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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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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.

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

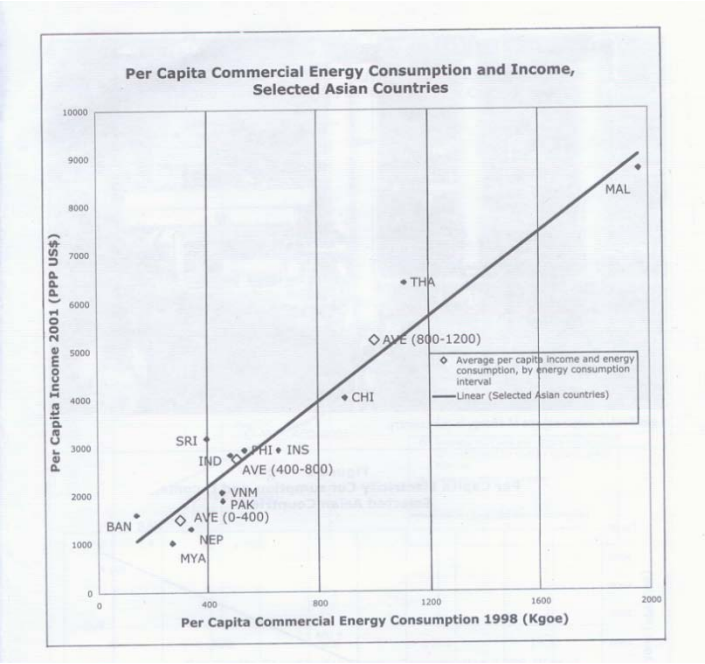
Economy is related to demand and supply dynamics of the unending and unlimited quantities and types of human centered goods and services. The dynamics of economy depend on many factors. The status of economy is measured by Gross Domestic/National Product (GDP/GNP) in terms of money, usually USA dollar ($) 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

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.

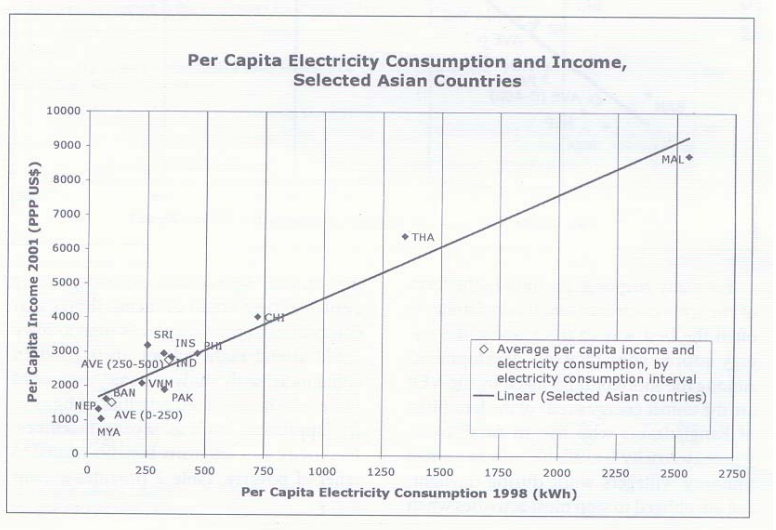
The economy or the energy consumption level reflects the quality of life of people of a country. The UNDP introduced the HDI method for comparison of quality of life status among the states of the world. The HDI was developed by Dr. Mahbubul Haque and Nobel laureate Prof. Amartya Sen. The higher the 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

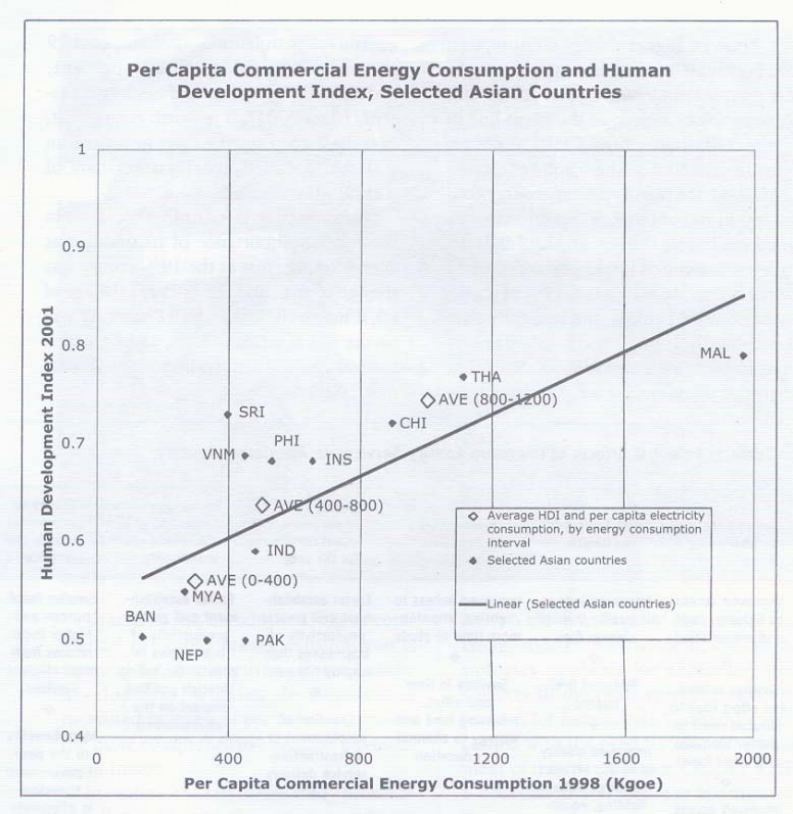


Fig. 3 : Per Capita Commercial Energy Consumption and Human Development Index of Selected Countries

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.

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

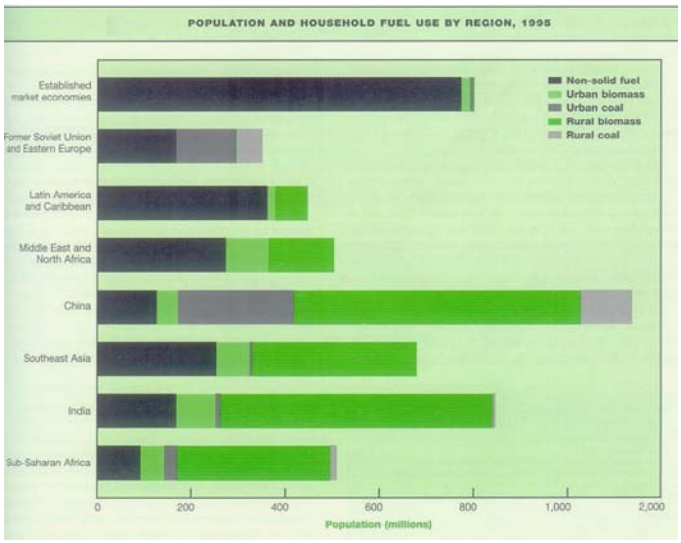
The energy systems affect surrounding environment and ecosystem. The harvesting of traditional fuels and exploration, processing till end uses of energy insult the natural environmental process. The affects include: major land use changes, due to fuel cycles such as coal, biomass and hydropower. "The 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.

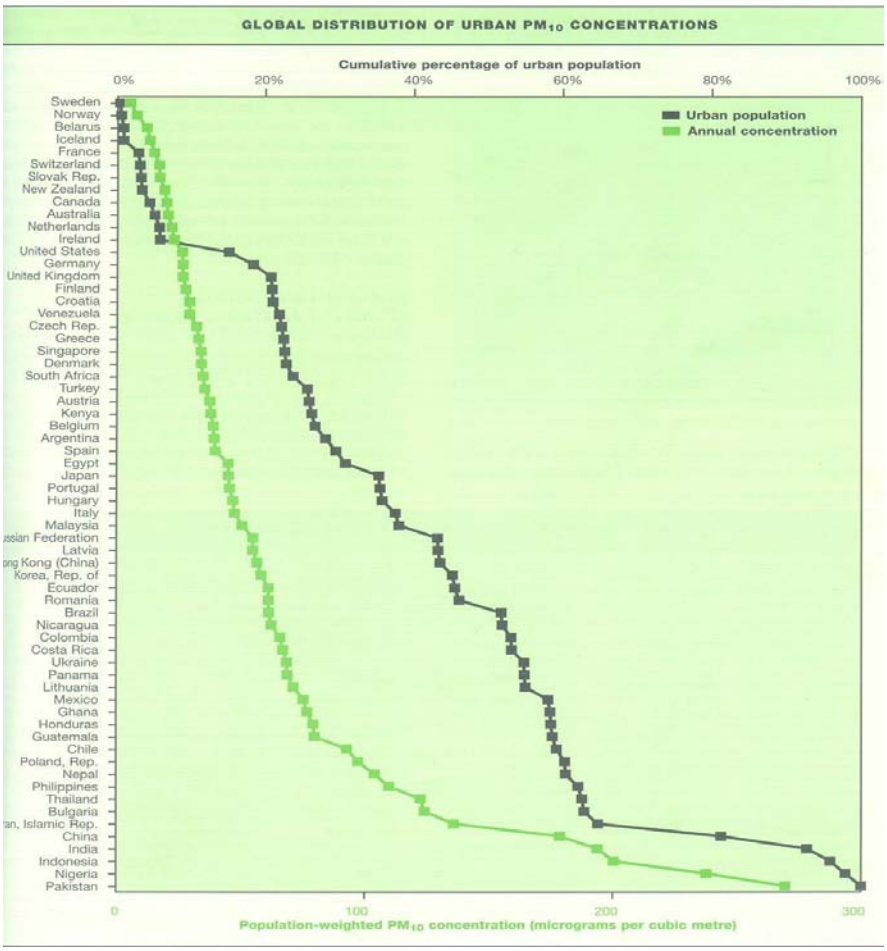


Fig. 4 : Global Distribution of Urban Particulates, Source: [4]

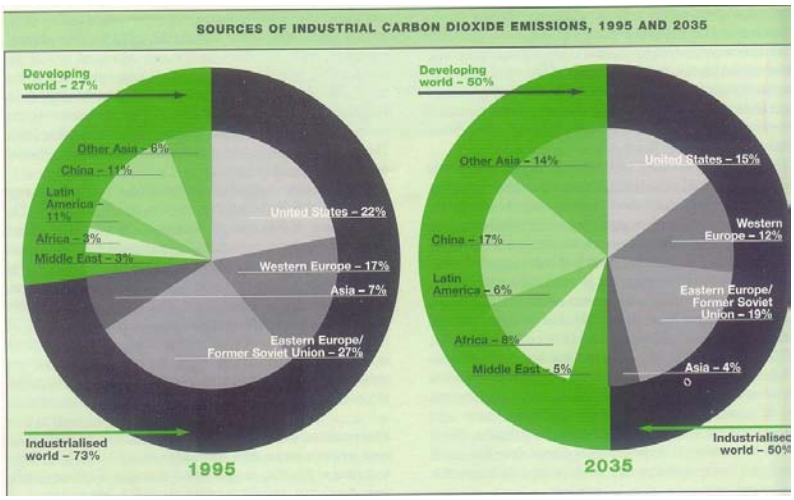
The ecological impacts of large dam associated with hydro plant are shown in Table-3.

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 0.6^0C.
- 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.

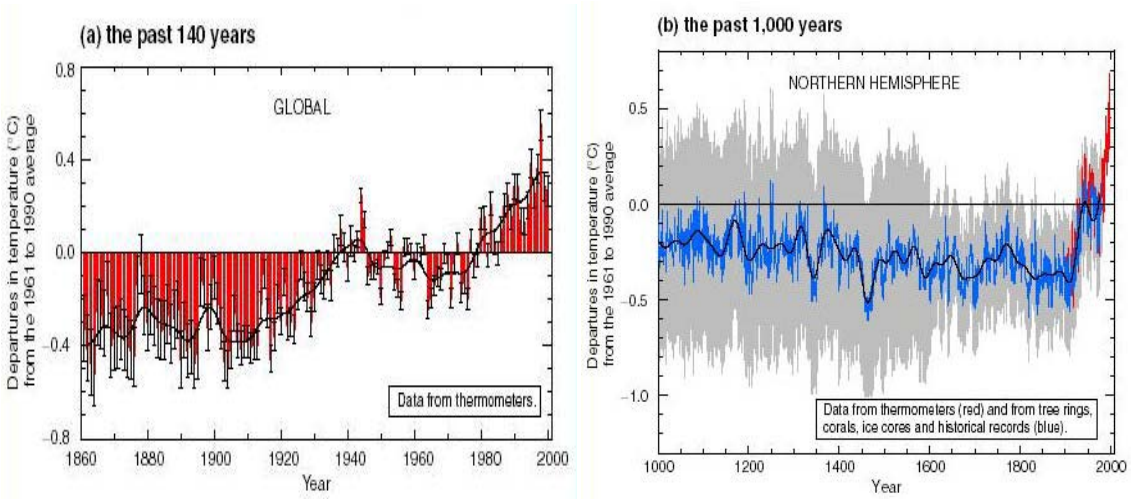


Fig 6 : Change in Earth Surface Temperature

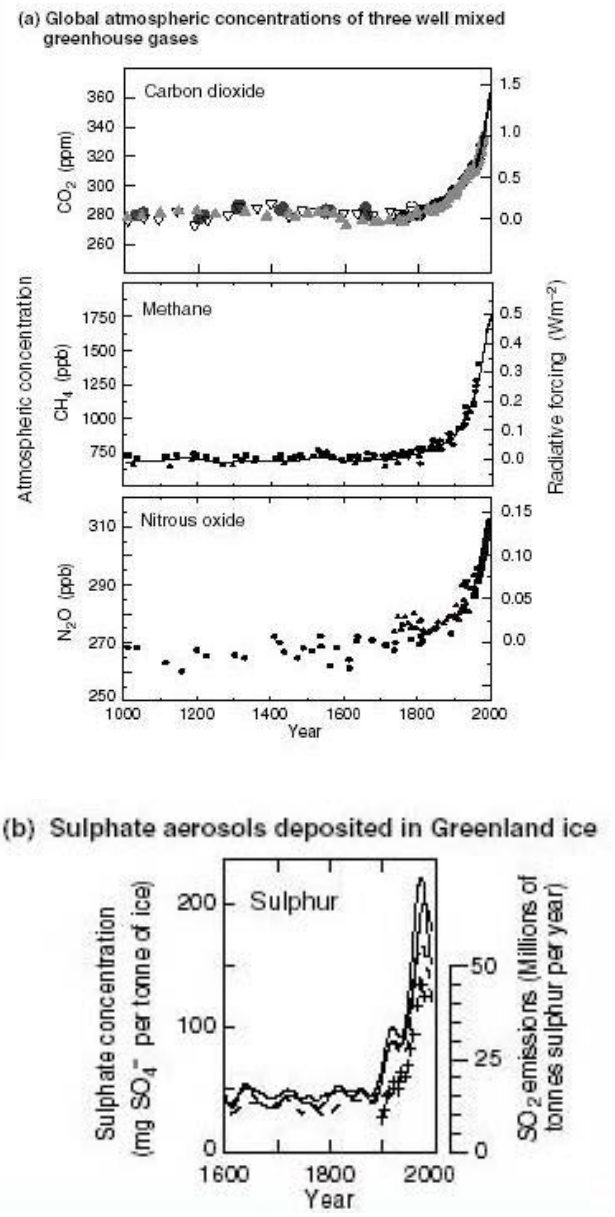


Fig 7 : Effects of Human Influence on the Atmosphere during the Industrial Era

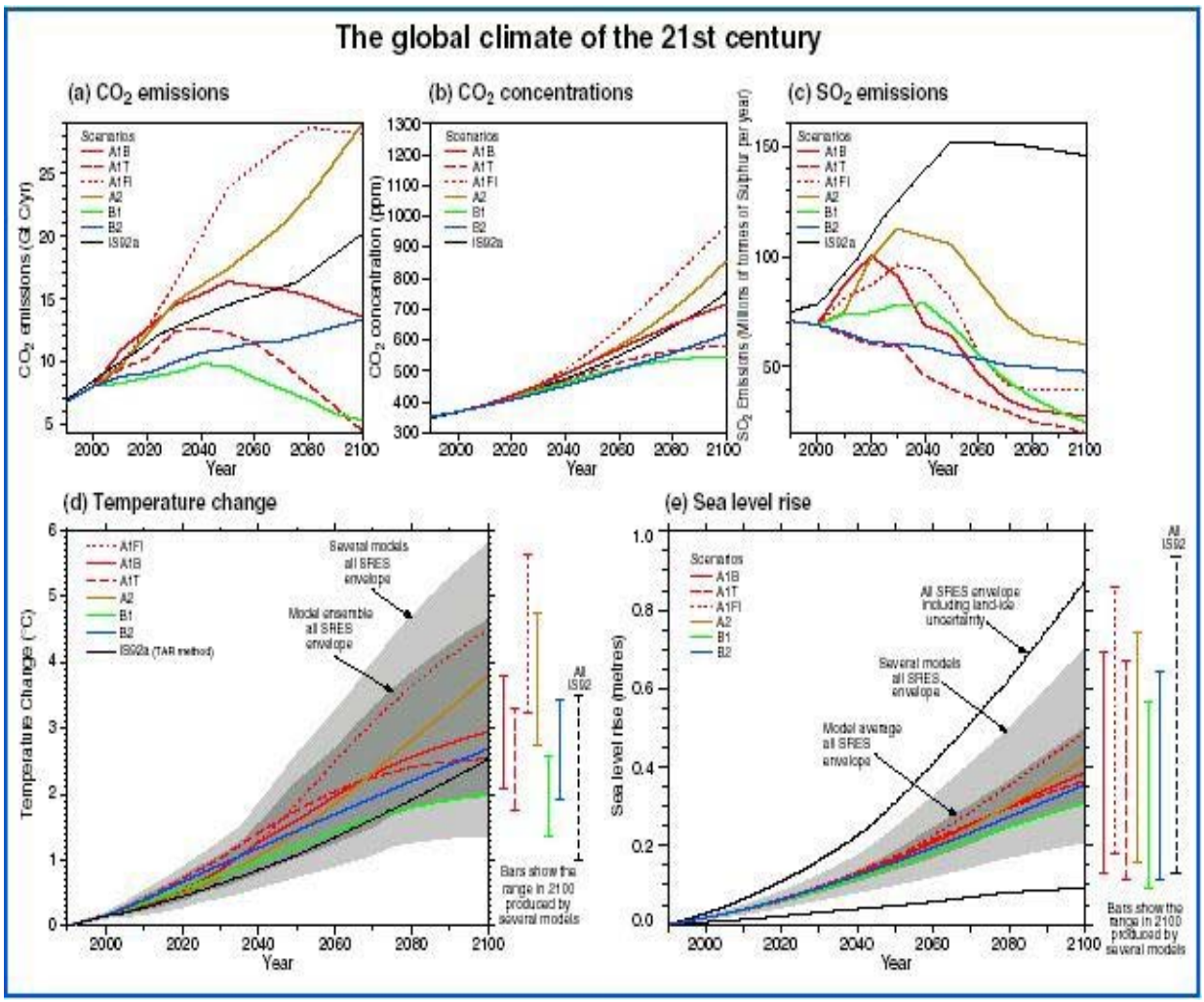


Fig 8 : World Climate Scenarios for the 21st Century

"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.

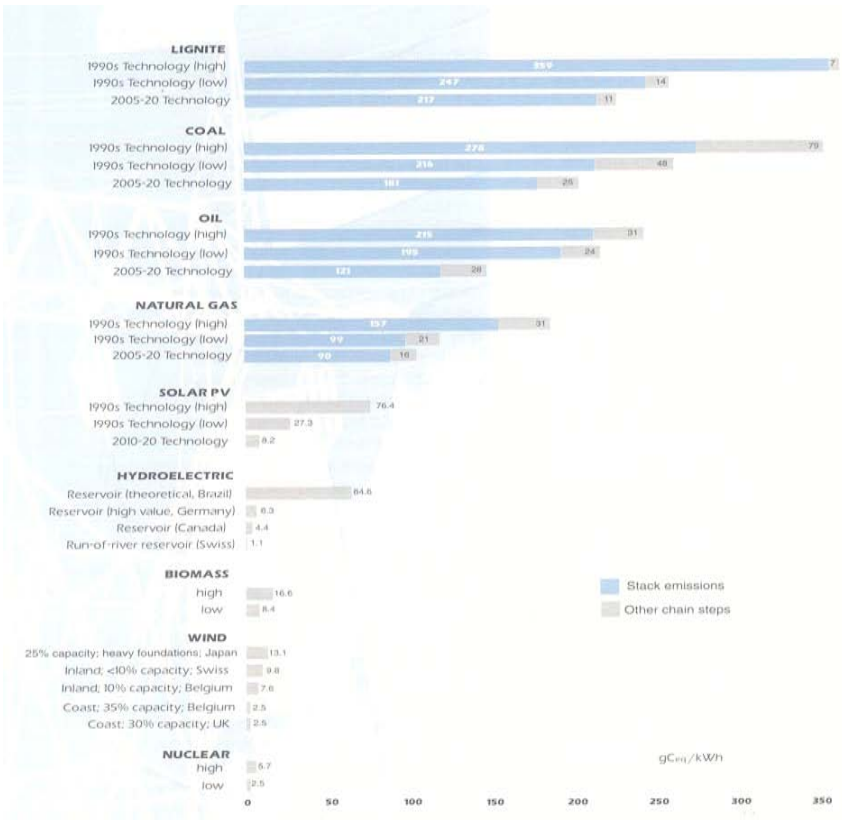


Fig 9 : Greenhouse Emissions by Different Energy Sources for Generation of Electricity

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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