

IMPACTS OF ENERGY GENERATION ON ENVIRONMENT

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ABSTRACT

Everything which surrounds the humans and where the entire social, economic and related such activities occur is referred as the Environment. The Ecology is the understanding and presentation of the relationships of organisms with one another and also with their environment which gets often affected. The current energy scenario and global consumption rate is alarming greatly as the tremendous increase in population causes a sharp increase in electrical energy demand. Surely electricity is playing a crucial role in everybody's life for the personal, social and economical growth resulting into excessive demand. The exhaustive extraction and practice of fossil energy is the main reason and contributor to many severe environmental issues. As these fuels will ultimately get depleted resulting into increased energy shortfall. Due to increasing concerns of climate change and energy security, every country is putting an effort to increase energy efficiency as well as switching over to new and renewable energy technologies. The generation of electric power from various sources results larger pollution than any industry and probable percentages of gaseous emissions are like, 60- 63% of sulfur dioxide contributes to acid rain, 20-22% of NO_x contributes to formation smog, 39% of carbon contributes to climatic changes and 30-33% of mercury results into various health complications and risks. The other major areas that get affected are, quantity and quality of water, solid and liquid wastes, capsulation of land and disruption of land uses. Reduction in per capita energy consumption, reforestation, reduction and control of gaseous emissions and converting the oceanic regions to absorb higher CO₂ results into sustained global development which advocates and ensures scientific and standard growth without affecting the ecology and the environment.

Keywords: Energy scenario, Energy generation, Emissions of Energy Systems, Environmental impacts

I. INTRODUCTION

Considering the global energy scenario, the energy usage index of a country indicate the overall growth and mean time pressurizes the energy generation system with larger demands of electricity [1-2]. An energy audit and conservation measure procedure needs to be carried out periodically to cross check the status of energy scenario and its impacts [3-4]. Globally, majority of the generation is dependent on conventional sources

namely, thermal, hydro and nuclear [5]. The main complication being faced is excessive emissions in various forms [5-8]. More ever those fossil fuels are exhaustible and predicted to face energy crisis in the near future. The waste and emissions from the generating system are alarming the environmental and health concerned to a greater extent. The following data projections of energy consumption and emissions are to be seriously considered for the corrective measures [4]. The impacts of energy generation and emission are mainly on land, water, climatic changes, health, acid rain and others on the environment are considered. The Kyoto protocol, which was created within the United Nations Framework Convention on Climate Change, strict measure and indices are assign and measured to keep the impacts on the environment to the extent planned [7-8].

II. ENVIRONMENTAL IMPACTS OF ENERGY GENERATION

A huge generation and usage of energy is being noticed due to enormous growth at a rapid rate [1-2]. It is crucial and necessary to understand implications of such. However, environmental impacts such as effects on land, acid rain, depletion of ozone depletion, destruction of ecosystem and release of gases into atmosphere are to be taken care without compromise [5-8]. In this regard choice of conventional energy and renewable energy system needs justification based on availability and investments on such [9-10].The table shows the massive impacts of CO₂ and other gases.

Table 1 Power Plant Emissions (g/kWh)

Plant Type /Gases	Coal	Oil	Gas
CO	0.11	0.19	0.2
NOX	3.54	2.02	2.32
SO2	9.26	5.08	0.004
CO2	1090	781	490

The conventional energy systems use mostly coal or gas as their input fuel [1-2]. The fuel is burned to produce steam to run the turbine to generate electricity. Generally coal with higher carbon content is preferred. The usual challenges faced are handling, disposal of materials and control of emissions and practice of clean coal technology is needed. With respect to hydroelectricity, suitable source and adequate catchment is necessary which results generation and cause change in biodiversity and eco-system [5-8]. The nuclear power systems are cost effective and have greater challenges and severe impacts [8-11]. Figure 1,2 and 3 represents the global energy consumption and generation.

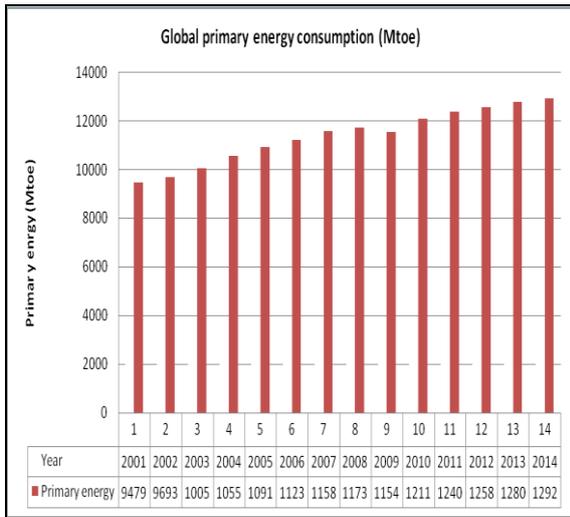


Fig 1 Global Primary consumption (MToe)

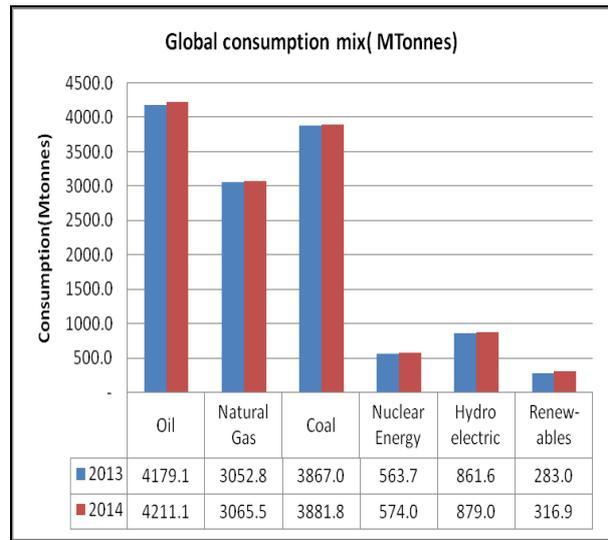


Fig 2 Global consumption (MToe)

Due to the ever increasing demand and shortage, a great challenge is being faced by the current power system to deliver the required load [9, 12-13]. The reason may be difficulty or cost of extraction of raw fuel and processing or nature and demand by value. In this regard conventional energy systems with their associated merit and demerits are supported by new and renewable systems. A wind, solar PV, diesel, Bio-mass and hybrid combinations are practiced as per the suitability [9-13]. Uses of renewable energy do not avoid all impacts entirely. Renewable energy sources are eco friendly and allow countries with no fossil fuel reserves to gain energy security and independence [9-12]. Figure 4 and 5 shows different generation systems and the power system. Renewable energy sources are those which are replenished at a rapid rate. Renewable energy sources are namely wind, solar energy, biomass and tidal.

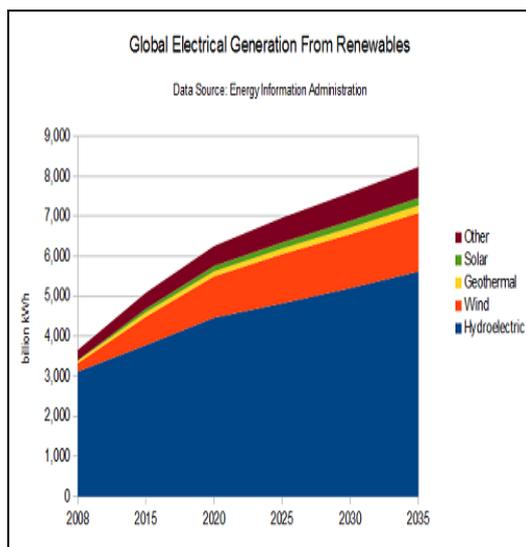


Fig 3 Global Electricity Generation from Renewable

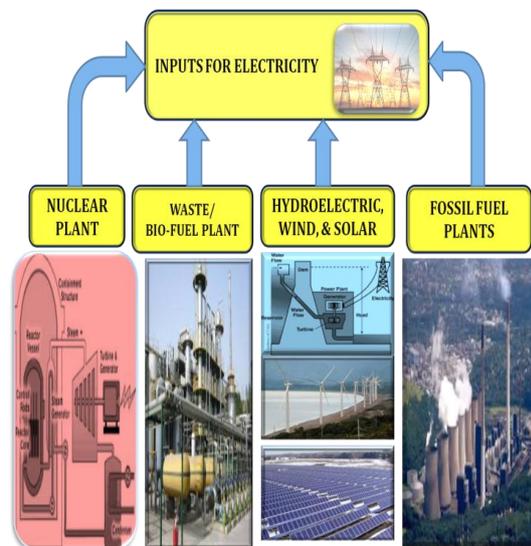


Fig 4 Different Energy systems

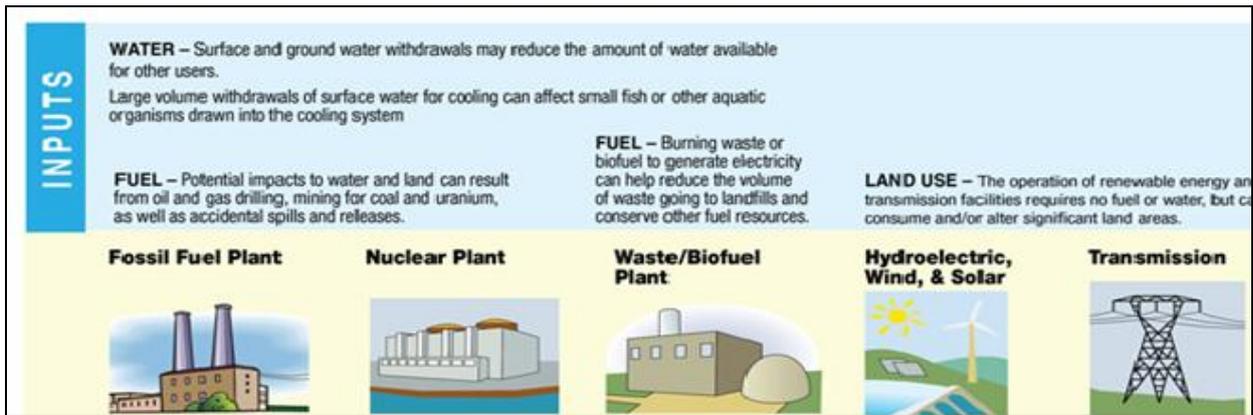


Fig 5 Typical inputs to Different Energy systems

Source: This figure illustrates some of the primary environmental impacts associated with electricity generation and transmission in Maryland.

Due to increasing concerns about climate change and energy security, nations are making an effort to increase energy efficiency and switch over to renewable sources [13]. Kinetic energy from the wind is converted to mechanical energy and to drive turbine to generate energy. Solar energy systems exploit the energy from solar radiation to produce usable energy. These energy systems have least impacts like huge land, noise and water etc [6, 8, 13]. The global climate change generally used to represent the noticeable changes to the earth's climate caused by various activities of human [6]. The term Global warming defines and explains predictions of a steady change in average world-wide temperatures. Regardless of type of generating system the climatic changes sure to occur [7, 10, 13]. The following points namely, land, water, gaseous emissions, solid wastes, health and ecological shifts are considered for discussion with proposed heading to understand the effect and influences [13].

2.1 Impacts on Land

Every power plant for its installation and operation require huge capital investment and area. Therefore to support the country's overall growth, lot of deforestation and land capturing will take place [3, 5, 10]. The major issues are storage and handling of raw fuel and waste materials at the energy systems. Generally in thermal and nuclear systems lot of on and off shore deposition results loss of cultivation and fertility as most of the waste materials are toxic [11, 13]. Excessive mining of raw fuels results surface irregularities and change in vegetation. With respect to hydroelectric systems the dams result river side floods and disturbances to the living habitats permanently. The growth and value of the locality depends on the life span of the energy system. A sudden loss or fall in land value is possible as and when the plant is decommissioned for various reasons. A nuclear reactor even after decommissioning leaves behind radioactive wastes and imposes land impacts that can exceed safety levels related to air or water impacts associated with any other generating technology [10, 12-13]. The proper environment friendly practices can reduce the severity of these impacts and not obsolete them. A generating plant built on land that is not reserved or valued for other uses, and which was sited with the best environmental controls and with full public input and agreement, may represent few significant environmental issues.

2.2 Impacts on Water and Marine Species

The main fuel to hydroelectric plant is water to drive turbines. Water is generally collected in the dam after diverted from the river. Water is also used for cooling the system components for their proper operations. Generally hydroelectric generation needs huge catchment area resulting into deforestation disturbance to flora-faun, migration of many fish and marine species, erosion of riverbeds and higher risks of floods leading to loss of vegetation, migration and disturbance to living beings etc [10, 12-13]. The natural disasters like earth quake etc affect such storage heavily. Higher evaporation of water and fungal growth leading health related disease are the other effects [13]. In case of nuclear power station huge quantity of water is consumed for obtaining steam, cooling and cleaning etc. The water quality after it is left out of the process is very important. The contaminated water having lot of toxic materials in it can cause severe effects on environment, ecological balance, agriculture, drinking and sanitation and what not [10, 12-13]. Similarly in thermal system, huge quantity of water is used in the sub processes inside the plant and water quality at final outlet and its inlet is comparable and due to which proper treatment is very necessary. The contaminants results various effects as discussed earlier. Over all scarcity of water for drinking and sanitation might result in the near future [10, 12-13].

2.3 Gaseous and Other Air Emissions

The earth's climate altering and is due to increase in fossil fuel burning such as coal, gas and oils. Burning fossil fuels releases carbon, oil and natural gas and carbon is transformed into carbon dioxide, contributing to the greenhouse effect [5-8]. The greenhouse effect allows energy from the sun to pass through the earth's atmosphere and then traps part of that energy and results higher temperature on the earth's surface [11-13]. The increase in emissions of CO₂ and other gases, such as methane, traced to fossil fuel burning and other human endeavor, boost heat trapping processes in the atmosphere. Ultimately raising the average global temperature. Atmospheric greenhouse gas concentrations are far higher than the past 800,000 years CO₂ at 395 ppm 30% higher and methane at 1025 ppb over 110% higher.

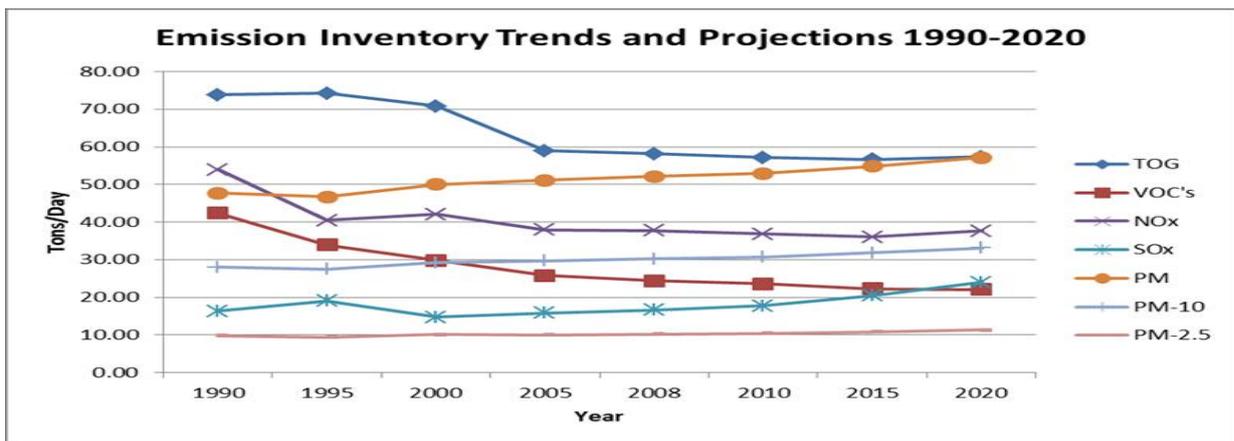


Fig 6 Gaseous Emission Trends

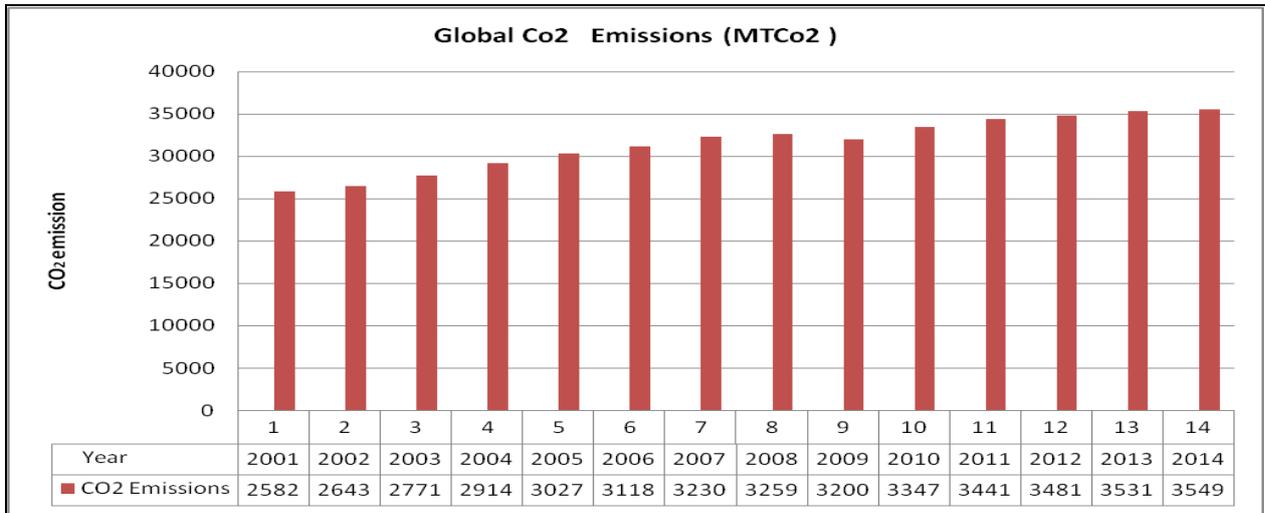


Fig 7 Historical Global CO₂ emissions

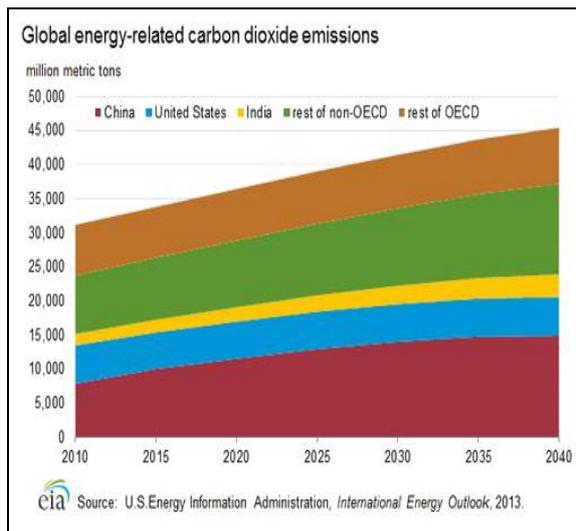


Fig 8 Global CO₂ Emissions County wise

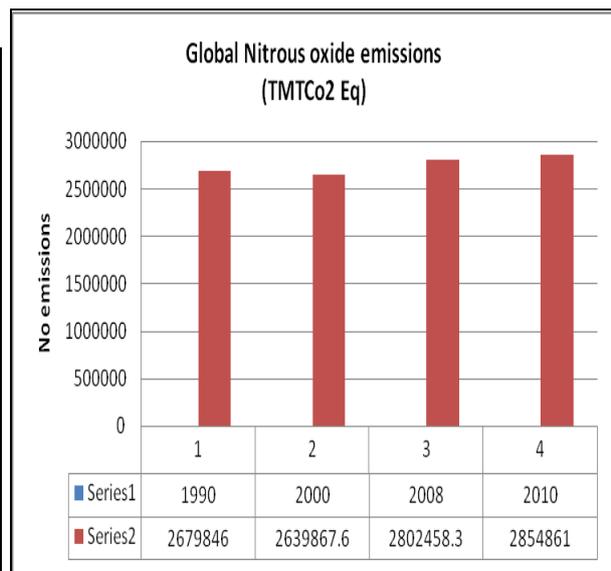


Fig 9 Global NO_x emissions

Figure 6,7.8 and 9 represent the emission trends and quantity of gaseous emissions from the generation systems. Acid rain is the result of pollutants like, NO_x and SO₂, in the atmosphere and their reaction with water and oxidants. The resulted acidic compounds create acid rain, acidifying lakes and streams, harming the land and monuments by depositing on the surfaces, forest and eco systems [6-8]. Ozone protects the earth from harmful ultraviolet rays. It is a layer naturally exists in the upper levels of the atmosphere. The heavy and thick fog known as smog is resulted by photochemical action with ozone in many countries where in huge emissions of NO_x exists [6-8, 10-13]. Usually it obstructs the sunlight and creates problems of visibility, allergic and respiratory issues to living beings. Mercury and other gaseous emissions do result such disorders [13].

2.4 Impacts on Health

Global warming causes major threat to human beings by increased infectious diseases as the temperatures nurture the mosquitoes and rodents which spread the disease [3]. Scientists at the Harvard Medical School have linked the US outbreaks of dengue fever, malaria, hanta virus and other diseases to global climate change. Burning of any fossil fuels form coal and nuclear systems result carbon dioxide and release of small quantity of uranium, radium and thorium particles into the atmosphere. Also small quantities of radioactive gases like krypton-85, xenon-133 and iodine-131 resulting health disorders like, Air pollution from coal plants affects respiratory and cardiovascular systems, causes abnormal neurological development in children, poor growth of the fetus before birth, and cancer [10-13]. Figure 10,11 and 12 shows the health impacts of mercury and other gaseous emissions caused by the power plants.

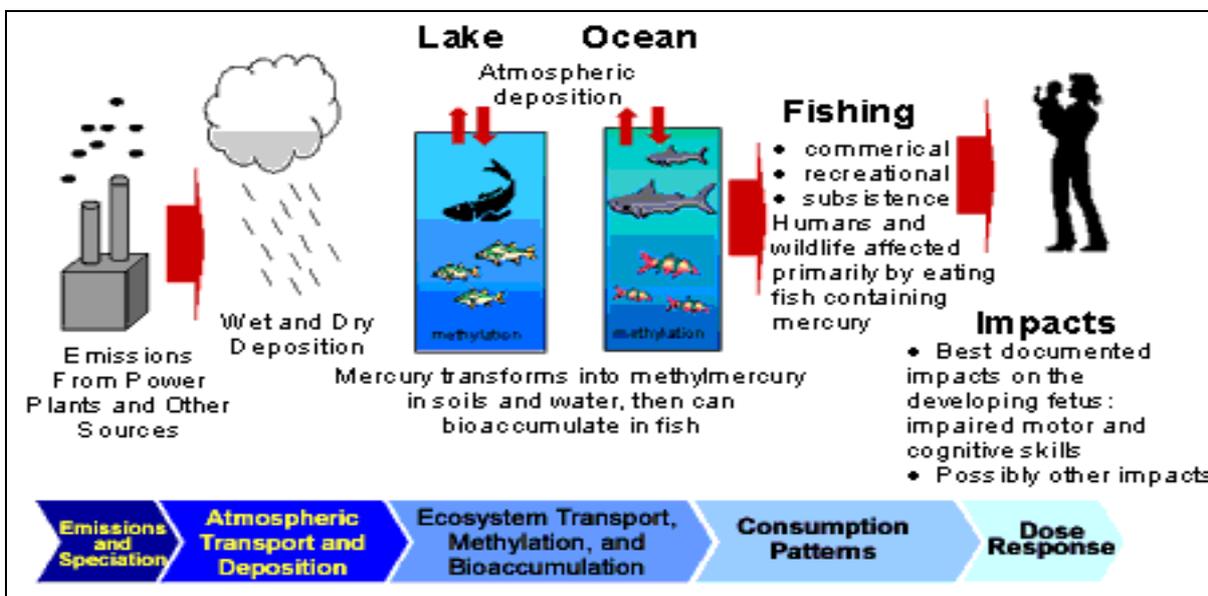


Fig 10 Health Impacts of power generation

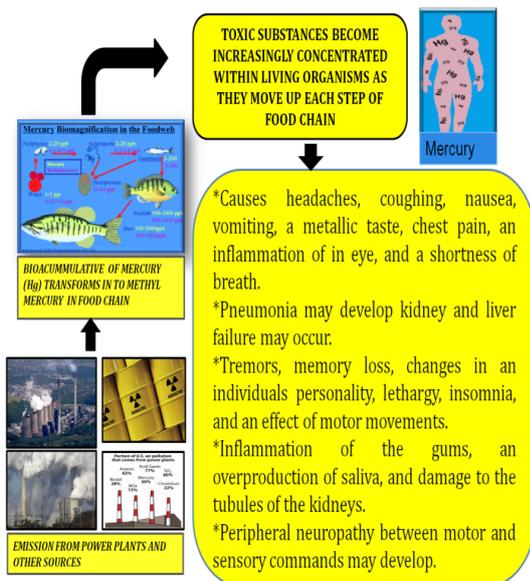


Fig 11 Health impacts of Mercury

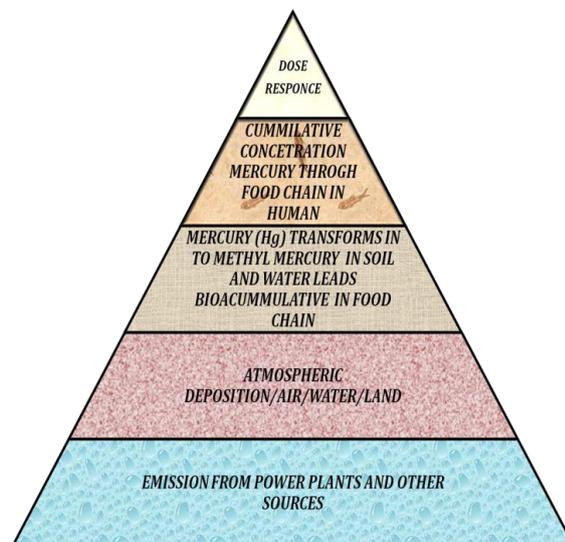


Fig 12 Cumulative Health impacts of emissions

III. CONCLUSIONS

The current work mainly presents energy scenario and environmental impacts of energy generation. To a greater extent coal is used in many countries for the generation of energy and lead to possible hazards or complications. Alternatively the renewable energy systems are the best substitute in such situations based the availability of resource. Environment related issues are strongly influencing the developing countries. Otherwise it leads to Global warming, Green house effects and other various areas as discussed. Reduction of per capita energy consumption, reforestation, reduction in emission of gases and making large ocean regions to absorb higher CO₂ are usual remedies. Sustainable development which ensures scientific and standard growth also advocates the global economic development without causing significant damage to the ecology and the environment need to be practiced. General awareness programs and good practices can change the scenario in incremental steps or otherwise world could meet the possible great energy and environmental disaster.

REFERENCES

- [1]. BP Statistical Review of World Energy June 2015 bp.com/statisticalreview #BPstats
- [2]. International Energy Agency © OECD/IEA, 2015 International Energy Agency 9 rue de la Fédération 75739 Paris Cedex 15, France www.iea.org.
- [3]. Health and the environment: addressing the health impact of air pollution, executive board 136th session Agenda item 7.2 EB136/CONF./9 Rev.1 29 January 2015.
- [4]. Mallikarjun G Hudedmani, Vishwanath M Soppimath. Energy Audit: an initiative to Energy Conservation. Discovery, 2015, 38(173), 46-51
- [5]. Carrasco, J.F. (2014) The Challenge of Changing to a Low-Carbon Economy: A Brief Overview. Low Carbon Economy, 5, 1-5. <http://dx.doi.org/10.4236/lce.2014.51001>
- [6]. Environmental And Health Impacts Of Electricity Generation, The International Energy Agency – Implementing Agreement For Hydropower Technologies And Programmes.
- [7]. Understanding CO₂ Emissions from the Global Energy Sector, Live wire- A knowledge note series for the energy practice 2014/5, 85126
- [8]. Trends in global CO₂ emissions: 2014 Report © PBL Netherlands Environmental Assessment Agency The Hague, 2014 ISBN: 978-94-91506-87-1 PBL publication number: 1490 JRC Technical Note number: JRC93171
- [9]. E. E. (Stathis) Michaelides, Alternative Energy Sources, Green Energy and Technology, DOI:10.1007/978-3-642-20951-2_2, Springer-Verlag Berlin Heidelberg 2012
- [10]. The Energy Project, Land and Water Fund of the Rockies, How the West Can Win: A Blueprint for a Clean and Affordable Energy Future (1996).
- [11]. Scientific Evidence of Health Effects from Coal Use in Energy
- [12]. Data from <http://esm.versar.com/pprp/ceir17/HTML/Chapter4-1-3.html>
- [13]. Textbook: M. M. El-Wakil, Power plant Technology, McGraw-Hill, 1984, reprinted 2002 Environmental impact of electric generation