-I: Indian Survey of Health Effect of Solid Fuels

Annex-II: Emissions under Different Scenarios

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Ozone Variation at Jabalpur and Inter Relationship Study with Various Meteorological Parameters

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Keywords: meteorological parameters, surface ozone, ambient NOx, air quality.

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OZONEVARIATIONATJABALPURANDINTERRELATIONSHIPSTUDYWITHVARIOUSMETEOROLOGICALPARAMETERS

Strictly as per the compliance and regulations of :

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Abstract- This paper presents the observations of continuous measurements of surface Ozone (O_3) and various meteorological parameters over Jabalpur, M.P, India, from January 2014 to December 2014. The diurnal cycle of surface O_3 concentration exhibited a peak in the afternoon and declined during nighttime on all days of observation. The ozone concentration is influenced by the intensity of solar radiation and chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. This study aims to observe the distribution of the surface zone concentration, characteristics of hourly and daily mean surface ozone with different climatic parameters, such as temperature, relative humidity, and wind speed etc. over Jabalpur. The seasonal variation of ozone showed a unique pattern attaining peak levels in summer and weakening in winter. Higher surface ozone concentrations observed during the summer months of the present study which can be attributed to the high intensity of solar radiation and high temperature levels which promote the photochemical generation of O_3. The destruction of O_3 is increased during the winter season as a result of scavenging of higher nitrogen oxides.

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I. Introduction

The troposphere ozone affects our climate, which has been undergoing a continuous change into what we experience today. Atmospheric chemistry is highly dependent on temperature, humidity and solar radiation and the observed warming will inherently affect the atmosphere. The presence of ozone in the troposphere is understood to arise from two basic processes: (i) tropospheric / stratospheric exchange that causes the transport of stratospheric air, rich in ozone, into the Troposphere and (ii) production of ozone from photochemical reactions occurring within the troposphere. The production of ozone in the troposphere is accomplished through a complex series of reactions referred to as the 'photochemical smog mechanism'. Urban air pollution in many cities is currently an issue of great concern to the general public maintaining a high profile on the political agenda. The reality of numerous situations in which the near-surface ozone concentration exceeds the adopted threshold values, has attracted considerable public attention due to the well-known harmful impact on biosphere, human health, animal populations, agriculture productivity and forestry. Surface ozone (O_3) with its precursors namely, carbon monoxide (CO) and oxides of nitrogen (NOx) have been taken on diurnal scale from a tropical semi-urban site, Pune (18.54N, 73.81E) in India. (Beig et al.2007). Ground level ozone is of great concern because of its effects on human health and ecosystem because it is not emitted directly into the atmosphere. It has important impact on the radioactive balance of the atmosphere (Selvaraj et al. 2011),Near surface, ozone is a pollutant of important concern due to its adverse effects on agricultural productivity and human health and is now a major environmental concern in many regions of the world. Surface ozone is mainly produced through photochemical reactions involving volatile organic compounds and NOx in the presence of sunlight, and also acts as a precursor for the highly reactive hydroxyl radical (Roy et al. 2003). Atmospheric O_3 (90%) layer is located in Stratosphere. Tropospheric O_3 contribute only (10%) to the total O_3 column, but its concentration have been steadily rising during last 100 years. Tropospheric O_3 production is the result of photochemical reaction of carbon monoxide (CO), methane (CH_4), and other hydrocarbons in the presence of NOx ($NO + NO_2$). O_3 destruction is also the result of photochemical reactions involving NO,OH. (Bhatia et al. 2012).The higher surface O_3 concentration observed in the mid-day and lower concentrations during night time was in tune with the solar UV flux. A significant seasonal variation for O_3 and NOx mixing ratios at this site was observed. The average O_3 mixing ratios were maximum during winter and minimum during the monsoon period. (Nishant et al. 2012). Diurnal variation of ozone and variation of ozone along with rainfall, cloud cover, temperature, wind speed and relative humidity in different months have been studied. Therefore, changes in these parameters due to climate change will necessarily impact surface ozone concentration. To assess the relation with

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meteorological parameters, the correlation coefficients between the surface ozone concentration and meteorological variables were calculated. The diurnal pattern of surface ozone explains that ozone production depends on the photochemical production process. (Selvaraj. R Samuel et al. 2013).Ozone is a naturally occurring gas found in the troposphere and other parts of the atmosphere. Ozone occurs naturally at ground-level in low concentrations. The two major sources of natural ground-level ozone are hydrocarbons, which are released by plants and soil, and small amounts of stratospheric ozone, which occasionally migrate down to the earth surface. Neither of these sources contributes enough ozone to be considered a threat to the health of humans or the environment. But the ozone that is a by product of certain human activities does become a problem at ground level and this is what we think of as 'bad' ozone Zhang, et al (2007). With increasing populations, more automobiles, and more industry, there's more ozone in the lower atmosphere.

Source: - Geographical map on satellite

II. Objective of The Study

In this study an attempt has been made to address briefly some of the important issues, relevant to the changing ozone, with special emphasis on various meteorological parameters in surface ozone over a Jabalpur site. Study related with the inter relation of ozone and available meteorological parameters (Temperature, Sun Shine, Rainfall, Relative humidity, Wind speed and Pressure) is also carried out and discussed.

III. Significance of the Study

This monitoring network study is generating huge amount of data, which need to be properly collected, collated, evaluated, interpreted and compiled in the form of reports. The data will provide information on the success of the abatement measures, air quality trend, and impact of policies etc. Good public information system is needed for air pollution in severely polluted countries.

IV. Monitoring Site and Measurements

The monitoring site is in Jabalpur city at Govt. Model Science College (Autonomous) Jabalpur, PG Deptt. of Environmental Science. Jabalpur (23.1667° N, 79.9333° E.) sub capital of Madhya Pradesh is located in Centre in M.P and has an area of about 367 sq km. It is a densely populated, cosmopolitan city and has one of the highest living standards in M.P. The surface ozone recording system, EC 9810 O_3 UV photometric ozone analyzer was used to determine tropospheric ozone levels. The concentrations were correlated to meteorological parameters. The daily and hourly ozone concentrations ranged between 10.00 am to 05.00 pm respectively are taken into account for Jabalpur (M.P). The measured hourly ozone concentration was below as compared to the one hour ozone standard. Ozone behavior shows daily diurnal peaking between 12:00 and 16:00 hours and a low from evening to early morning was observed thus, suggesting anthropogenic activities as a possible source of tropospheric ozone in Jabalpur.

V. Materials and Methods

a) *Ambient Air Quality Station*

Ambient Air Quality Monitoring Systems (AQMS) monitored the level of pollutants –NOx, CO, CH_4, Particulate Matter (PM_{10}& $PM_{2.5}$),Ozone, etc. in the ambient atmosphere. From a single analyzer to complete systems provides a wide range of solutions to meet much of the Ambient Air Quality Monitoring demands.

Ecotech established an instrument for environmental monitoring that is Win AQMS (Air Quality Monitoring Station). Win AQMS has been designed as a client/server program. This means that Win AQMS has two parts: the client and the server. The server handles all the communication between the logger and the analysers, recording of data and starting/stopping of calibrations. The client is concerned with giving the users access to settings and data. On its own the server has no user interface and there is no way you can interact with it using the mouse or keyboard. The client is the visual interface of Win AQMS and communicates with the server by requesting information or receiving information that it has asked for at a prior time. This arrangement means that the Win AQMS server must always be turned on before the Win AQMS client program can connect to it.

b) *Ozone (O_3) analyser*

The EC 9810 ozone (O_3) analyser is a non dispersive ultraviolet (UV) photometer which alternately switches a selective ozone scrubber in and out of the measuring stream and computes the ratio of transmitted light giving an accurate and reliable measure of ozone concentration in the presence of common atmospheric compounds. A mercury vapor lamp is used as the light source. Its 254 nm line is close to the center of the ozone absorption band. The selective scrubber uses manganese dioxide (MnO_2) to selectively destroy ozone and pass other common absorbers such as SO_2 and aromatics. Since absorbances add, the resulting difference in beam intensity between the scrubbed and non-scrubbed cycle is a function of ozone concentration. The system is under the control of the EC9800 series microprocessor module. Software algorithms handle all internal adjustments, continuously perform diagnostics, indicate errors, display status and make calculations of ozone concentration. The only operator functions are to perform routine maintenance on the pneumatics and periodically verify calibration of the unit. The microprocessor continuously monitors the source and many other parameters, making adjustment as necessary to ensure stable and accurate operation. In addition to temperature and pressure compensation, the EC9810 analyser can readjust its span ratio based on a known concentration of gas used to span the analyser. Thus feature is not automatically implemented and must be selected by the operator. Data collection and recording is available for either a data acquisition system (such as data logger) or a strip chart recorder. A DB50 connector is also included for digital input control and digital output status. The EC9810 also features internal data storage capabilities. The instrument includes an over-range feature that, when enabled, automatically switches the analog output to a preselected higher range if the reading exceeds 90% of the nominal range. When the reading returns to 80% of the nominal range, the analyser automatically returns to that range.

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c) Ambient Air Quality Station

(AAQMS)

(O_3) Analyser

d) AWS (Automatic Weather Station

This instrument provides metrological data e.g. wind speed, pressure, humidity, temperature, wind direction and rain fall with the help of intercept-software. It gives every 10 minutes data.

AWS *(Automatic weather station)*

Observation Tables

e) Annual avg. value of O_3 with various meteorological parameters. [2014]

Month	Temp. (°C) max. Min.	O_3 (ppb)
JANUARY	17	35
FEBRUARY	18	38
MARCH	22	41
APRIL	29	50
MAY	32	56
JUNE	33	56
JULY	29	32
AUGUST	28	33
SEPTEMBER	27	30
OCTOBER	25	29
NOVEMBER	21	29
DECEMBER	16	24

Fig.1.

Month	Sun Shine (°C)	O_3 (ppb)
JANUARY	6	35
FEBRUARY	8	38
MARCH	8	41
APRIL	9	50
MAY	10	56
JUNE	7	56
JULY	4	32
AUGUST	4	33
SEPTEMBER	6	30
OCTOBER	8	29
NOVEMBER	8	29
DECEMBER	7	24

Fig.2.

Month	Rain Fall (mm)	O_3 (ppb)
JANUARY	24.8	35
FEBRUARY	76.0	38
MARCH	4.4	41
APRIL	0.0	50
MAY	10.6	56
JUNE	159.4	56
JULY	316.5	32
AUGUST	241.7	33
SEPTEMBER	199.0	30
OCTOBER	41.6	29
NOVEMBER	0.0	29
DECEMBER	4.8	24

Fig.3.

Month	R.H (%)	O_3 (ppb))
JANUARY	75	35
FEBRUARY	68	38
MARCH	57	41
APRIL	37	50
MAY	46	56
JUNE	46	56
JULY	73	32
AUGUST	76	33
SEPTEMBER	75	30
OCTOBER	67	29
NOVEMBER	55	29
DECEMBER	61	24

Fig.4.

Month	W.S (m/s)	O_3 (ppb)
JANUARY	3	35
FEBRUARY	3	38
MARCH	3	41
APRIL	4	50
MAY	6	56
JUNE	7	56
JULY	6	32
AUGUST	6	33
SEPTEMBER	4	30
OCTOBER	3	29
NOVEMBER	2	29
DECEMBER	2	24

Fig.5.

Month	Pressure (m/s)	O_3 (ppb)
JANUARY	11	35
FEBRUARY	10	38
MARCH	13	41
APRIL	10	50
MAY	12	56
JUNE	17	56
JULY	21	32
AUGUST	22	33
SEPTEMBER	21	30
OCTOBER	16	29
NOVEMBER	9	29
DECEMBER	8	24

Fig.6.

Graphs:-

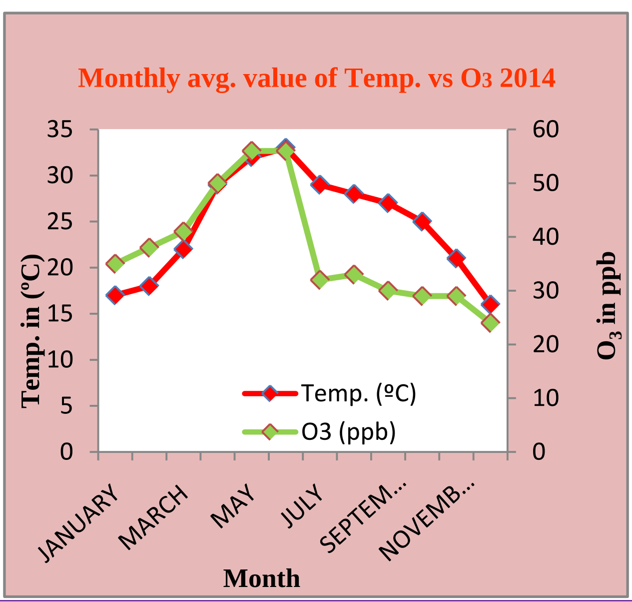


Fig. 1

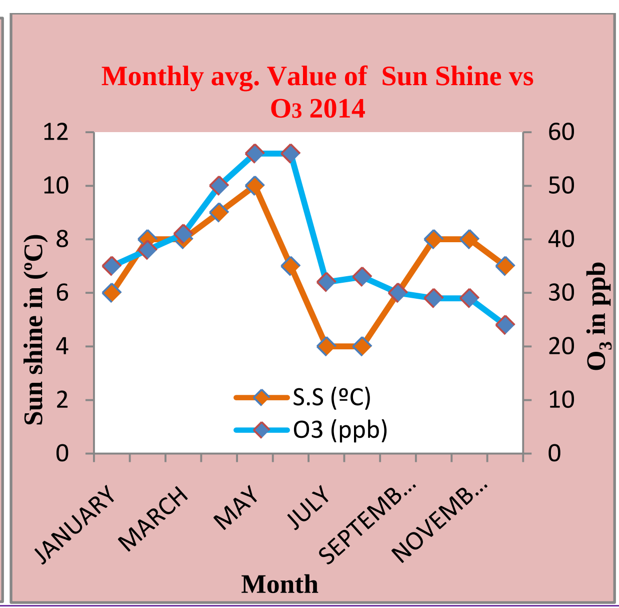


Fig. 2

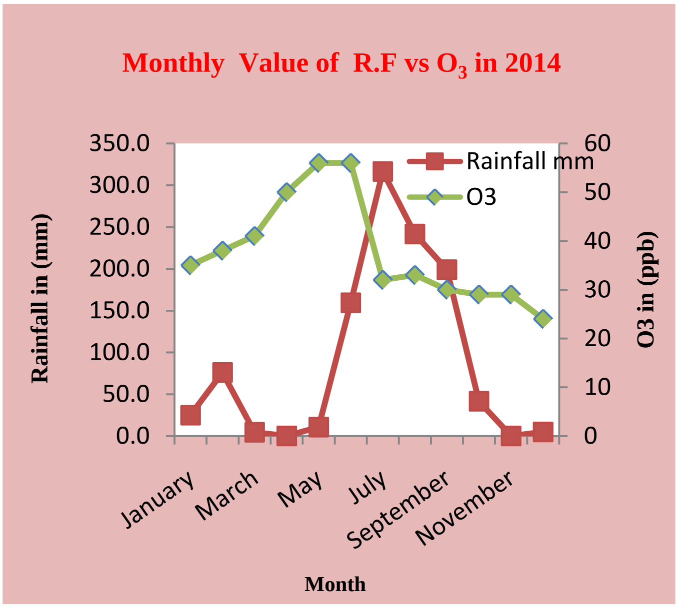


Fig. 3

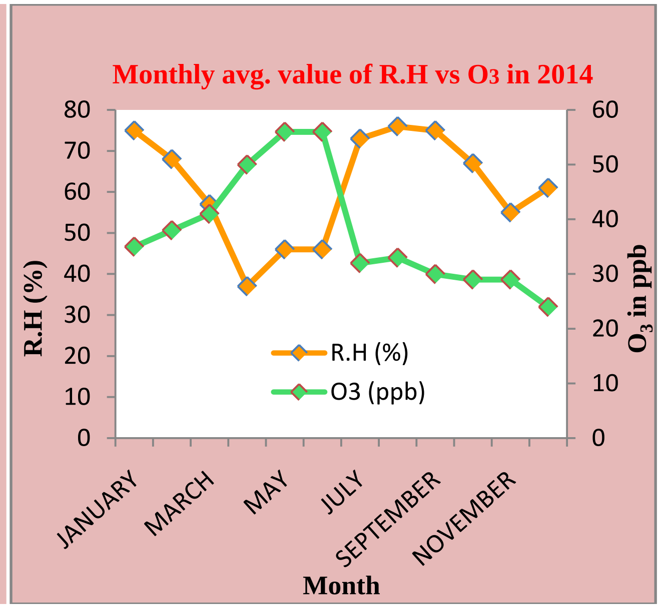


Fig. 4

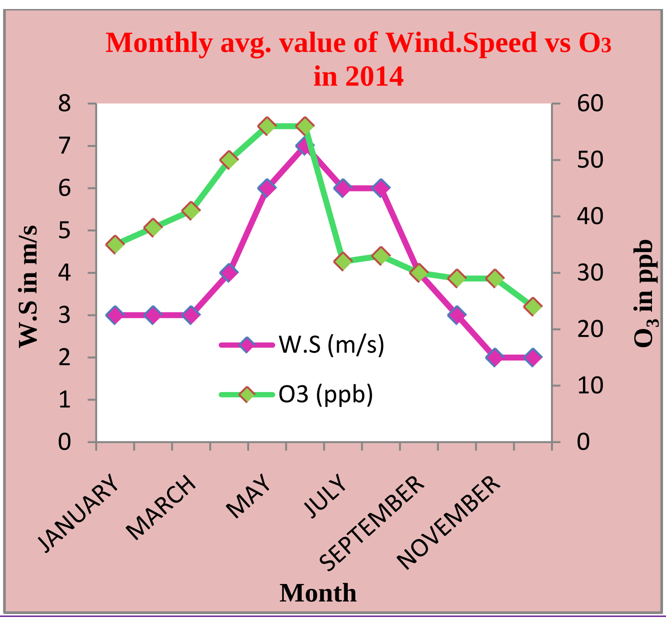


Fig.5

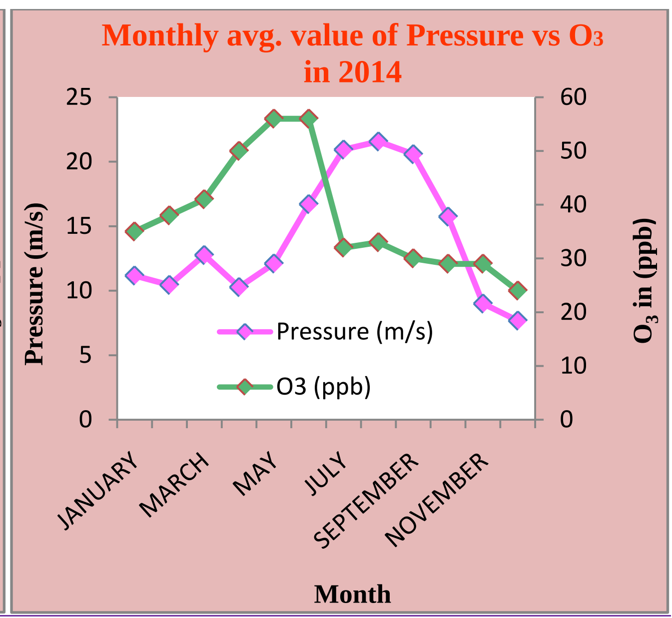


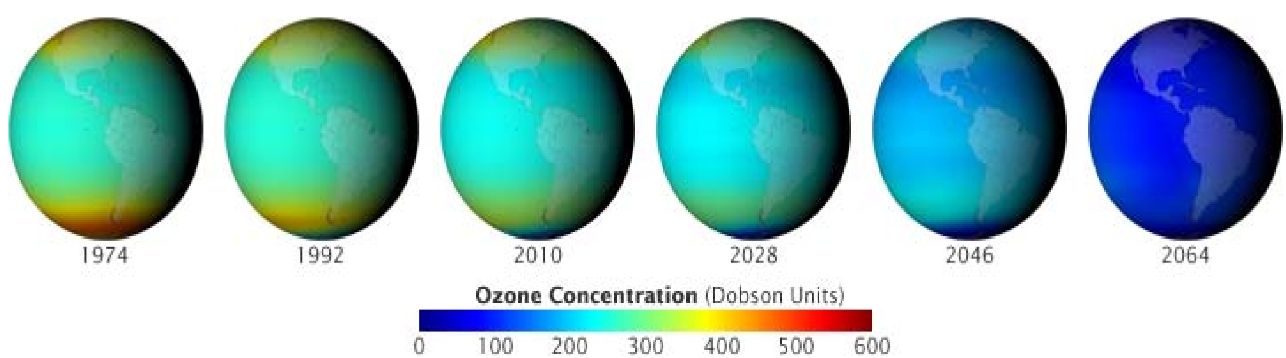
Fig.6

Source: - MOES [Ministry of Earth Science, New Delhi]

Air Quality Index for Ozone (based on 8-hr.avg. concentration)

Index Values (Conc. Range)	Air Quality Descriptors	Cautionary Statements for Ozone
0 – 50 (0-59 ppb)	Good	**No health impacts are expected when air quality is in this range.**
51 – 100 (60-75 ppb)	Moderate	**Unusually sensitive people should consider limiting prolonged outdoor exertion**
101 – 150 (76-95 ppb)	Unhealthy for Sensitive Groups	**Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion**
151 – 200 (96-115 ppb)	Unhealthy	**Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children should limit prolonged outdoor exertion.**
201 – 300 (116-374 ppb)	Very Unhealthy	**Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.**

Source –NASA



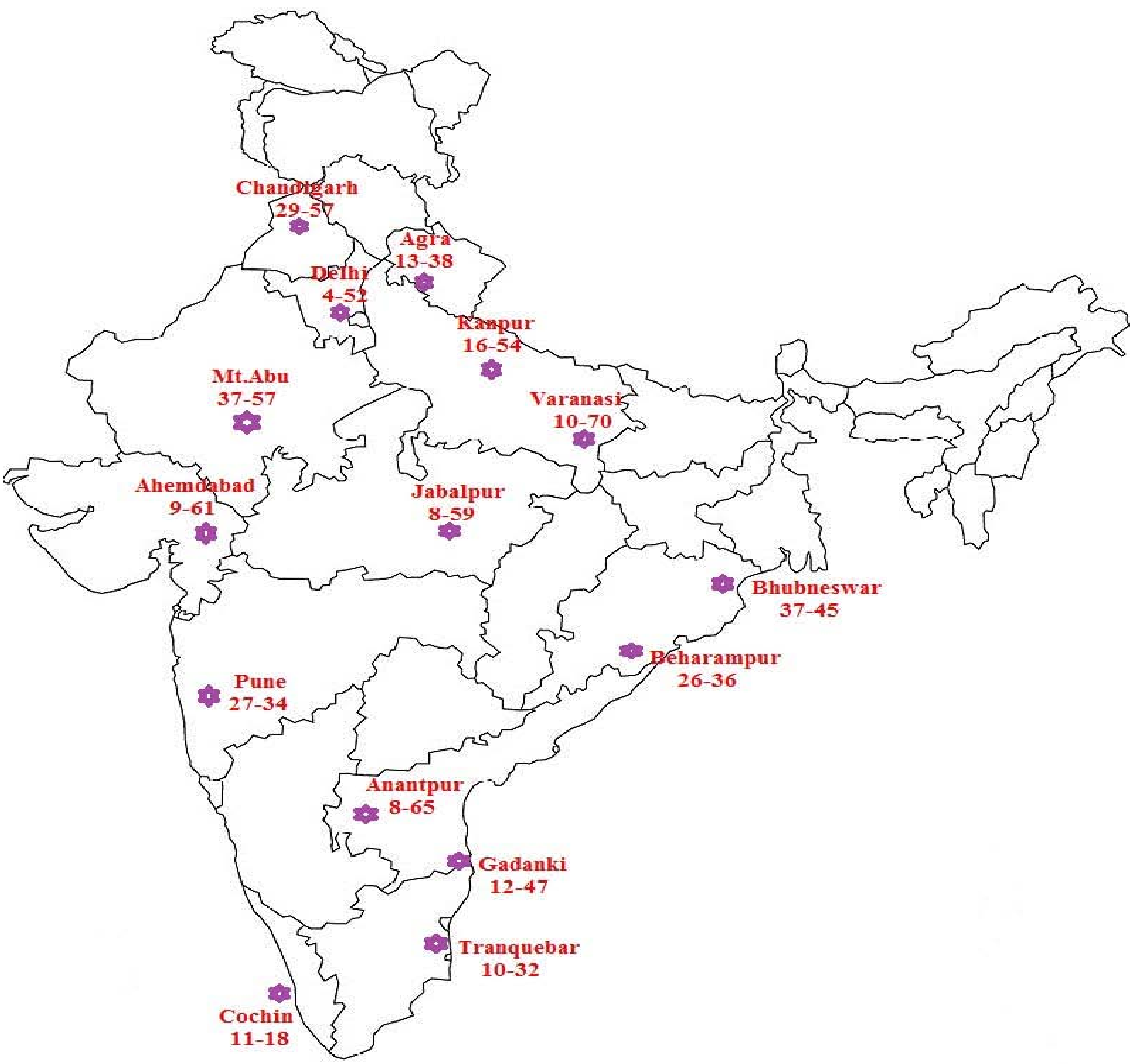


Fig.1 : Surface Ozone concentration(ppb) in different sites in india

VI. Result & Discussion

Annual variation of daytime ozone and its correlation with various meteorological parameters such as *Temperature, Sun Shine, Rainfall, Relative Humidity, Wind Speed and Pressure* we observed during the period from January 2014 to December 2014.The analyzer average data for every 10 minutes interval and stores in the memory which were retrieved regularly for use in the study. The 10 minute data were averaged for each day to find the day time ozone ratio, and then average for a month were again averaged to determine the day time monthly average ozone ratio [*Fig*. 1, 2, 3, 4, 5, 6] . The monthly average of day time ozone ratio from January 2014 to December 2014. Ozone is primarily increasing due to rising NOx emissions, augmented by intercontinental transport. It can be observed that [*Fig.1]* in month of May temperature increase then the ozone concentration also increases to *55ppb* and another one when sunshine increased in month of April and May the ozone concentration increases to *58ppb*. [*Fig. 2*]. So this time is perfect situation to form of ozone mixing ratio. It has been observed that [*Fig. 3*] Jabalpur usually receives the first monsoon showers during the 2nd week of June. Hence the month of June, July, August are included under the monsoon season and a lower day time ozone ratio is expected during this period. In the

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month of July 2014, the average ozone ratio was observed to be lower as *30ppb.* The lowest ozone ratio was recorded in the month of September *28ppb*. [*Fig.4*] The daily average humidity was high in August compared to November and December. All these factors might have played an important role in lowering the ozone.*[Fig.5]* The daily average wind speed was found to be high in May and ozone is also high *58ppb* in the same month because the air helps to flow O_3 molecules in the atmosphere. And the last one [*Fig. 6*] observed that atmospheric pressure was low in the month of May, so ozone is highest in this month *60ppb* and compared to pressure which was high in the month of July and August then O_3 decreases to *28ppb* in this month.

VII. Conclusion

An extensive study of day time ozone and relevant meteorological parameters at Jabalpur is presented. The ozone value was found to increase with sunrise and was highest between May due to high temperature. Ozone levels are low at late night and lowest during early morning hours.

However, it can be clearly observed that there was a significant difference in the average ozone values for various seasons. Summer season showed peak ozone ratio values followed by pre monsoon and almost similar values during monsoon and post monsoon periods. Such behavior could be expected due to its direct relationship to the availability of precursors gases and favorable for meteorological conditions.

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New Energy Sources: Technological Status and Economic Potentialities

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New Energy Sources: Technological Status and Economic Potentialities

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Abstract- There are different types of energy sources: traditional, commercial, primary, renewable and the new energy sources. The new energy sources, from the perspective of this paper are those that have been innovated in the recent past and are still being innovated by the scientists and technologists to meet the energy challenges. The availability of the fossil fuels or the commercial sources: coal, oil and gas is finite. Human beings have already used a considerable portion of the reserves. The reserves are maturing. Besides, these sources cause environmental pollutions: particulates, acid rains, toxic pollutants, particularly greenhouse gases. The greenhouse gases are warming up the globe with consequent climatic changes. Global warming and climatic change is presently one of the major challenges before human race.

New energy sources are important to meet the ever growing need of energy for smooth transition from the present day predominantly finite sources to pseudo unlimited energy sources like fusion or solar energy. In order to achieve the goal of sustainable development, national as well as international commitment and coordinated efforts are essential to harness the new: nuclear, solar, wind, tidal, geothermal, biomass, hydrogen and other new renewable sources optimally.

The paper tried to focus on the technical status and economic potentialities of a number of the new energy techniques or sources that appear to suit sustainable development.

I. Introduction

Energy is one of the key elements for economic development of a country. There are various types and forms of energy sources. The sources are evolving from predominantly traditional sources like firewood, vegetable wastes, cow dung etc. to commercial sources e.g. coal, oil and gas and now though slowly, to new sources e.g. nuclear, photovoltaic, LNG, CNG, hydrogen, wind turbine, geothermal etc.

The human knowledge is expanding. The technology is becoming more and more sophisticated. There are continued and consistent efforts among the scientists, technologists and researchers to move towards more efficient and cost effective energy sources. The new energy sources are the outcome of the application of the new knowledge, research findings and innovated technology.

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The availability of the sources, end uses and environmental considerations and finally the cost effectiveness are the deciding factors in the selection of the type of source.

The reserves of the presently dominant primary sources: coal, oil and gas are maturing. Nature took about three million years to produce these sources. Much more exploration efforts are now required to find new reserves and the growth of consumption rates lags the discovery rate.

At some stage of future date people will have no option other than to use the new sources particularly fissile and renewable sources till pseudo infinite source like fusion become technically and economically cost effective. Yet, the new energy sources are increasingly used from the perspective of cost, accessibility and environmental considerations.

Strong political will, continued R& D, public awareness will be required to harness the benefit of new energy sources optimally.

II. New Energy Sources

a) *Perception*

The universe consists of fundamentally of mass and energy. Energy and mass are always conserved. Neither of the two can be created but the conversion from one to other is possible. In fact most of the energy sources are not new. The techniques of using the energy sources and or conversions from one form of the source to other form of energy are new. The techniques are becoming more and more sophisticated with the passage of time and as the human knowledge is expanding and the capability is increasing.

The new energy sources, from the perspective of this paper are those sources or techniques that have been *evolved or innovated lately from the consideration of efficiency, cost optimization, environment, user friendliness etc*.

From the aforesaid perspectives, an improved oven which uses firewood or vegetable wastes is a new technique. While the biogas produced out of cow dung for domestic use may be termed as, at least from the perspective of this paper, a new source. The new technique and the source are more efficient, user friendly and less polluting.

There are many such devices or techniques and the sources. The paper will touch only a few ones. Out of these only the important and the promising ones will

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be discussed further in the subsequent presentations of the short course.

b) Fundamental Forces

Energy is required to do work. Work is defined as force multiplied by distance. For any work at least equal amount (at 100% efficiency, which is practically impossible) of energy is required. *There are three fundamental forces: electromagnetic force, gravitational force and the strong nuclear force*. Any one of these three forces is involved in the process of work and the delivery of energy or conversion of the same.

i. *Electromagnetic Force*

Energy is produced out of commercial energy sources: coal, oil and gas or traditional fuels through interactions of electromagnetic forces. The interactions take place by *chemical reactions* during burning.

ii. *Gravitational Force*

The source of hydropower is *gravitational force* converted to potential energy. The energy produced depends on height and quantity of flow that can be sustained. The commercial hydropower is being used for about 140 years. But the pumped storage hydro power station is relatively new and may be termed as new source. Pumped hydropower stations are used for peak loads of electrical power system from economic considerations. The number and cumulative capacity of such stations are increasing.

iii. *Strong Nuclear Force*

Strong nuclear force is the force that holds the particles in the nucleus i.e. neutron and proton. It is also called gluon. The root of solar energy is *fusion. The fusion energy is the result of interactions of strong nuclear force.* The nuclei of two lighter atoms usually of hydrogen, deuterium and tritium are fused together to produce a heavier atom releasing enormous amount of energy.

Energy produced from nuclear power stations also come from the strong nuclear force. Here the process is reverse. Energy is produced when a heavy nucleus, usually of uranium or thorium, breaks (*fissions*) to form two lighter atoms and the release of particles. Enormous amount of energy is also produced during the process of fission.

c) Solar Energy

The source of the most of the renewable energy sources: solar, wind, tide, biomass, ocean current etc is the sun. Solar energy falls in the group of traditional energy as long as it is used for drying of crops, clothes etc. in traditional way. But the photovoltaic, innovated solar cooking devices or solar thermal power stations etc. fall into the category of new energy techniques or sources.

d) Wind Energy

Traditional use of wind power for sailing, processing of crops fall in the category of traditional energy source. But the wind turbine that generates electricity can be termed as new energy technique or source.

e) Geothermal Energy

The origin of geothermal energy is the heat trapped in the interior of the earth during its formation. *Some scientists believe that the source of the trapped heat is nuclear fission*. The fission is still taking place in the core of the earth where heavy atoms of uranium and thorium were concentrated due to the gravitational force at the time of formation of the earth.

f) Nuclear Energy

The *fissile energy sources*: *uranium* (Ur^{235}, Ur^{233}) *and Plutonium* (Pu^{239}) fall under new energy sources. The source of *fusion energy is hydrogen, deuterium, tritium and helium*. Nuclear energy is generated by *fission or fusion through interactions of strong nuclear forces.*

g) Category of New Energy

The new energy techniques or sources can be categorized under three broad groups-

- Renewable;
- Nuclear; and
- Advanced technologies.

III. Technical and Theoretical Potential

The technical and theoretical potentials of the renewable and fissile sources are extremely large. The summary of the potentialities of the global fossil and nuclear sources are shown at Table-1 and that of renewable sources are shown at Table-2 .

Table 1 : Summary of the Global Fossil & Nuclear Energy Sources, Source [1. p.166]

Summary Of Global Fossile And Fissile Resourses (Thousands Of Exajoules)						
Resource	Consumed by end 1998	Consumed in 1998	Reserves	Resources	Resource base[a]	Additional occurrences
Oil	5.14	0.14	11.11	21.31	32.42	45
Conventional	4.85	0.13	6.00	6.07	12.08	
Unconventional	0.29	0.01	5.11	15.24	20.35	45

Gas	2.38	0.08	14.88	34.93	49.81	930
Conventional	2.35	0.08	5.45	11.11	16.57	
Unconventional	0.03	0.00	9.42	23.81	33.24	930
Coal	5.99	0.09	20.67	179.00	199.67	
Fissile total	**13.51**	**0.32**	**46.66**	**235.24**	**281.89**	**975**
Uranium						
Open cycle in thermal reactors[b]	n.e.	0.04	1.89	3.52	5.41	7.1[c]
Closed cycle with fast reactors[d]	-	-	113	211	325	426[b]
Fossile and fissile total[e]	**n.e.**	**0.36**	**48**	**446**	**575**	**1,400**

n.e. Not estimated. – Negligible.

a. Sum of reserves and resources. b. Calculated from the amount in tones of uranium, assuming 1 tonne = 589 terajoules (IPCC, 1996a). c. Does not include uranium from seawater or other fissile materials. d. Calculated assuming a 60-fold increase relative to the open cycle, with 1 tonne = 35,340 terajoules. e. All totals are rounded. Source: Author's calculations from previous chapter tables.

N.B. *Sea water contains less than 3 parts per billion of uranium. But the quantity of uranium is about 4.5 billion tons or 700 times of known terrestrial resources recoverable at a cost of $ 130/Kg. Uranium from sea water can be extracted at $ 300/Kg. Some recent studies reveal that it can be produced at cost as low as $ 80 to 100/Kg. [].*

Table 2 : Summary of the Technical Potential of Global Renewable Energy Sources, Source [1. p. 168]

Summary of the Renewable Resource Base (Exajoules A Year)			
Resource	Current use[a]	Technical potential	Theoretical potential
Hydropower	9	50	147
Biomass energy	50	>276	2,900
Solar energy	0.1	>1,575	3,900,000
Wind energy	0.12	640	6,000
Geothermal energy	0.6	5,000	140,000,000
Ocean energy	n.e.	n.e.	7,400
Total	56	>7,600	>144,000,000

n.e. Not estimated. a. The electricity part of current use is converted to primary energy with an average factor of 0.385. Source: Author's calculations from previous chapter tables.

The principal reasons for the minimal use of the vast potentials of the renewable energy sources are:

- Technologies are yet to be cost effective;
- Low energy density;
- Time dependence;
- Season dependence;
- Others

The primary reason for under use of nuclear power is geopolitics. There are of course the issues of safety, proliferation, waste management and safeguards that have to be properly addressed by the United Nations and the community of the states.

IV. New Renewable Energy Source Status

a) Background

The renewable sources supplied 56 ± 10 exajoules or about 14% of world primary energy consumption in 1998 [2]. Out of the total 38 ± 10 exajoules came from biomass. Hydropower and modern biomass contributed 9 and 7 exajoules respectively [2].

Renewable energy sources depend on energy flows through the earth's ecosystem out of the insolation (solar radiation) of sun and the geothermal energy of the earth [2]. From prehistoric period people used renewable energies in many ways for cooking, heating, processing crops, sailing boats and ships etc. The sources can be sub-grouped into the following:-

- Biomass energy;
- Hydro;
- Wind energy;
- Solar energy;
- Marine energy; and
- Geothermal energy.

The renewable energy sources have enormous potentiality and can meet many times the present world energy demand. If the sources are applied in a modern way, these may effectively help in attaining, environmental, social and economic goals.

The sources are briefly outlined in this paper. These will be further elaborated in the subsequent six lectures to presented under *Module-5: Renewable Energy*. The current status of renewable energy is shown at Table-3.

Table 3 : Current Status of Renewable Energy Technologies, Source [2]

Technology	Increase in installed capacity in past five years (percent a year)	Operating capacity, end 1998	Capacity factor (percent)	Energy production 1998	Turnkey investment costs (U.S. dollars per kilowatt)	Current energy cost of new systems	Potential future energy cost
Biomass energy Electricity Heat[a] Ethanol	≈ 3 ≈ 3 ≈ 3	40 Gwe >200 GWth 18 bin litres	25-80 25-80	160 TWh (e) >700 TWh (th) 420 PJ	900-3,000 250-750	5-15 ¢/kWh 1-5 ¢/kWh 8-25 $/GL	4-10 ¢/kWh 1-5 ¢/kWh 6-10 $GL
Wind electricity	≈ 30	10 Gwe	20-30	18 TWh (e)	1,100-1,700	5-13 ¢/kWh	3-10 ¢/kWh
Solar photovoltaic electricity	≈ 30	500 Mwe	8-20	0.5 TWh (e)	5,000-10,000	25-125 ¢/kWh	5 or 6-25 ¢/kWh
Solar thermal electricity	≈ 5	400 Mwe	20-35	1 TWh (e)	3,000-4,000	12-18 ¢/kWh	4-10 ¢/kWh
Low-temperature solar heat	≈ 8	18 GWth (30 min m^2)	8-20	14 TWh (th)	500-1,700	3-20 ¢/kWh	2 or 3-10 ¢/kWh
Hydroelectricity Large Small	≈ 2 ≈ 3	640 Gwe 23 Gwe	35-60 20-70	2,510 TWh (e) 90 TWh (th)	1,000-3,500 1,200-3,000	2-8 ¢/kWh 4-10 ¢/kWh	2-8 ¢/kWh 3-10 ¢/kWh
Geothermal energy Electricity Heat	≈ 4 ≈ 6	8 Gwe 11 GWth	45-90 20-70	46 TWh (e) 40 TWh (th)	800-3,000 200-2,000	2-10 ¢/kWh 0.5-5 ¢/kWh	1or 2-8 ¢/kWh 0.5-5 ¢/kWh
Marine energy Tidal Wave Current OTEC	0 - - -	300 Mwe exp.phase exp.phase exp.phase	20-30 20-35 25-35 70-80	0.6 TWh (e) - - -	1,700-2,500 1,500-3,000 2,000-3,000 -	8-15 ¢/kWh 8-20 ¢/kWh 8-15 ¢/kWh -	8-15 ¢/kWh - 5-7 ¢/kWh -

a. Heat embodied in steam (or hot water in distric heating), often produced by combined heat and power systems using forest residues, black liquor, or bagasse.

b) Biomass Energy

Biomass has very large energy potential. The solar to biomass conversion efficiency is less than 1%. The production of biomass as such requires large area of land.

i. *Heat*

A vast global population, mostly living in rural areas of underdeveloped and developing countries use biomass for cooking and heating. Greater use of improved ovens for cooking and heating will have great beneficial impact on the lives of these people. The improved ovens possess higher burning efficiency and produce less undesirable emissions.

ii. *Electricity*

Electricity can be produced through thermo-chemical conversion of biomass. Total installed capacity of such power plants is 40 Gwatt [1]. The plant size and efficiency ranges from 20 to 100 MW and 20 to 40% respectively.

iii. *Gasification*

Demonstration gasification plants with 40% efficiency have been built. Presently a biomass integrated gas (BIG) combined cycle (CC) 30 Mwe power plant costs about US $ 2800 to 5000 per Kw. Additional R& D works are required to develop economically viable BIG/CC power plant.

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iv. *R&D*

Additional and continued R& D activities are required on the biogas production, production of liquid and gaseous biomass based fuels (bio-oil and bio-crude). Oil seeds and rapeseeds can be converted to esters to replace diesel. R& D works are going on to produce methanol, hydrogen and hydrocarbon.

v. *Environmental Impacts*

Large biomass production is associated with soil erosion and increased water usage. It also causes pollutions out of the use of agrochemicals and fertilizers. Further studies and research are required to reduce the adverse effects and cost of production and also to balance the negative effects with beneficial outcome.

c) *Hydro Energy*

i. *Background*

Hydropower uses gravitational force for the production of energy. The precipitation is stored at higher natural storage enhanced by dam. The potential energy of the stored water at high altitude is converted to kinetic energy and runs turbine to produce electricity. The theoretical and technical potential of hydropower are 147 and 50 Exajoules per year respectively. Current use is 9 exajoules per year [1].

The first commercial hydropower station was commissioned at Appleton, Wisconsin, USA in 1882. The technologies are improving and getting diversified. The pumped storage hydropower stations are new. The hydropower stations can be of the following types: *runoff river plants, runoff with pondage and reservoir plants (most common type).*

ii. *Present Status*

Among the renewable sources hydropower stations are by far the largest contributor (17% of the total) to the generation of global electricity. Canada with installed capacity of 66954 Mwe is the largest producer of hydroelectricity. *Rest of the renewable sources contribute only 2% of the global electricity.*

Norway gets 99% of electricity out of hydropower. The size of hydropower station ranges from a few Kw (micro hydropower station) to 12600 Mwe (super large) at Brazil/Uruguay. The Gorges dam in China will have installed capacity of 18,300 Mwe (planned to be commissioned in 2009).

iii. *Negative Factors*

A hydropower station in the past used to be considered as environment friendly. The notion has changed. The plant causes dislocation of communities and bio-species. " Ecosystem impacts usually occur downstream and range from changes in fish biodiversity and the sediment load of the river to coastal erosion and pollution" [2]. The plants also cause greenhouse emissions. The hydropower station usually is very much capital intensive with long construction and amortization periods and therefore becoming less attractive for the investors. The possible dam failure may cause havocs in the down stream.

d) *Wind Energy*

i. *Background*

The theoretical and technical potential of global wind energy is about 6000 and 640 exajoules per year respectively. The current use is only about 0.12 exajoules [2]. Wind power had been used for mechanical power long before the industrial revolution in Europe and other parts of the globe. The progress was barred with the advent of commercial fuels: coal and oil and the invention of steam engine. Recently wind energy is again drawing attention of the technologists and the entrepreneurs. Considerable progress has been achieved lately in the design and production of the wind turbines.

The first wind turbine grid connection was accomplished in 1980. The installed capacity of grid connected wind turbine rose to about 13500 Mwe in 2000. Besides, more than a million wind pump are in operation to supply water for the livestocks. Tens of thousands of wind generators are being used for charging batteries in China, Mongolia and Central Asia.

The minimum wind energy density of 400 watt per square meter at a height of 30 meters above ground is required for the plant to be viable.

ii. *Technical Development*

Wind energy turbines are becoming larger. The average size of a wind turbine was 30 Kw in mid 1970s. The size increased to 200 Kw and 700 Kw in 1992 and 1999 respectively. The average size now is about 1200 Kw. The higher the size the more is the efficiency.

The present day wind turbines are more controllable and grid compatible. Fewer number of components are being used to improve reliability and maintainability and also to reduce cost. Improved materials are being used for the manufacture of turbine blades and other parts. Works are in progress to build special offshore wind turbines.

iii. *Negative Factors*

Wind flow is mostly intermittent. The wind speed varies with time, season and geographical locations. The capacity factor of a wind turbine based power plant as such is quite low. The environmental effect of wind turbine is primarily limited to noise and aesthetics (as it obstructs free vision).

e) *Solar Energy*

i. *Background*

The theoretical and technical potential of solar energy is 3,900,000 and 1575 Exajoules per year respectively. The current usage is only about 0.1 Exajoules per year. The principal reason for the minimal use is low energy density. The maximum solar energy density occurs near equator. The density is about 1Kw per square meter. The average energy density ranges from 100 to 300 watt per square meter. The new use of solar energy can be categorized into two broad heads:

solar photovoltaic; and

solar thermal electricity.

Table –4 shows the forecasts of potential contribution of solar energy to world energy consumption by different studies.

Table-4 : Solar Energy Contribution Forecasts. Source: [2]

Potential Contribution Of Solar Energy Technologies To World Energy Consumption According To Different Studies (Exajoules Of Electricity)			
Study	2020-2025	2050	2100
WEC, 1994 a,b	16		
IIASA and WEC, 1998	2-4	7-14	
RIGES, 1993 (solar and wind)	17	35	
Shell, 1996	<10	200	
Greenpeace and SEI, 1993 (solar and wind)	90	270	830
Reference: total world energy consumption	400-600	400-1,200	

ii. *Photovoltaic*

Edmond Becquerel discovered the photovoltaic effect in 1839. AT&T first demonstrated PV cell in 1954. The first solar power satellite, Vanguard 1 was launched in 1963. The efficiency of solar PV is improving. The cost per watt peak of solar panel has gone down from several hundred to about 4 US $. The PV based energy supply systems are becoming more and more cost effective for isolated electrical demands of a few Kws depending on the location and the operating loads.

There are different types of PV panels with varied characteristics. *These are: single crystal silicon, multi crystalline silicon, amorphous silicon, crystalline silicon films on glass, cadmium telluride, copper-indium/gallium diselenide etc.* The efficiency varies between 9 to 24%.

The photovoltaic market expanded at the rate of over 15% per year between 1983 and 1999. The market is presently growing even at a faster rate. The solar PV domestic units are becoming popular and cost effective in areas isolated from the grid to meet electrical energy needs for lighting and appliances like radio and television. More than 50,000 such units are now operating in Bangladesh.

The rooftop based PV panels are now being connected to the grid. The energy payback time of these systems are shown at Table-5. The PV potentialities will be covered in greater depth in *Module –5*.

Table-5 : Payback Time for Grid Connected Rooftop Photovoltaic Systems. Source: [2]

Estimated Energy Payback Time Of Grid-Connected Rooftop Photovoltaic Systems (Years)			
	State of the art	Near to medium term (<10 years)	Long term
Modules			
Crystalline silicon	3-8	1.5-2.5	<1.5
Thin film	2-3	0.5-1.5	<0.5
Balance of system	<1	0.5	<0.5
Total system			
Crystalline silicon	4-9	2-3	<2
Thin film	3-4	1-2	<1

Note: Based on an insolation of 1,500 kilowatt-hours per square metre a year.

Source: Alsema, Frankl and Kato, 1998.

iii. *Solar Thermal Electricity*

The operating capacity of solar thermal based electric power plants in 1998 was 500 Mw. The capacity is lagging far behind compared to the wind turbines. Several types of solar thermal electricity are presently being considered. These are outlined below:-

a. *Parabolic Trough System*

The parabolic trough (solar farm) consists of long parallel rows of identical concentrator modules, typically using trough-shaped glass mirrors. Tracking the sun from east to west by rotation on one axis, the trough collector concentrates the direct solar radiation onto an absorber pipe located along its focal line. A heat transfer medium, typically oil at temperatures up to 400 degrees Celsius, is circulated through the pipes. Generating systems connected to the grid in southern California since the mid-1980s, parabolic troughs are the most mature STE technology (Pilkington, 1996). There are more than 100 plant-years of experience from the nine operating plants [2].

b. *Central Receiver/Power Tower*

The solar central receiver or power tower is surrounded by a large array of two-axis tracking mirrors-termed heliostats- reflecting direct solar radiation on to a fixed receiver located on the top of the tower. Within the receiver, a fluid transfers the absorbed solar heat to the power block where it is used to heat a steam generator.

Advanced high-temperature power concepts are now under investigation, heating pressurized air to more than 1,000 degrees Celsius to feed it into the gas turbines of modern combined cycles. (Solar One) operated with steam from 1982-88. After modification of the complete plant in 1996, it operated as Solar Tower for a few thousand hours, with molten salt as the heat-transfer and energy storage medium, delivering power to the electricity grid on a regular basis (Pacheco and others, 2000) [2].

c. Dish/Engine Power Plants

Dish/ engine power plants. Parabolic dish systems consist of a parabolic-shaped point focus concentrator in the form of a dish that reflects solar radiation onto a receiver mounted at the focal point. These concentrators are mounted on a structure with a two-axis tracking system to follow the sun. The collected heat is often used directly by a heat engine, mounted on the receiver.

Several dish/engine prototypes have operated successfully in the last 10 years, including 7-25 kilowatts-electric units developed in the United States. But there has not yet been a large-scale deployment. In Spain six units with a 9-10 kilowatts-electric rating are operating successfully. Australia has demonstrated a 400 square metre, 10 kilowatts-electric 'big dish' at the Australian National University in Canberra (Luzzi, 2000) [2].

e) Marine Energy

The oceans cover more than two-thirds of the Earth's surface. The oceans have an enormous energy resource potential which is vastly more energy than the human race could possibly use. The energy of the seas is stored partly as kinetic energy from the motion of waves and currents and partly as thermal energy from the sun.

The theoretical potential of ocean energy is about 7400 exajoules per year. Although most marine energy is too diffuse and too far from where it is needed to be economically exploited, in special situations it can be effectively captured for practical use.

The principal marine energy resources can be summarized, in order of maturity and use, as below:-

Tidal barrage energy;
Wave energy;
Tidal/marine currents;
Ocean thermal energy conversion (OTEC);
Salinity gradient/osmotic energy; and
Marine biomass fuels.

The current status of marine renewable energy technologies is shown at Table-6.

Table-6 : Current Status of Marine Renewable Energy Technologies, Source [2]

Current Status of Marine Renewable Energy Technologies				
Technology	Maturity	Load factor (percent)	Installed capital cost (dollars per kilowatt)	Unit cost of electricity (dollars per kilowatt-hour)
Tidal barrage	Virtually abandoned	20-30	1,700-2,500	0.08-0.15
Wave-shoreline OWC	Experimental	20-30	2,000-3,000	0.10-0.20
Wave- near shoreline OWC	Commercial 2002-05	25-35	1,500-2,500	0.08-0.15
Wave-offshore-point absorber	Commercial 2010 or later	30-60	2,500-3,000	0.06-0.15
Tidal current turbine	Commercial 2005-10	25-35	2,000-3,000	0.08-0.15
OTEC	Commercial 2005-10	70-80	Unclear	Unclear

g) Geothermal Energy

i. Background

Human beings had been using geothermal energy for bathing and washing for thousands of years. But it is only in the 20th century that it has been harnessed on a larger scale for space heating, industrial energy use, and electricity production. The theoretical and technical potential of geothermal energy is 14,000,000 and 5,000 exajoules per year [1]. These are extremely large quantities.

ii. Development

Prince Piero Ginori Conti initiated electric power generation with geothermal steam at Larderello in Italy in 1904. The first large municipal district heating service started in Iceland in the 1930s.

Geothermal energy has been used commercially for some 70 years, and on the scale of hundreds of megawatts for 40 years, both for electricity generation and as source of heat for direct use. Its use has increased rapidly in the past three decades-at the rate of about 9% per year during 1975-95 for electricity and, about 6% a year for direct use. Geothermal resources have been identified in more than 80 countries, with quantified records of geothermal use in 46.

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iii. *Electricity production*

The growth of the total generation capacity in 1990-98 was about 40%, with the largest additions in the Philippines (957 megawatts), Indonesia (445 megawatts), Japan (315 megawatts), Italy (224 megawatts), Costa Rica (120 megawatts), Iceland (95 megawatts), the United States (75 megawatts), New Zealand (62 megawatts), and Mexico (43 megawatts) [2].

iv. *Heat Pumps*

Geothermal heat pumps are rated among the most energy-efficient space conditioning equipment available in the United States. Reducing the need for new generating capacity, they perform at greater efficiencies than conventional air source heat pumps used for air conditioning.

The summary of the global geothermal electricity generation and direct use for the year 1997 is shown in Table-8.

Table-8 : Summary of Electricity Generation and Direct Use of Geothermal Energy in 1997, Source [2]

Electricity Generation and Direct use of Geothermal Energy, 1997						
Region	Electricity generation			Direct use		
	Installed capacity (giga watts-electric)	Total production		Installed capacity (giga watts-thermal)	Total production	
		Terawatt-hours (electric)	Percent		Terawatt-hours (thermal)	Percent
European Union	0.75	3.8		1.03	3.7	
Europe, other	0.11	0.5		4.09	16.1	
Total Europe	0.86	4.3	10	5.12	19.8	52
North America	2.85	16.2		1.91	4.0	
Latin America	0.96	6.9				
Total Americas	3.81	23.1	53	1.91	4.0	10
Asia	2.94	13.0	30	3.08	12.2	32
Oceania	0.36	2.9	6	0.26	1.8	5
Africa	0.05	0.4	1	0.07	0.4	1
World total	**8.02**	**43.8**	**100**	**10.44**	**38.2**	**100**

Source: Based on Stefansson and Fridleifsson, 1998.

V. Nuclear

a) *Background*

Albert Einstein's epoch making theory of relativity (1905) led to the famous mass energy conversion equation- $E= mc^2$. Chadwick discovered neutron in 1932 and Livingstone and Lawrence, proton in the same year. German scientists Otto-Hann, Strassman and Myers demonstrated fission in 1938. Enrico Fermi demonstrated sustainable chain reaction on 2nd December1942 at the University of Chicago.

The atom bomb explosions in Nagasaki and Hiroshima in August 1945 made the people of the world stunned about the tremendous potentiality of nuclear power. President Eisenhower of USA placed his proposal of "Atom for Peace" in the United Nations ( ) and assured full support and cooperation for the peaceful use of nuclear power for the benefit of humanity. The International Atomic Energy Agency was established in 1957 with the full support and active cooperation of the USA.

Nuclear power industry mainly flourished during 50s to early 70s. Then the development stuck up on the issues of proliferation, safeguards, safety and waste managements. The issues are in fact more political than technical. The recent oil price hike and the global warming issues are again drawing attentions of the world leaders towards nuclear energy. Nuclear power can help substantially in addressing the greenhouse and sustainability issues.

b) *Nuclear Energy*

Energy is released when the nuclei of the fissile atoms of Ur^{235} or Ur^{233} or Pu^{239} are fissioned by the striking neutrons. This has been elaborated in Fig. 1.

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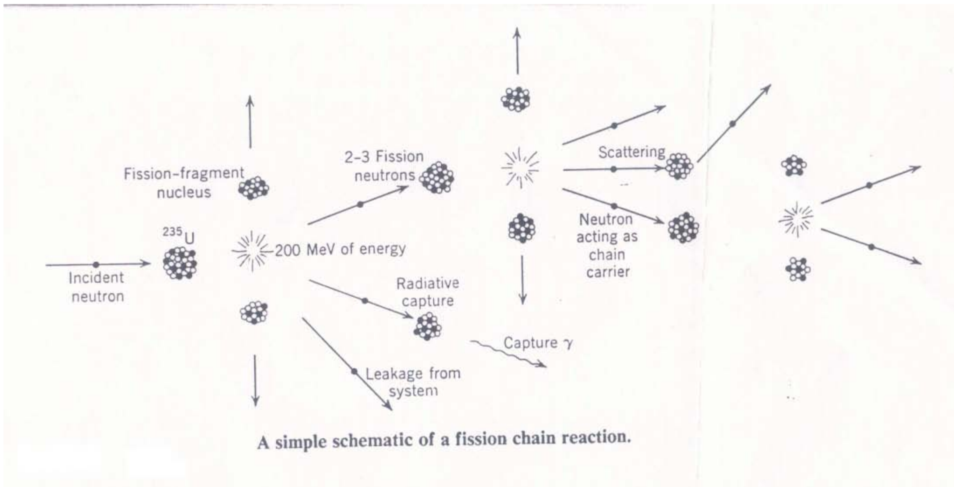

Fig. 1 : Fission Chain Reaction

c) Nuclear Materials

Nuclear materials consist of uranium, thorium and plutonium. These materials are grouped into: *fissile and fertile materials. The fissile materials are those atoms that can be fissioned by thermal neutrons. The fertile materials are the ones that can be converted to fissile materials through nuclear interactions. The fertile materials are:* Ur^{238} , $Ur^{236,}$ $Ur^{234,}$ Th^{232} etc. Most of the present day power reactors are thermal reactors and use Ur^{235} as the fuel. The uranium that is obtained in the nature contains only 0.71% Ur^{235}. The remaining is primarily Ur^{238}.

The trading of nuclear materials can only take place under strict regulatory control and IAEA observations in pursuant to the international treaties, conventions and protocols.

d) Present Status

Today nuclear power plants generate 17% of the global electricity. Annex-1 shows the nuclear power status and the nuclear share of electricity generation.

Cost of electricity generated form the nuclear power plants are very competitive as may be seen at Fig. 2.

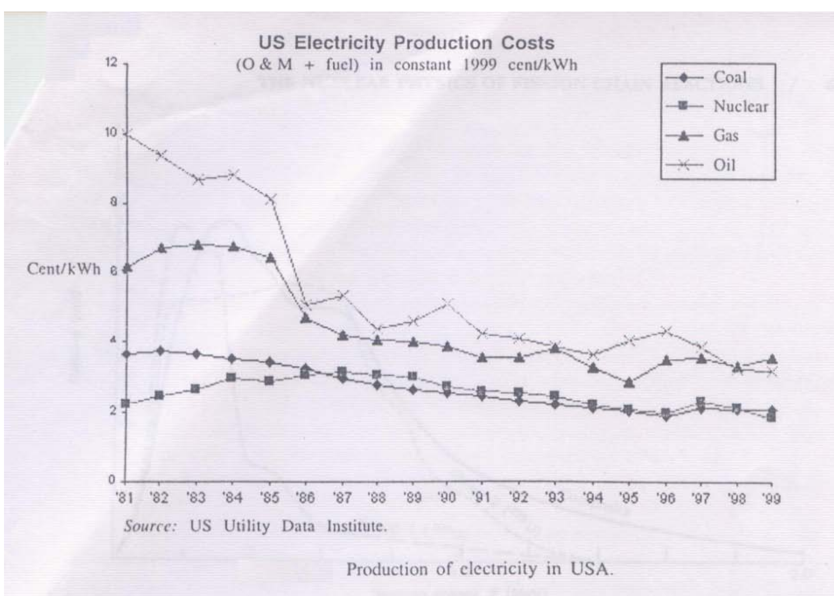

Fig.2 : Comparison of Electricity Production Costs from Different Sources

All the present day power plants are thermal reactors. There are different types of nuclear power plants: PWR, BWR, GCR, HWR and the advanced versions of these four basic types.

The nuclear power systems are basically of two types: open cycle and closed cycle. Annex-II elaborates the two cycles. At present the open cycle options is mostly pursued. But from the point of view of source conservation and other related aspects closed cycle option should be critically reviewed for future developments.

e) Special Features

Nuclear power cycle produce very little greenhouse gases and particulates. The system is environmentally much more cleaner compared to other alternatives (**Annex-III**).

The amount of fuel required for production of electricity is much less compared to the fossil fuel fired plants. A 1000 Mwe nuclear power plant requires only about 30 tons of fuel per year compared to 1.1, 1.4 and 2.2 million tons of fuel for a similar capacity gas, oil and coal fired power plants respectively (**Annex-IV**). The nuclear power option, therefore, can relieve enormous pressure from the communication system. Plant capacity factor of nuclear plant is high (70 to 80%)compared to the fossil fired plants.

f) Breeder Reactors

The fertile materials that is Ur^{238} or Th^{232} is used as a blanket surrounding the reactor core in breeder reactors. The fertile materials are gradually converted to fissile materials by neutron activations. The newly breed fertile materials after the processing, are again used for production of electricity. The energy potential of nuclear materials thus is increased at least by 60 times. Considerable works were carried out by Japan and France to develop breeder reactors. The R& D works on breeder reactors should be pursued. The nuclear reactors will be covered in more details under Module – 4 of the course.

VI. Advanced Technologies

a) Development Trend

The technological revolutions are underway in power generation to achieve the sustainability goal of near zero air pollutant and greenhouse gas emissions. The technological revolution is under way in power generation. Advanced systems are gradually replacing steam turbine technologies as part of the long term goal. Natural gas fired combined cycles with efficiency of 55% are becoming cost effective. Cogeneration is usually more efficient and can play an important role in energy economy. R& D works are going on in syngas (mixture of CO and H^2), synthetic liquid fuels, coal gasification, and hydrogen as energy carrier.

The fuel cycle and hydrogen will be covered exclusively in L 3.3. Development works are going on for conversion of hydrogen from coal, gas and biomass, liquefaction and gasification of coal etc.

b) Fusion

Fusion is the fusing of two light nuclei to form a heavier nucleus [Fig .3]. Fusion takes place at plasma state, at an ambient temperature of the order of 10^8 C. A large amount of energy is released during the process of fusion. The fusion equations are shown below:-

- ${}_1H^2 + {}_1H^2 \longrightarrow {}_2He^3 + {}_0n^1$ +3.2 Mev
- ${}_1H^2 + {}_1H^2 \longrightarrow {}_2He^3 + {}_1p^1$ +4 Mev
- ${}_1H^2 + {}_1H^3 \longrightarrow {}_2He^4 + {}_0n^1$ + 14.1 Mev
- ${}_1H^2 + {}_2He^3 \longrightarrow {}_2He^4 + {}_1p^1$ +18.3 Mev

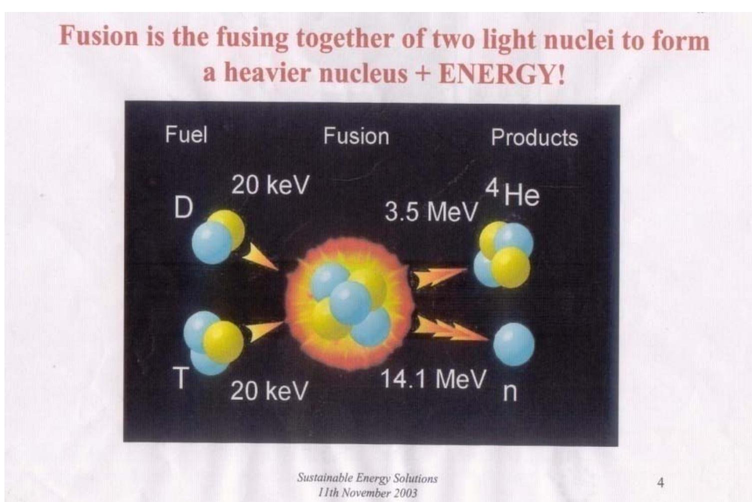

Fig. 3 : Fusion Reaction

The fusion reactions do not emit any greenhouse gas and there is little waste burden for the future generation. The possibility of large accident is also low. The amount of deuterium available in seawater is sufficient to meet the energy demand for billions of years and as such may be termed as pseudo infinite source.

The physics of fusion is quite well known. The technology is developing. It started with Tokmac process. The EU, Japan, USA, Russia, Canada, China and other countries are collaborating to develop the process. It appears to be a long way to go for the real technological break through to harness fusion energy. The time schedule is dependent on many factors, and as such is not reliably foreseen.

Experts and the associated scientists believe, "In the long term, nuclear fusion could provide power generation from abundant fuel source with zero carbon emissions and without the problems associated with long term highly radioactive wastes". They also believe that " technical feasibility of fusion power generation could be demonstrated within 25 years given adequate resource…." [11]

VII. Need and Importance

Electricity is the most preferred from of energy. The growth rate of electricity is the highest compared to other forms of energy. The Fig. 4 shows the future growth scenarios of different type of energy sources.

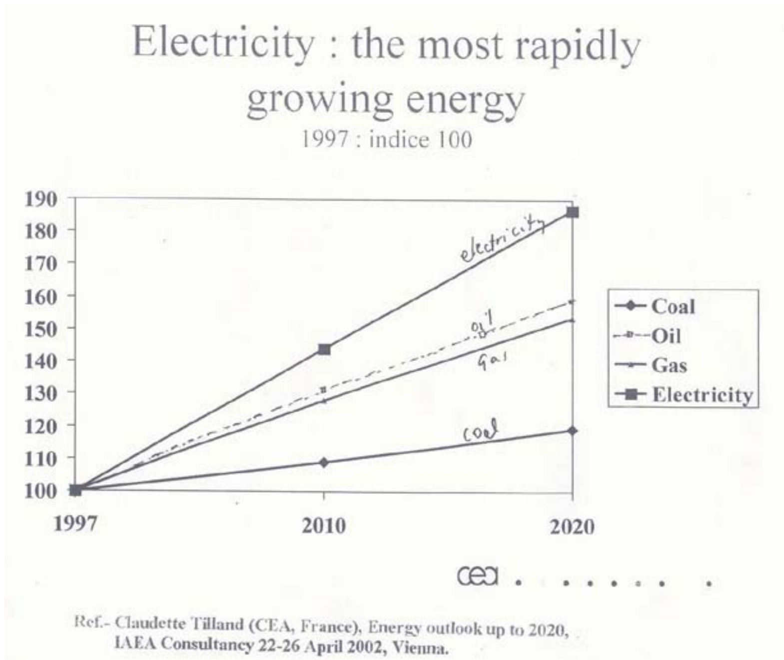

Fig. 4 : Growth Scenarios of Different Energy Sources

The share of world primary energy by different source for the global production of electricity is shown at Fig. 5. The share of the different types of fossil fuels is shown in Fig 6.

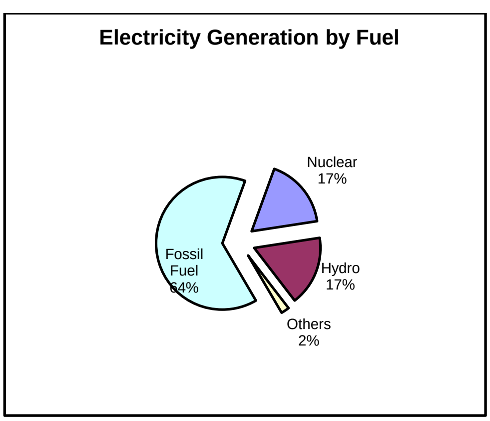

Fig. 5 : Global Electricity Generation by Sources

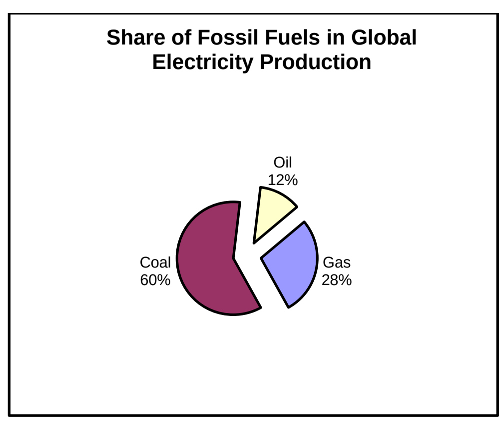

Fig. 6 : Share of Fossil Fuel in Global Electricity Generation

The prime importance of the new sources is to achieve the sustainability goals. But most of the new sources are yet to mature and become economically competitive. These have the limitations for operation as base loads.

But nuclear power is technically proven and economically competitive source. It can play an effective role in addressing the issue of greenhouse gas as well as in achieving the goals of sustainability and millennium development commitments.

VIII. Future Strategy

The new renewable energy sources are yet to be cost effective. Continued R& D will be required to make the sources economic. Besides, the sources are dependent on geographical locations, time, season, and other factors. The sources as such cannot be used as base load power supply stations. A possible strategy for optimizing the share of renewable sources is shown at Fig. 8. Continued R&D and collaborative works will also be required to expedite the development of the renewable sources. A logical flow diagram for the development activities is highlighted in Fig.9.

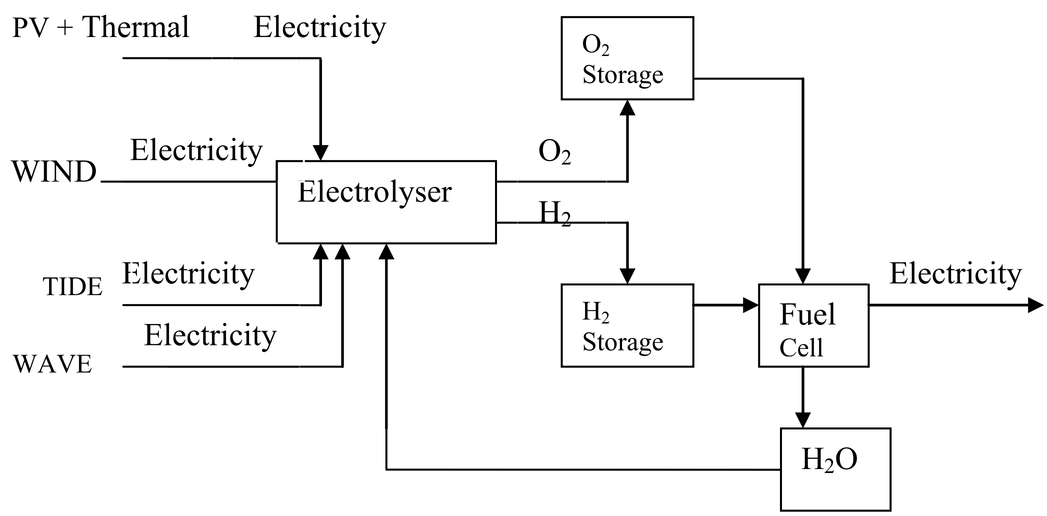

Fig . 8 : Possible Strategy for Optimizing Use of Renewable Sources

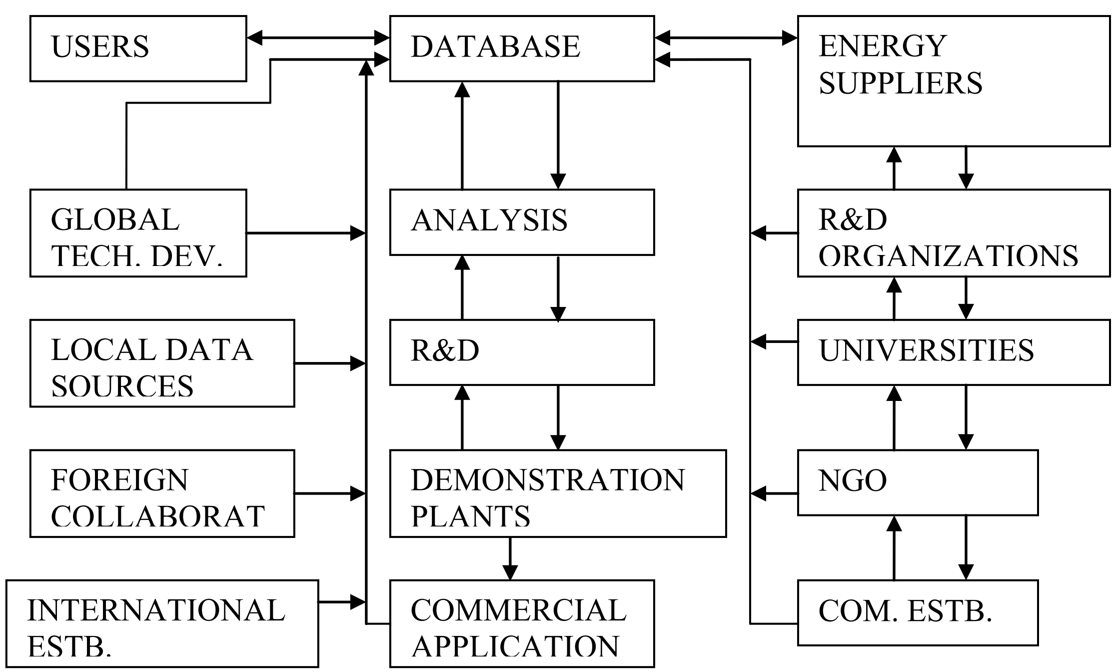

Fig. 9 : Proposed Flow Diagrams for Development of New Sources

IX. Conclusion

Energy is key for economic development as well as for the improved quality of life. The demand of different forms of energy particularly electricity are increasing and it will continue to increase. The energy sources have to be sustainable, accessible and affordable for the global population particularly those living in the least developing and developing countries.

The 2.5 billion deprived population of the world who live on less than $ 2 a day use solid fuels. The solid fuels are harmful for health and environment. Improved ovens, biogas and solar photovoltaic can meet the basic needs of fuel for cooking and electricity for lighting.

The current path of energy system is not compatible with the sustainable development objectives. The present energy system has to be remodeled with the combination of more efficient and less polluting new energy technologies and sources. The future sources will have greater share of the renewable and new energy sources.

Many of the new and renewable energy sources and the technologies are still in the process of R&D and are yet not cost effective. The R&D works have to be pursued with more intensity and clear objectivity.

Nuclear power can assist in addressing the issues of greenhouse gas and sustainability provided the world leaders cooperate in resolving the existing barriers.

Strong political will and cooperation among the states, multinational companies, R&D institutions universities, NGOs, media, civil societies and the communities at stakes will be required to achieve the goals of sustainable development and the millennium development goals.

Annexes

Annex-I: Nuclear Power Status Around the World
Annex-II:Nuclear Fuel Cycle
Annex-III: Greenhouse Gas Emissions from Electricity Production Chains
Annex-IV: Fuel Requirements for a 1000 Mwe Power Station

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Effect of First Order Chemical Reaction for Coriolis Force and Dust Particles for Small Reynolds Number in the Atmosphere Over Territory

By M. A. Bkar Pk & Ripan Roy
Rajshahi University, Bangladesh

Abstract- In the atmospheric boundary layer there are horizontal pressure gradient and Coriolis force to the velocity distribution signify that, the horizontal component of the velocity in the boundary layer turns left (right) with increasing height in the Southern (Northern) Hemisphere, downward (upward) motion occurs on the windward (lee) side of the mountain, and downward (upward) motion also occurs on the slope to the right (left) of the geostrophic wind in the Northern Hemisphere, whereas in the Southern Hemisphere upward (downward) motion occurs on the slope to the left (right) of the geostrophic wind. Using Navier-Stokes equations for three-dimensional stationary flows, hydrostatic and continuity equations, the effects of first order reactant of Coriolis force and dust particles for small Reynolds number in the atmospheric boundary layer over territory is obtained.

Keywords: atmospheric boundary layer, coriolis parameter, first-order reactant, navier-stokes equations, dust particles, maple, geostrophic wind, reynolds number.

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EFFECTOFFIRSTORDERCHEMICALREACTIONFORCORIOLISFORCEANDDUSTPARTICLESFORSMALLREYNOLDSNUMBERINTHEATMOSPHEREOVERTERRITORY

Strictly as per the compliance and regulations of :

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M. A. Bkar Pk [α] & Ripan Roy [σ]

Abstract- In the atmospheric boundary layer there are horizontal pressure gradient and Coriolis force to the velocity distribution signify that, the horizontal component of the velocity in the boundary layer turns left (right) with increasing height in the Southern (Northern) Hemisphere, downward (upward) motion occurs on the windward (lee) side of the mountain, and downward (upward) motion also occurs on the slope to the right (left) of the geostrophic wind in the Northern Hemisphere, whereas in the Southern Hemisphere upward (downward) motion occurs on the slope to the left (right) of the geostrophic wind. Using Navier-Stokes equations for three-dimensional stationary flows, hydrostatic and continuity equations, the effects of first order reactant of Coriolis force and dust particles for small Reynolds number in the atmospheric boundary layer over territory is obtained.

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I. Introduction

In recent years, a large number of analytical and numerical models for the study of the mean and turbulent motions in the planetary boundary layer under various thermal stratifications have been constructed. The main difficulty of solving the Navier-Stokes equations exactly is the contribution of the nonlinear terms representing fluid inertia which then troubled the conventional analysis in general case. Lyberg and Tryggeson [1, 2007] discussed the analytical solution of the Navier-Stokes equations for internal flows. Chae and Choe [2, 1999] studied the regularity of solutions to the Navier-Stokes equations. Nugroho *et al.,* [3, 2009] explained on a special class of analytical solutions to the three-dimensional incompressible Navier-Stokes equations. Wang [4, 1991] studied the exact solutions of the steady Navier-Stokes equations. Thailert [5, 2005] explained a one class of regular partially invariant solutions of the Navier-Stokes equations. Shapiro [6, 1993] studied the use of an exact solution of the Navier-Stokes equations in a validation test of a three- dimensional nonhydrostatic numerical model. Rajagopal [7, 1984] explained a class of exact solutions to the Navier-Stokes equations. Nugroho [8, 2013] discussed on analytical solutions to the three-dimensional incompressible Navier-Stokes equations with general forcing functions and their relation to turbulence. Bkar Pk *et al.*, [9, 2012] also studied the decay of energy of MHD turbulence for four-point correlation. He [10, 2013] studied the decay of dusty fluid MHD turbulence for four-point correlation in a rotating system. He [11,2013] also discussed the decay of MHD turbulence prior to the ultimate phase in presence of dust particle for four-point correlation. Kao [12, 1976] discussed a model for turbulent diffusion over terrain. Velocity distribution in the atmospheric boundary layer over a flat surface was first studied by Ekman [13, 1905] who assumed a constant eddy viscosity in the planetary boundary layer, and obtained an exact solution to the Navier-Stokes equations for the balance between Coriolis, pressure-gradient and viscous forces. However, most of these investigations have emphasized on flows in the boundary layer over flat surfaces.

For flows in the planetary boundary layer over flat surfaces, the mean motion may be assumed to be homogeneous in the horizontal, therefore, the Navier-Stokes equations become linear Ekman and the motion is horizontal. However, when the homogeneity in the topographical configuration of the earth's surface is taken into account, the motion is three-dimensional and the equations of motion are no longer linear. Because of increasing concern about atmospheric pollution in many population centers, industrial and power plants, which are located in valleys and terrain and since atmospheric motion is the mechanism for the transport and dispersion of pollutants, there is a growing interest in the atmospheric motion and pollution in these regions. Kao [14, 1981] also discussed an analytical solution for three dimensional stationary flows in the atmospheric boundary layer over terrain. In this work we have obtained an analytical solution to the Navier-Stokes equation for small Reynolds number and dust particles in the atmosphere over mountain-terrain and to analyze the effects of dust particle and Coriolis force on the velocity distribution in the boundary layer due to first

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order chemical reaction and the result has been discussed graphically.

II. Mathematical Formulation

Consider stationary flows of small Reynolds number and dust particles in the planetary and surface boundary layers over terrain. The Navier-Stokes equations, hydrostatic and continuity equations may be expressed as

$$u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}=f(v-v_g)+f^*(v-v_g)+R(v-v_g)+K\frac{\partial^2 u}{\partial z^2} \quad (1)$$

$$u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial v}{\partial z}=-f(u-u_g)-f^*(u-u_g)-R(v-v_g)+K\frac{\partial^2 v}{\partial z^2} \quad (2)$$

$$\frac{\partial p}{\partial z}=-\rho g,$$

and

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0.$$

where

p is the pressure,
g is the gravity acceleration,
ρ is the density,
f is the Coriolis parameter,
f^* is dust particles parameter,
R is first order chemical reaction,
K is the coefficient of eddy diffusivity assumed constant as a first approximation and u, v, w are the components of the velocity of x, y, z respectively.

The equation of motion in the surface boundary layer for stationary flow can be articulated as

$$\frac{\partial}{\partial z}|u+iv|=\frac{u_*}{k}\left(\frac{1}{z}+\frac{a}{L}\right) \quad (3)$$

where

$$i=(-1)^{\frac{1}{2}},\ \ u_*=\left(\frac{\tau}{\rho}\right)^{\frac{1}{2}},$$

a is a constant which has been experimentally determined,
u_* is the friction velocity,
L is Monin-Obukhov length and
k the von Karman's constant.

The boundary conditions for this model are

$$u=v=w=0,\quad at\ z=h(x,y) \quad (4)$$

$$u\to u_g, v\to v_g,\quad as\ z\to\infty \quad (5)$$

$$u+iv=A\frac{\partial}{\partial z}(u+iv), at\ z=h(x,y)+h_s \quad (6)$$

where

$h(x,y)$ is the topographical configuration of the terrain,
h_s is the thickness of the surface boundary layer,
$G=u_g+iv_g$ is the geostrophic wind velocity and
A is a constant.

Because at the solid boundary i.e., $z=h(x,y)$, all components are zero. If z tends to infinity then the velocity tends to the geostrophic velocity. As a result, the wind direction coincides with the wind stress at the lower boundary of the planetary boundary layer.

Combining equations (1) and (2), we get

$$\left(u\frac{\partial}{\partial x}+v\frac{\partial}{\partial y}+w\frac{\partial}{\partial z}\right)(u+iv-G)=\left(K\frac{\partial^2}{\partial z^2}-if-if^*-iR\right)(u+iv-G) \quad (7)$$

It has the following solution which satisfies the boundary conditions (5):

$$(u+iv)=G+(B_r+iB_i)\exp\{-(1+i)\mu\delta\} \quad (8)$$

$$w = [u_g + \exp\{-\mu\delta\}\{B_r \cos\mu\delta\}] + B_i \sin\mu\delta \frac{\partial h}{\partial x} + [(v_g + \exp\{-\mu\delta\})$$

$$\{B_i \cos\mu\delta] - B_r \sin\mu\delta\}\frac{\partial h}{\partial y} \tag{9}$$

where B_r and B_i are constants, and $\mu = (\frac{f+R+f^*}{2K})^{\frac{1}{2}}$.

In view of the fact that wind has no direction in the surface boundary layer, its velocity in the surface boundary layer may be expressed as

$$u + iv = |u + iv|e^{i\alpha} \tag{10}$$

At the lower boundary of the planetary boundary layer, equation (8) yields

$$(u + iv)_{z=h(x,y)+h_s} = G + (B_r + iB_i) \tag{11}$$

Combining equation (10) and (11) we get

$$(B_r + iB_i) = |u + iv|_{z=h(x,y)+h_s} e^{i\alpha} - G, \tag{12}$$

Then equation (8) can be written for dust particle as

$$(u + iv) = G + \{|u + iv|_{z=h(x,y)+h_s} e^{i\alpha} - G\} \times \exp\{-(1 + i)\mu\delta\} \tag{13}$$

for $z \geq h(x,y) + h_s$.

where α is the angle made between the geostrophic wind and the wind in the surface boundary layer.

Applying boundary conditions from equations (6) to equation (13) we can write

$$|u + iv|_{z=h(x,y)+h_s}\{A\mu(\cos\alpha - \sin\alpha) + \cos\alpha\} - A\mu(u_g - v_g) = 0 \tag{14}$$

$$|u + iv|_{z=h(x,y)+h_s}\{A\mu(\cos\alpha - \sin\alpha) + \sin\alpha\} - A\mu(u_g + v_g) = 0 \tag{15}$$

The solutions of equations (14) and (15) for A and $|u + iv|_{z=h(x,y)+h_s}$, we get

$$A = \frac{u_g(\cos\alpha - \sin\alpha) + v_g(\cos\alpha + \sin\alpha)}{2\mu(u_g \sin\alpha - v_g \cos\alpha)}$$

$$|u + iv|_{z=h(x,y)+h_s} = u_g(\cos\alpha - \sin\alpha) + v_g(\cos\alpha + \sin\alpha) \tag{16}$$

Using equation (16) into equation (13), we can write

$$u + iv = (u_g + iv_g) - \exp\{-(1 + i)\mu\delta\}$$
$$\times \{(u_g + iv_g) - [u_g(\cos\alpha - \sin\alpha) + v_g(\cos\alpha + \sin\alpha)]e^{i\alpha}\}$$

$$u + iv = (u_g + iv_g) - \{\cos(1 + i)\mu\delta - i\sin(1 + i)\mu\delta\} \times \{(u_g + iv_g) -$$
$$[u_g(\cos\alpha - \sin\alpha) + v_g(\cos\alpha + \sin\alpha)](\cos\alpha + i\sin\alpha)\}$$

$$u + iv = (u_g + iv_g) - (u_g + iv_g)\cos(1 + i)\mu\delta + i(u_g + iv_g)\sin(1 + i)\mu\delta$$
$$+ \{\cos(1 + i)\mu\delta - i\sin(1 + i)\mu\delta\}[u_g(\cos\alpha - \sin\alpha) + v_g(\cos\alpha + \sin\alpha)](\cos\alpha + i\sin\alpha)$$

$$u + iv = (u_g + iv_g) - (u_g + iv_g)\cos(1 + i)\mu\delta + i(u_g + iv_g)\sin(1 + i)\mu\delta$$
$$+ \{\cos(1 + i)\mu\delta - i\sin(1 + i)\mu\delta\}[u_g\cos\alpha(\cos\alpha - \sin\alpha) + v_g\cos\alpha(\cos\alpha + \sin\alpha)$$
$$+ iu_g\sin\alpha(\cos\alpha - \sin\alpha) + iv_g\sin\alpha(\cos\alpha + \sin\alpha)]$$

$$u + iv = (u_g + iv_g) - (u_g + iv_g)\cos(1 + i)\mu\delta + i(u_g + iv_g)\sin(1 + i)\mu\delta$$
$$+ u_g\cos\alpha(\cos\alpha - \sin\alpha)\cos(1 + i)\mu\delta + v_g\cos\alpha(\cos\alpha + \sin\alpha)\cos(1 + i)\mu\delta$$
$$+ iu_g\sin\alpha(\cos\alpha - \sin\alpha)\cos(1 + i)\mu\delta + iv_g\sin\alpha(\cos\alpha + \sin\alpha)\cos(1 + i)\mu\delta$$
$$- iu_g\cos\alpha(\cos\alpha - \sin\alpha)\sin(1 + i)\mu\delta - iv_g\cos\alpha(\cos\alpha + \sin\alpha)\sin(1 + i)\mu\delta$$
$$+ u_g\sin\alpha(\cos\alpha - \sin\alpha)\sin(1 + i)\mu\delta + v_g\sin\alpha(\cos\alpha + \sin\alpha)\sin(1 + i)\mu\delta$$

$$u+iv=\left(u_g+iv_g\right)-\left(u_g+iv_g\right)(\cos\mu\delta\cos i\mu\delta-\sin\mu\delta\sin i\mu\delta)$$
$$+\left(iu_g-v_g\right)(\sin\mu\delta\cos i\mu\delta+\cos\mu\delta\sin i\mu\delta)$$
$$+\left(u_g\cos^2\alpha-u_g\sin\alpha\cos\alpha\right)(\cos\mu\delta\cos i\mu\delta-\sin\mu\delta\sin i\mu\delta)$$
$$+\left(v_g\cos^2\alpha+v_g\sin\alpha\cos\alpha\right)(\cos\mu\delta\cos i\mu\delta-\sin\mu\delta\sin i\mu\delta)$$
$$+\left(iu_g\sin\alpha\cos\alpha-iu_g\sin^2\alpha\right)(\cos\mu\delta\cos i\mu\delta-\sin\mu\delta\sin i\mu\delta)$$
$$+\left(iv_g\sin\alpha\cos\alpha+iv_g\sin^2\alpha\right)(\cos\mu\delta\cos i\mu\delta-\sin\mu\delta\sin i\mu\delta)$$
$$-\left(iu_g\cos^2\alpha-iu_g\sin\alpha\cos\alpha\right)(\sin\mu\delta\cos i\mu\delta+\cos\mu\delta\sin i\mu\delta)$$
$$-\left(iv_g\cos^2\alpha+iv_g\sin\alpha\cos\alpha\right)(\sin\mu\delta\cos i\mu\delta+\cos\mu\delta\sin i\mu\delta)$$
$$+\left(u_g\sin\alpha\cos\alpha-u_g\sin^2\alpha\right)(\sin\mu\delta\cos i\mu\delta+\cos\mu\delta\sin i\mu\delta)$$
$$+\left(u_g\sin\alpha\cos\alpha-u_g\sin^2\alpha\right)(\sin\mu\delta\cos i\mu\delta+\cos\mu\delta\sin i\mu\delta)$$

$$u+iv=\left(u_g+iv_g\right)-\left(u_g+iv_g\right)(\cos\mu\delta\cosh\mu\delta-i\sin\mu\delta\sinh\mu\delta)$$
$$+\left(iu_g-v_g\right)(\sin\mu\delta\cosh\mu\delta+i\cos\mu\delta\sinh\mu\delta)$$
$$+\left(u_g\cos^2\alpha-u_g\sin\alpha\cos\alpha\right)(\cos\mu\delta\cosh\mu\delta-i\sin\mu\delta\sinh\mu\delta)$$
$$+\left(v_g\cos^2\alpha+v_g\sin\alpha\cos\alpha\right)(\cos\mu\delta\cosh\mu\delta-i\sin\mu\delta\sinh\mu\delta)$$
$$+\left(iu_g\sin\alpha\cos\alpha-iu_g\sin^2\alpha\right)(\cos\mu\delta\cosh\mu\delta-i\sin\mu\delta\sinh\mu\delta)$$
$$+\left(iv_g\sin\alpha\cos\alpha+iv_g\sin^2\alpha\right)(\cos\mu\delta\cosh\mu\delta-i\sin\mu\delta\sinh\mu\delta)$$
$$-\left(iu_g\cos^2\alpha-iu_g\sin\alpha\cos\alpha\right)(\sin\mu\delta\cosh\mu\delta+i\cos\mu\delta\sinh\mu\delta)$$
$$-\left(iv_g\cos^2\alpha+iv_g\sin\alpha\cos\alpha\right)(\sin\mu\delta\cosh\mu\delta+i\cos\mu\delta\sinh\mu\delta)$$
$$+\left(u_g\sin\alpha\cos\alpha-u_g\sin^2\alpha\right)(\sin\mu\delta\cosh\mu\delta+i\cos\mu\delta\sinh\mu\delta)$$
$$+\left(u_g\sin\alpha\cos\alpha-u_g\sin^2\alpha\right)(\sin\mu\delta\cosh\mu\delta+i\cos\mu\delta\sinh\mu\delta) \quad (17)$$

Separating real and imaginary part in equation (17), we get respectively,

$$u=u_g-u_g\cos\mu\delta\cosh\mu\delta+v_g\sin\mu\delta\sinh\mu\delta+u_g\cos\mu\delta\sinh\mu\delta$$
$$-v_g\sin\mu\delta\cosh\mu\delta+\left(u_g\cos^2\alpha-u_g\sin\alpha\cos\alpha\right)\cos\mu\delta\cosh\mu\delta$$
$$+\left(v_g\cos^2\alpha+v_g\sin\alpha\cos\alpha\right)+u_g\sin\alpha\cos\alpha\sin\mu\delta\sinh\mu\delta$$
$$-u_g\sin^2\alpha\sin\mu\delta\sinh\mu\delta+v_g\sin\alpha\cos\alpha\sin\mu\delta\sinh\mu\delta$$
$$+v_g\sin^2\alpha\sin\mu\delta\sinh\mu\delta+u_g\cos^2\alpha\cos\mu\delta\sinh\mu\delta$$
$$-u_g\sin\alpha\cos\alpha\cos\mu\delta\sinh\mu\delta+v_g\cos^2\alpha\cos\mu\delta\sinh\mu\delta$$
$$+v_g\sin\alpha\cos\alpha\cos\mu\delta\sinh\mu\delta$$
$$+\left(u_g\sin\alpha\cos\alpha-u_g\sin^2\alpha\right)\sin\mu\delta\cosh\mu\delta$$
$$+\left(v_g\sin\alpha\cos\alpha+v_g\sin^2\alpha\right)\sin\mu\delta\cosh\mu\delta$$
$$u=u_g-\exp\{-\mu\delta\}\times\{u_g\cos\mu\delta+v_g\sin\mu\delta$$
$$-\left[u_g(\cos\alpha-\sin\alpha)+v_g(\cos\alpha+\sin\alpha)\right]\times\cos(\mu\delta-\alpha)\} \quad (18)$$

$$v=v_g+u_g\sin\mu\delta\sinh\mu\delta-v_g\cos\mu\delta\cosh\mu\delta+u_g\sin\mu\delta\cosh\mu\delta$$
$$-v_g\cos\mu\delta\sinh\mu\delta-\left(u_g\cos^2\alpha-u_g\sin\alpha\cos\alpha\right)\sin\mu\delta\sinh\mu\delta$$
$$-\left(v_g\cos^2\alpha+v_g\sin\alpha\cos\alpha\right)\sin\mu\delta\sinh\mu\delta$$
$$+u_g\sin\alpha\cos\alpha\cos\mu\delta\cosh\mu\delta-u_g\sin^2\alpha\cos\mu\delta\cosh\mu\delta$$
$$+v_g\sin\alpha\cos\alpha\cos\mu\delta\cosh\mu\delta+v_g\sin^2\alpha\cos\mu\delta\cosh\mu\delta$$
$$-u_g\cos^2\alpha\sin\mu\delta\cosh\mu\delta+u_g\sin\alpha\cos\alpha\sin\mu\delta\cosh\mu\delta$$

$$-v_g\cos^2\alpha\sin\mu\delta\cosh\mu\delta - v_g\sin\alpha\cos\alpha\sin\mu\delta\cosh\mu\delta$$
$$+(u_g\sin\alpha\cos\alpha - u_g\sin^2\alpha)\cos\mu\delta\sinh\mu\delta$$
$$+(v_g\sin\alpha\cos\alpha + v_g\sin^2\alpha)\cos\mu\delta\sinh\mu\delta$$
$$v = v_g - \exp\{-\mu\delta\}\times\{-u_g\sin\mu\delta + v_g\cos\mu\delta$$
$$+[u_g(\cos\alpha-\sin\alpha)+v_g(\cos\alpha+\sin\alpha)]\times\sin(\mu\delta-\alpha)\} \quad (19)$$

with

$$w = u\frac{\partial h}{\partial x} + v\frac{\partial h}{\partial y}, \quad \text{where } \delta = [z - h(x,y) - h_s]$$

In the surface boundary layer with the wind at the lower boundary of the planetary layer, let the wind distribution in the surface boundary layer be

$$|u+iv| = \frac{u_*}{k}\{\ln\left[\frac{\delta+h_s+z_0}{z_0}\right] + a[\frac{\delta+h_s}{L}]\} \quad (20)$$

At the lower boundary of the planetary boundary layer, equation (3) becomes

$$|u+iv|_{z=h(x,y)+h_s} = \frac{u_*}{k}[\ln(\frac{h_s+z_0}{z_0}) + a\frac{h_s}{L}],$$

Substituting this value in equation (16) we get

$$u_* = \frac{k[u_g(\cos\alpha-\sin\alpha)+v_g(\cos\alpha+\sin\alpha)]}{[\ln(\frac{h_s+z_0}{z_0})+a\frac{h_s}{L}]} \quad (21)$$

It is noticed that u_* depends on G, L and α.

Substitution of (21) into (20) gives the velocity profiles in the surface boundary layer,

$$|u+iv| = \frac{[u_g(\cos\alpha-\sin\alpha)+v_g(\cos\alpha+\sin\alpha)]}{[\ln(\frac{h_s+z_0}{z_0})+a\frac{h_s}{L}]}\times\{\ln\left[\frac{\delta+h_s+z_0}{z_0}\right] + a[\frac{\delta+h_s}{L}]\} \quad (22)$$

$$w = |u+iv|(\cos\alpha\frac{\partial h}{\partial x} + \sin\alpha\frac{\partial h}{\partial y}),$$

for $h(x,y) \le z \le h(x,y) + h_s$.

If v_s and v_n be the velocity components along the s and n axes respectively. it is evidently that s and n axes be respectively oriented parallel and horizontally perpendicular to the geotrophic wind. Therefore, G becomes a real number, then α is the cross-isobaric angle of the wind at the surface, and equation (17) reduces into the form

$$v_s + iv_n = G + G\{(\cos\alpha-\sin\alpha)e^{i\alpha} - 1\}\times\exp\{-(1+i)\mu\delta\}$$
$$= G + G\sin\alpha\{-(\sin\alpha+\cos\alpha) + i(\cos\alpha-\sin\alpha)\}\times\exp\{-(1+i)\mu\delta\} \quad (23)$$

Since

$$e^{i[\alpha+(\frac{3}{4\pi})]} = \cos\left[\alpha+\left(\frac{3}{4\pi}\right)\right] + i\sin[\alpha+(\frac{3}{4\pi})]$$

Equation (23) can be written as

$$v_s + iv_n = G[1+\sqrt{2}\sin\alpha\exp\left(-\mu\delta + i\left\{\alpha+\left(\frac{3}{4\pi}\right)-\mu\delta\right\}\right) \quad (24)$$

Therefore,

$$v_s = G\left(1+2^{\frac{1}{2}}\exp\{-\mu\delta\right\}\sin\alpha\ \cos\{\alpha+\frac{3}{4\pi}-\mu\delta\}) \quad (25)$$

$$v_n = 2^{\frac{1}{2}}G\exp\{-\mu\delta\}\sin\alpha\ \sin\{\alpha+\frac{3}{4\pi}-\mu\delta\} \quad (26)$$

$$w = G\left(1+2^{\frac{1}{2}}\exp\{-\mu\delta\right\}\sin\alpha\ \cos\{\alpha+\frac{3}{4\pi}-\mu\delta\})\frac{\partial h}{\partial x}$$

$$+2^{\frac{1}{2}}\,G\exp\{-\mu\delta\}\sin\alpha\,\sin\{\alpha+\tfrac{3}{4\pi}-\mu\delta\}\frac{\partial h}{\partial y} \tag{27}$$

for $z > h(x,y) + h_s$, equation (22) becomes

$$|v_s + iv_n| = \frac{G(\cos\alpha - \sin\alpha)}{[\ln\left(\frac{h_s+z_0}{z_0}\right) + a\frac{h_s}{L}]} \times \{\ln\left[\frac{\delta + h_s + z_0}{z_0}\right] + a[\frac{\delta + h_s}{L}]\}$$

$$w = |v_s + iv_n|(\cos\alpha\frac{\partial h}{\partial x} + \sin\alpha\frac{\partial h}{\partial y}),\ \text{for } h(x,y) \le z \le h(x,y) + h_s. \tag{28}$$

The cross-isobaric angle α may be estimated from equation (26) by putting $v_n = 0$ at the geostrophic wind level, $z = H$. Thus,

$$\alpha = (\frac{\Omega\sin\phi}{K})^{\frac{1}{2}}[\delta - H] - \frac{3}{4\pi} \tag{29}$$

Substitutions of (29) into equations (24), (25), (26) and (28) yield, respectively,

$$v_s = G\left(1 + 2^{\frac{1}{2}}\ \exp\{-\mu\delta\} \times \sin\left\{\mu\delta - \frac{3}{4\pi}\right\}\cos\mu\,(H - z)\right) \tag{30}$$

$$v_n = 2^{\frac{1}{2}}\,G\exp\{-\mu\delta\}\ \times sin\left\{\mu[\delta - H] - \frac{3}{4\pi}\right\}\sin\mu\,(H - z) \tag{31}$$

$$w = G\frac{\partial h}{\partial x} + 2^{\frac{1}{2}}\,G\exp\{-\mu\delta\} \times sin\left\{\mu[\delta - H] - \frac{3}{4\pi}\right\} \times [\cos\mu\,(H - z)\frac{\partial h}{\partial x}$$

$$+\ \sin\mu\,(H - z)\frac{\partial h}{\partial y}],\ \text{for } z > h(x,y) + h_s \tag{32}$$

$$|v_s + iv_n| = \frac{2^{\frac{1}{2}}G\cos\{\mu[\delta - H] - \frac{1}{2\pi}}{[\ln\left(\frac{h_s+z_0}{z_0}\right) + a\frac{h_s}{L}]} \times \{\ln\left[\frac{\delta + h_s + z_0}{z_0}\right] + a[\frac{\delta + h_s}{L}]\} \tag{33}$$

for $h(x,y) < z \le h(x,y) + h_s$.

For small Reynolds number and dust particles in the planetary boundary layer of topography, the pressure gradient and Coriolis forces on stationary flows due to first order reactant, we consider a model mountain of which the height takes the form

$$h^*(x^*,y^*) = a\mu H\{\frac{1}{1+\exp\{-b[(x^{*2}+y^{*2})^{\frac{1}{2}}+c]\}} + \frac{1}{1+\exp\{b[(x^{*2}+y^{*2})^{\frac{1}{2}}-c]\}} - 1\} \tag{34}$$

If $f^*$and R are absent then equation (34) becomes

$$h^*(x^*,y^*) = a\vartheta H\{\frac{1}{1+\exp\{-b[(x^{*2}+y^{*2})^{\frac{1}{2}}+c]\}} + \frac{1}{1+\exp\{b[(x^{*2}+y^{*2})^{\frac{1}{2}}-c]\}} - 1\} \tag{35}$$

where $\vartheta = (\frac{f}{2K})^{\frac{1}{2}}$. This is the same equation that Kao has been obtained in [14].

III. Results and Discussion

For $f = f^* = 0.125$ and $k = 1$, I have computed the non-dimensionalized velocity components, $U^* = \frac{v_s}{G}, V^* = \frac{v_n}{G}$ and $W^* = \frac{w}{G}$ with the use of equations (30)-(33) in (34) and plotted the results on Figures (1 -5) shows the effect on the height of the mountain and surface boundary thickness on the earth due to first order chemical reactant and μ. we have computed the non-dimensionalized velocity components, $U^* = \frac{v_s}{G}, V^* = \frac{v_n}{G}$ and $W^* = \frac{w}{G}$ with the use of equations (30)-(33) in (35) and plotted the results on Figures (1-5). Where $x^* = \vartheta x, y^* = \vartheta y, h^* = \vartheta h, h_s^* = \vartheta h_s$ are the non-dimensionalized coordinate x, y, height of the mountain, and the surface boundary thickness respectively.

For $f = f^* = 0.125$ and $k = 0.50, 0.25, 0.15$ Figures 6, 7 and 8 show the effect on the height of the mountain and surface boundary thickness on the earth due to first order chemical reactant and μ. The distribution of the non-dimensional velocity components in the vertical cross section passing through the mountain top, parallel to the geostrophic wind. We have computed the non-dimensionalized velocity components, $U^* = \frac{v_s}{G}, V^* = \frac{v_n}{G}$ and $W^* = \frac{w}{G}$ with the use of equations (30)-(33) in (34) and plotted the results on Figures 6, 7 and 8.

It is seen that $U^* = V^* = W^* = 0$ at the surface of the mountain, and that $U^* \to 1, V^* \to 0$ as $z \to \infty$. On the windward slope of the mountain, a horizontal convergence of U^* results in an upward motion, whereas on the lee side of the mountain a downward motion occurs as a consequence of a horizontal divergence of U^*.

For $a = b = c = 1,\ H = 1,\ h^*(0,0) = 0.1,\ h_s^* = 0.1$, and $z_0^* = 0.0001$. Figures (1-5) show the distribution of the non-dimensional velocity components in the vertical cross-section perpendicular to the geostrophic wind, passing through the mountain top. It is seen that that $U^* = V^* = W^* = 0$ at the surface of the mountain and that $U^* \to 1, V^* \to 0$ as $z \to \infty$.

Here $x^* = \vartheta x,\ y^* = \vartheta y,\ h^* = \vartheta h,\ h_s^* = \vartheta h_s$ are the nondimensionalized coordinate x, y, height of the mountain, and the surface boundary thickness respectively.

Figures 6, 7 and 8 show the distribution of the non-dimensional velocity components in the vertical cross section passing through the mountain top, parallel to the geostrophic wind. We have computed the non-dimensionalized velocity components, $U^* = \frac{v_s}{G}, V^* = \frac{v_n}{G}$ and $W^* = \frac{w}{G}$ with the use of equations (30)-(33) in (34) and plotted the results on Figures 6, 7 and 8. Effects on the height of the mountain and surface boundary thickness due to some values of R and μ are shown in the figures. Figure 3 and 6 are same though the values of μ are different.

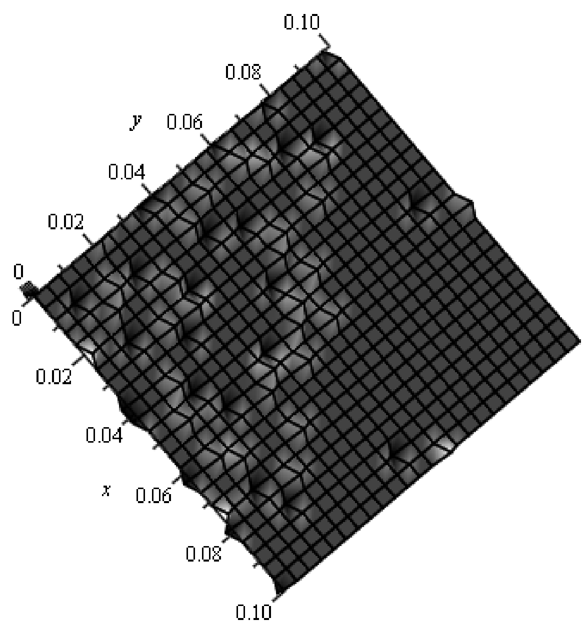

Figure 1 : Effects on the height of the mountain and surface boundary thickness due to $R = 0\ and\ \mu = 0.35.$

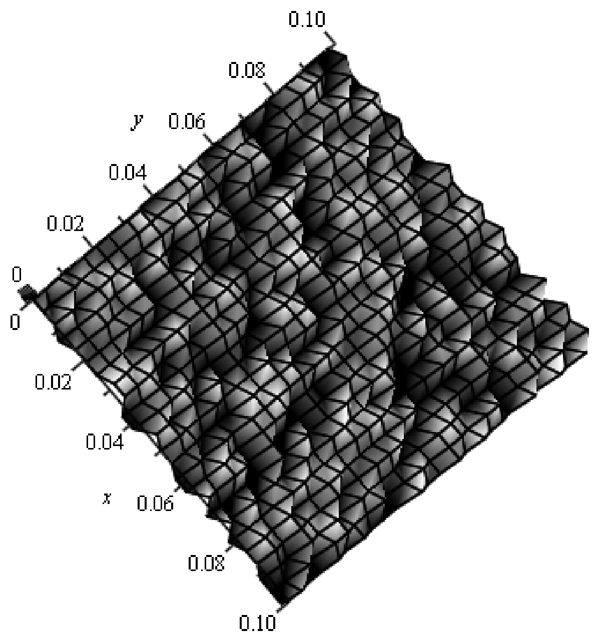

Figure 2 : Effects on the height of the mountain and surface boundary thickness due to $R = 0.125 \text{ and } \mu = 0.45.$

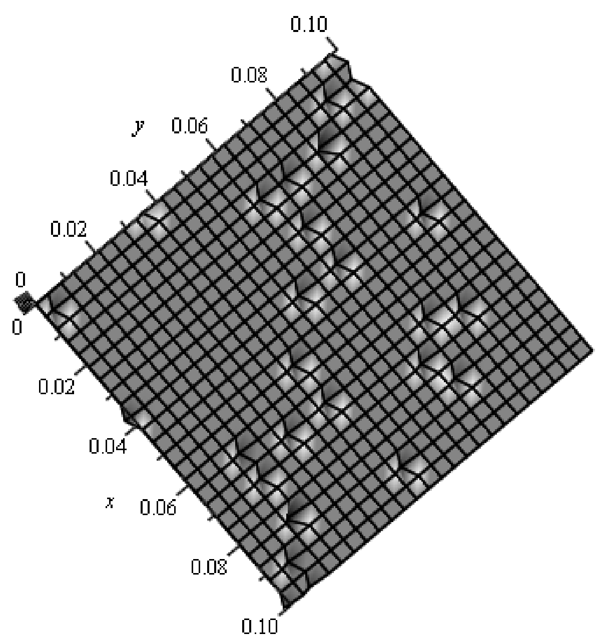

Figure 3 : First order chemical reaction due to $R = 0.250 \text{ and } \mu = 0.50.$

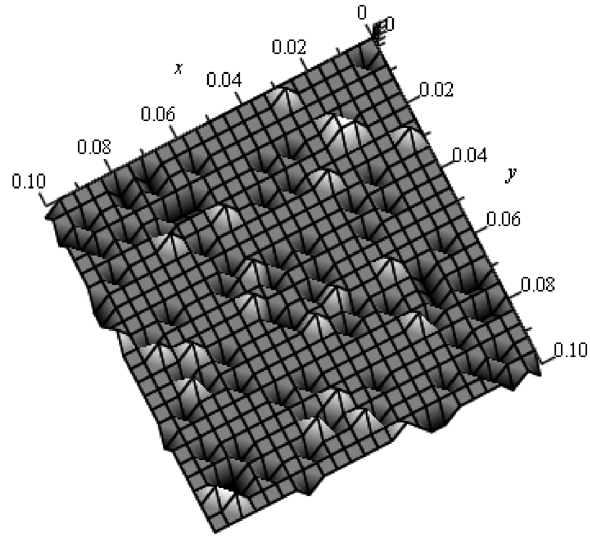

Figure 4 : Effects on the height of the mountain and surface boundary thickness due to $R = 0.50$ and $\mu = 0.61.$

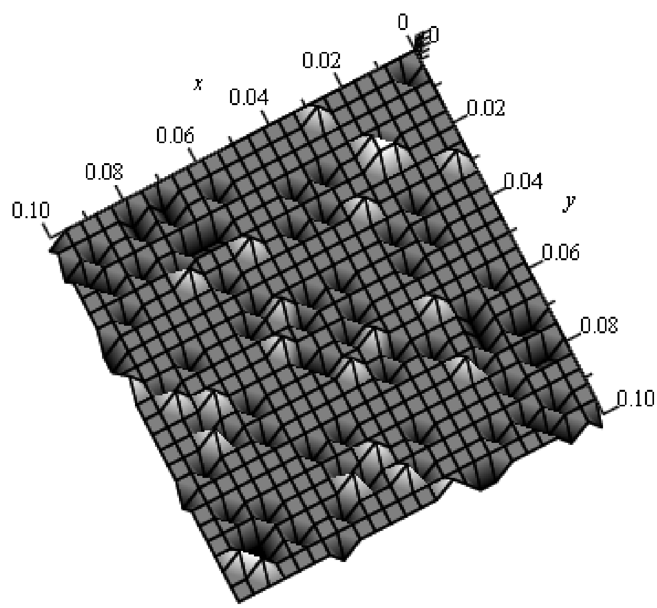

Figure 5 : First order chemical reaction due to $R = 1$ and $\mu = 0.80$

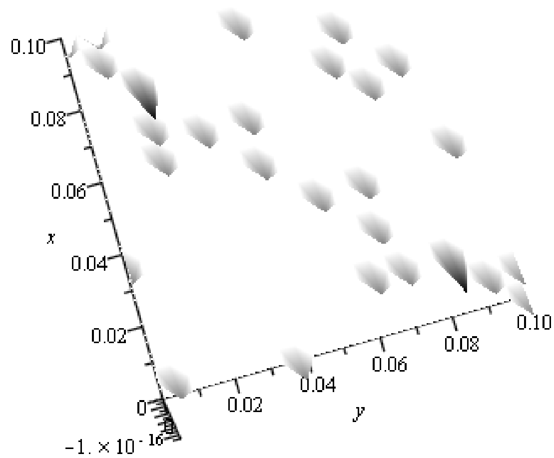

Figure 6 : Effects on the height of the mountain and surface boundary thickness due to

$R = 0 \; and \; \mu = 0.50$

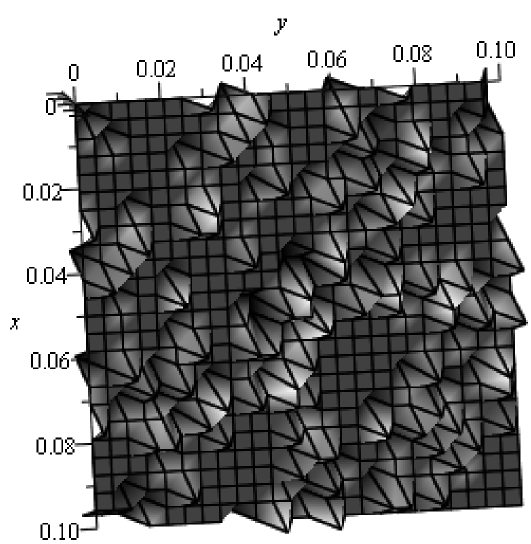

Figure 7 : First order chemical reaction due to $R = 0.50 \; and \; \mu = 1.22.$

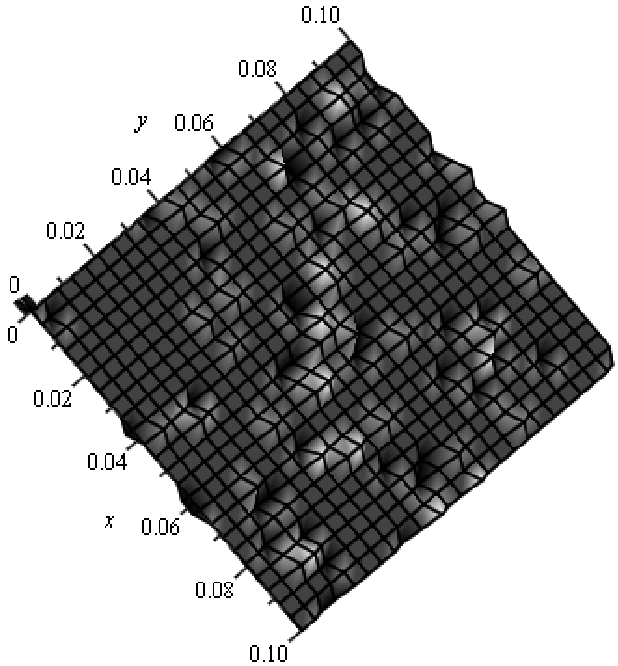

Figure 8 : First order chemical reaction due to $R = 1 \; and \; \mu = 2.03$

IV. Conclusion

Effects of first order reactant of dust particle, Coriolis force and small Reynolds number on topography, horizontal pressure gradient forces on the velocity distribution in the atmospheric boundary layer increases due to increases of μ which indicates that:

- The cross-isobaric angle is a function of the coefficient of eddy diffusivity.
- The horizontal component of the velocity in the boundary layer turns right with increasing height in the Northern Hemisphere.
- Downward (upward) motion occurs on the windward (lee) side of the mountain.
- Downward (upward) motion also occurs on the slope to the left (right) of the geostrophic wind in the Southern Hemisphere, whereas in the Northern Hemisphere upward (downward) motion occurs on the slope to the left (right) of the geostrophic wind.
- Cross-isobaric angle α decreases with increasing height of the topography.

Therefore, there would be more chance of getting precipitation on the windward side due to absent of dust particle and chemical reaction and on the slope to the left (right) of the geostrophic wind in the Southern (Northern) Hemisphere there would be less possibility of getting precipitation due to present of more dust particles and chemical reaction. Because of increasing concern about atmospheric pollution in many population centers, industrial regions and power plants, which are located in valleys and terrain and since atmospheric motion is the mechanism for the transport and dispersion of pollutants.

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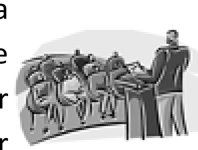

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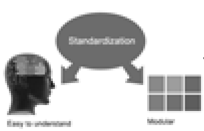

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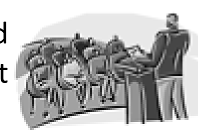

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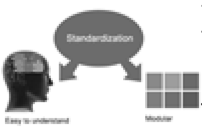

After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
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3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

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23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.
- Do not give permission to anyone else to "PROOFREAD" your manuscript.
- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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