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From The Desk of the Editor-in-chief...

जलमजलस्थानगतिम्, सर्वथाएवरक्षणीयम्,
जन्तूनांसुखजीवनहेतु, जलस्यरक्षणम्नूनंभवतु!

Drinking water and sanitation is one of the major threats that our planet earth is now facing. More than three million children under the age of five die each year from environment-related causes, such as contaminated water and lack of adequate sanitation. Water scarcity is a stark reality and not a mirage that can be ignored for long. It is a result of myriad political, environmental, economic and social forces that it has been highlighted and has now become a challenge that has to be dealt effectively.

You may observe that the level of freshwater on Earth has remained almost constant over time, by being continually recycled through the atmosphere and back into our glasses—but now, the population has exploded. This means that every year, there is a competition for clean, copious supply of water for drinking, cooking, bathing and various other purposes for the sustenance of life.

As per the National Geographic reports, 'Freshwater makes up a very small fraction of all water on the planet. While nearly 70 percent of the world is covered by water, only 2.5 percent of it is fresh. The rest is saline and ocean-based. Even then, just 1 percent of our freshwater is easily accessible, with much of it trapped in glaciers and snowfields. In essence, only 0.007 percent of the planet's water is available to fuel and feed its 6.8 billion people. Due to geography, climate, rapid innovations and scientific developments, regulations, and ample of natural resources, few regions of the world seem to be relatively flushed with fresh-water, while others face drought and debilitating pollution. The developing world is facing a major crisis because of availability of clean water.

According to the United Nations, water use has grown at more than twice the rate of population increases in the last century. By 2025, an estimated 1.8 billion people will live in areas plagued by water scarcity, with two-thirds of the world's population living in water-stressed regions because of use, growth, and climate change. The challenge we now face as we head into the future is how to effectively conserve, manage, and distribute the water we have. It's time to generate awareness about this challenge and take effective measures to overcome the same. The current government in India has taken strategic steps to keep the rivers clean especially River Ganga. The clean water rule is simple: 'Keep the waterways safe and the drinking water clean.'

किञ्चित्जलमपितीतम्दाहकंष्टं करोतिदूरम् । शुष्कतपनं हाहाकारः जलसंरक्षणम्परिहारकः ।।

Water is life we must conserve it.

Happy Reading!

Dr. Sanjeev Bansal

Causes and Prevention of air pollution in modern age

Tanya Bhattacharya*

Jyoti Garg**

Air pollution happens when gases, dust particles, vapor (or smoke) or odor are brought into the climate such that makes it unsafe to people, creatures and plant. Air pollution undermines the health and wellness of people and other living creatures in our planet. It makes smog and corrosive rain, causes cancerous hazard and respiratory, lessens the ozone layer environment and adds to an unnatural weather change.

In this modern age, air pollution can't be got rid of with totally, however steps can be taken to lessen it. The administration has created, and keeps on creating, rules for air quality and statutes to limit discharges with an end goal to control air pollution. On an individual dimension, we can lessen our contribution to the pollution issue via carpooling or utilizing open transportation. Furthermore, purchasing vitality effective lights and machines or generally lessening our power use will diminish the toxins discharged in the generation of power, which makes the dominant part of modern air pollution.

Keywords: particulate, VOC, Ozone (O₃), precipitator, oxides

INTRODUCTION

Air pollution is the presentation into the climate of chemicals, particulates, or organic materials that causes uneasiness, infection, or passing to people, harm other living life forms, for example, sustenance harvests, or harm the common habitat or manufactured condition.

A substance in the air that can be unfavorable to people and the earth is known as an air poison. Toxins can be as strong particles, fluid beads, or gases. What's more, they might be natural or man-made. Toxins can be delegated essential or auxiliary. Generally, essential contaminations are straightforwardly delivered from a procedure, for example, fiery remains from a volcanic emission, the carbon monoxide gas from an engine vehicle fumes or sulfur dioxide discharged from production lines. Auxiliary contaminations are not transmitted straightforwardly. Or maybe, they shape in the air when essential toxins respond or interface. A critical case of an auxiliary poison is ground level ozone – one of the numerous optional contaminations that make up photochemical exhaust cloud. A few poisons might be both essential and auxiliary: that is, they are both discharged specifically and framed from other essential contaminations.[1]

Essential contaminations discharged by human activity include:

1. Sulfur oxides (SO_x) - especially sulfur dioxide, a substance compound with the condition SO₂. SO₂ is conveyed by volcanoes and in various mechanical methodology.

Since coal and oil consistently contain sulfur fuels, their start produces sulfur dioxide. Further oxidation of SO₂, by and large inside seeing a driving force, for instance, NO₂, outlines H₂SO₄, and along these lines destructive downpour. This is one reason for stress over the regular impact of the use of these fills as power sources.

2. Nitrogen oxides (NO_x) - especially nitrogen dioxide are expelled from high temperature consuming, and are moreover conveyed typically in the midst of rainstorms by electric discharge. Can be seen as the darker obscurity curve above or tuft downwind of urban networks. Nitrogen dioxide is the invention compound with the condition NO₂. It is one of only a handful couple of nitrogen oxides. This blushing darker noxious gas has a trademark sharp, biting aroma. NO₂ is a champion among the most obvious air toxins.[2]
3. Carbon monoxide (CO) - is a dreary, unscented, non-troubling anyway very unsafe gas. It is a thing by divided start of fuel, for instance, vaporous oil, coal or wood. Vehicular exhaust is an essential wellspring of carbon monoxide.

* Department of Corporate Consulting, Moody's Analytics Knowledge Services, India

** Amity Business School, Amity University Uttar Pradesh, India

4. Flimsy normal blends - VOCs are a basic outside air pollution. In this field they are normally apportioned into the diverse groupings of methane (CH₄) and non-methane (NMVOCs). Methane is a capable ozone draining substance which adds to improve an Earth-wide temperature support. Other hydrocarbon VOCs are similarly tremendous ozone hurting substances by methods for their activity in making ozone and in illustration out the life of methane noticeable all around, regardless of the way that the effect contrasts depending upon neighborhood air quality. Inside the NMVOCs, the fragrant blends benzene, toluene and xylene are suspected malignant growth causing operators and may incite leukemia through postponed introduction. 1, 3-butadiene is another unsafe compound which is normally associated with present day occupations.
5. Particulates-then again insinuated as particulate issue (PM), barometrical particulate issue, or fine particles, are minor particles of solid or liquid suspended in a gas. Curiously, airborne suggests particles and the gas together. Wellsprings of particulates can be fake or normal. A couple of particulates happen typically, starting from volcanoes, dust whirlwinds, timberland and prairie fires, living vegetation, and sea shower. Human activities, for instance, the expending of oil subordinates in vehicles, control plants and diverse present day techniques similarly make basic proportions of fog concentrates. Landed at the midpoint of over the globe, anthropogenic pressurized canned items—those made by human activities – by and by speak to around 10 percent of the total whole of fog amasses in our condition. Extended elements of fine particles noticeable all around are associated with prosperity dangers, for instance, coronary sickness, adjusted lung limit and lung malignancy.[6]

Driving forward free radicals related with airborne fine particles could cause cardiopulmonary disease.

Harmful metals, for instance, lead and mercury, especially their blends.
6. Chlorofluorocarbons (CFCs) - destructive to the ozone layer transmitted from things directly disallowed from use.
7. Soluble base (NH₃) - delivered from agricultural strategies. Smelling salts is a compound with the formula NH₃. It is ordinarily experienced as a gas with a trademark sharp smell. Smelling salts, either clearly or roundaboutly, is moreover a structure impede for the mix of various pharmaceuticals. In spite of the way that in wide use, soluble base is both unforgiving and hazardous.
8. Smells – for instance, from waste, sewage, and mechanical strategies

Ground level ozone (O₃) confined from NO_x and VOCs. Ozone (O₃) is a key constituent of the troposphere. It is similarly a basic constituent of explicit areas of the stratosphere generally known as the Ozone layer. Photochemical and compound reactions including it drive tremendous quantities of the manufactured systems that occur noticeable all around by day and by night. At unusually high obsessions acknowledged by human activities, (as it were, the start of non-sustainable power source), it is a tainting, and a constituent of smog.[3]

CAUSES: FACTORS RESPONSIBLE FOR AIR POLLUTION

Air contamination can result from both human and regular activities. Natural events that pollute the air include forest fires, volcanic ejections, wind disintegration, dust dispersal, vanishing of natural mixes and normal radioactivity. Wellsprings of air contamination allude to the different areas, exercises or factors which are in charge of the discharging of toxins into the environment.

Man-made sources for the most part identified with consuming various types of fuel.

"Stationary Sources" incorporate stacks of power plants, manufacturing facilities (factories) and waste incinerators, just as heaters and different kinds of fuel-consuming warming gadgets. In creating and poor nations, customary biomass consuming is the real wellspring of air poisons; conventional biomass incorporates wood, edit waste and excrement.

"Versatile Sources" incorporate engine vehicles, marine vessels, airplane and the impact of sound and so on.

Synthetic concoctions, dust and controlled consume rehearses in farming and ranger service the

executives. Controlled or recommended consuming is a procedure at times utilized in forest the board, cultivating, prairie rebuilding or ozone harming substance decrease. Fire is a characteristic piece of both forest and meadow biology and controlled fire can be an apparatus for foresters. Controlled consuming invigorates the germination of some alluring timberland trees, along these lines reestablishing the woods. [5]

Exhaust from paint, hair spray, varnish, vaporized splashes and different solvents.

Waste deposition in landfills, which produce methane. Methane is profoundly combustible and may frame hazardous blends with air.

Military, for example, atomic weapons, poisonous gases, germ fighting and rocketry.

1. *Natural sources*

Residue from regular sources, normally vast zones of land with few or no vegetation. Methane, radiated by the absorption of sustenance by creatures, for instance steers.[4]

Radon gas from radioactive rot inside the Earth's outside. Radon is a dry, unscented, normally happening, radioactive respectable gas that is shaped from the rot of radium. It is viewed as a wellbeing danger. Radon gas from normal sources can collect in structures, particularly in kept zones, for example, the storm cellar and it is the second most incessant reason for lung malignant growth, after cigarette smoking. Smoke and carbon monoxide from out of control fires. Vegetation transmits naturally huge measures of VOCs on hotter days. These VOCs respond with essential anthropogenic contaminations - explicitly, NO_x, SO₂, and anthropogenic natural carbon mixes - to deliver an occasional cloudiness of auxiliary poisons. Volcanic movement, which deliver sulfur, chlorine, and cinder particulates. An absence of ventilation inside concentrates air contamination where individuals regularly invest the dominant part of their energy. Radon (Rn) gas, a cancer-causing agent, is oozed from the Earth in specific areas and caught inside houses. Building materials including covering and compressed wood produce formaldehyde (H₂CO) gas. Paint and solvents emit unstable natural mixes (VOCs) as they dry. Lead paint can decline into residue and be breathed in.

Deliberate air contamination is presented with the utilization of deodorizers, incense, and other scented things. Controlled wood fires in stoves and chimneys can include critical measures of smoke particulates into the air, all around. Indoor contamination fatalities might be caused by utilizing pesticides and other substance splashes inside without appropriate ventilation.

Carbon monoxide (CO) harming and fatalities are regularly caused by flawed vents and stacks, or by the consuming of charcoal inside.

Organic wellsprings of air contamination are likewise found inside, as gases and airborne particulates. Pets deliver dander, individuals create dust from moment skin pieces and disintegrated hair, dust vermin in bedding, covering and furniture create catalysts and micrometer-sized fecal droppings, occupants discharge methane, shape frames in dividers and produces mycotoxins and spores, cooling frameworks can brood Legionnaires' malady and form, and houseplants, soil and encompassing greenery enclosures can create dust, residue, and form. Inside, the absence of air flow enables these airborne contaminations to gather more than they would somehow or another happen in nature.

OUTCOMES: EFFECTS OF AIR POLLUTION

1. *Health Effects*

Air contamination is a critical hazard factor for numerous wellbeing conditions including respiratory contaminations, coronary illness, and lung disease, as indicated by the WHO. The wellbeing impacts caused via air contamination may incorporate trouble in breathing, wheezing, hacking, asthma and irritation of existing respiratory and cardiovascular conditions. These impacts can result in expanded prescription use, expanded specialist or crisis room visits, more healing facility confirmations and sudden passing. The human wellbeing impacts of poor air quality are expansive, yet mainly influence the body's respiratory framework and the cardiovascular framework. Singular responses to air toxins rely upon the kind of poison an individual is presented to, the level of presentation, the person's wellbeing status and hereditary qualities.[7]

The most well-known wellsprings of air contamination incorporate particulates, ozone, nitrogen dioxide, and sulfur dioxide. Both indoor and open air contamination have caused roughly 3 million death around the world. Kids matured under five years that live in creating nations are the most defenseless populace as far as absolute death inferable from indoor and open air contamination. The World Health Organization expresses that 2.4 million individuals pass on every year from causes straightforwardly owing to air contamination, with 1.5 million of these deaths owing to indoor air contamination.

The most detectably terrible transient nonmilitary work force defilement crisis in India was the 1984 Bhopal Disaster. Discharged current vapors from the Union Carbide preparing plant, having a spot with Union Carbide, Inc., U.S.A., executed more than 25,000 people totally and hurt some place in the scope of 150,000 to 600,000. The United Kingdom persevered through its most exceedingly awful air sullying event when the December 4 Great Smog of 1952 encircled over London. In six days more than 4,000 kicked the container, and 8,000 more passed on inside the following months. A coincidental break of Bacillus anthracis spores from a characteristic battling research office in the past USSR in 1979 close Sverdlovsk is acknowledged to have been the purpose behind numerous standard resident deaths.[8]

Around the world, kids living in urban territories with high prologue to air harms are at extended risk of making asthma, pneumonia and other lower respiratory illnesses. Since adolescents are outside more and have higher minute ventilation they are continuously frail to the dangers of air sullying. Threats of low starting birth weight are in like manner inspired in such urban regions.

Radioactive toxic substances – made by nuclear impacts, nuclear events, war explosives, and trademark strategies, for instance, the radioactive spoil of radon.

Particulates produced using vaporous fundamental poisons and blends in photochemical exhaust cloud. Fumes cloud is a kind of air pollution; "exhaust cloud" is a portmanteau of smoke and fog. Commendable

fumes cloud results from a great deal of coal devouring in a zone brought about by a mix of smoke and sulfur dioxide. Current fumes cloud does not as a rule start from coal but instead from vehicular and mechanical transmissions that are followed up on in the atmosphere by splendid light from the sun to outline discretionary pollutions that furthermore unite with the basic outpourings to shape photochemical brown haze.

Ground level ozone (O₃) molded from NO_x and VOCs. Ozone (O₃) is a key constituent of the troposphere. It is also a basic constituent of explicit areas of the stratosphere routinely known as the Ozone layer. Photochemical and engineered reactions including it drive a substantial number of the compound strategies that occur in the atmosphere by day and by night. At peculiar high obsessions acknowledged by human activities (for the most part the consuming of non-sustainable power source), it is a poison, and a constituent of brown haze.

The most discernibly awful flashing nonmilitary work force pollution crisis in India was the 1984 Bhopal Disaster. Discharged present day vapors from the Union Carbide modern office, having a spot with Union Carbide, Inc., U.S.A., killed more than 25,000 people all things considered and hurt some place in the scope of 150,000 to 600,000. The United Kingdom persevered through its most recognizably terrible air defilement event when the December 4 Great Smog of 1952 encircled over London. In six days more than 4,000 passed on, and 8,000 more kicked the basin inside the following months. An unexpected opening of Bacillus anthracis spores from a natural battling research focus in the past USSR in 1979 close Sverdlovsk is acknowledged to have been the purpose behind numerous nonmilitary work force passings.

Around the world, kids living in urban zones with high prologue to air harms are at extended threat of making asthma, pneumonia and other lower respiratory pollutions. Since children are outside more and have higher minute ventilation they are logically helpless against the dangers of air pollution. Threats of low beginning birth weight are moreover expanded in such urban networks.

2. *Natural Effects*

Harmful air poisons (lethal synthetic substances noticeable all around) can frame corrosive rain. It can likewise shape unsafe ground level ozone. These demolish trees, crops, homesteads, creatures and keep on making water bodies hurtful to people and creatures that live and rely upon water.

3. *Practical Effects*

The impact of air contamination on the economy might be a determined one. In straightforward dialect, the economy flourishes when individuals are solid, and business that relies upon developed crude materials and regular assets are running at full effectiveness. Air contamination lessens rural product and business woodland yields by billions of cash every year. This notwithstanding individuals remaining off work for wellbeing reasons can costs the economy extraordinarily.

CONTROL: MEASURES TO DECREASE AIR POLLUTION

Arrangement endeavors on contamination are dependably a major issue. This is the reason avoidance mediations are dependably a superior method for controlling air contamination. These counteractive action strategies can either originate from government (laws) or by individual activities. In some huge urban areas, observing types of gear have been introduced at numerous focuses in the city. Specialists read them consistently to check the nature of air.

1. *Government (or network) level avoidance*

Governments all through the world have officially made a move against air contamination by presenting environmentally friendly power vitality. A few governments are putting resources into wind vitality and sunlight based vitality, just as other sustainable power source, to limit consuming of petroleum derivatives, which cause substantial air contamination.

Governments are additionally driving organizations to be progressively mindful with their assembling exercises, so that despite the fact that regardless they cause contamination, they are a ton controlled. Organizations are additionally assembling more vitality effective vehicles, which dirty not exactly previously.[10]

2. *Singular Level Prevention*

Urge family to utilize the transport, train or bicycle when driving. On the off chance that we as a whole do this, there will be less vehicles on street and less vapor.

Use vitality (light, water, steam, fire woods) carefully. This is on the grounds that loads of petroleum products are scorched to produce power, thus in the event that we can chop down the utilization, we will likewise chop down the measure of contamination we make. Reuse and re-use things. This will limit the reliance of delivering new things. Keep in mind producing ventures make a great deal of contamination, so on the off chance that we can re-use things like shopping plastic packs, garments, paper and jugs, it can help.[9]

CONTROL GADGETS FOR PREVENTING POLLUTION

The accompanying things are normally utilized as contamination control gadgets by industry or transportation gadgets. They can either wreck contaminants or expel them from a fumes stream before it is transmitted into the climate.

1. Electrostatic precipitators: An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate gathering gadget that expels particles from a streaming gas, (for example, air) utilizing the power of a prompted electrostatic charge. Electrostatic precipitators are exceedingly productive particulates, for example, residue and smoke from the air stream.

2. Pack houses: Designed to deal with substantial residue stacks, a residue authority comprises of a blower, dust channel, a channel cleaning framework, and a residue repository or residue expulsion framework (recognized from air cleaners which use dispensable channels to expel the residue).

3. Particulate scrubbers: Wet scrubber is a type of contamination control innovation. The term depicts an assortment of gadgets that utilization toxins from a heater pipe gas or from different gas streams. In a wet scrubber, the dirtied gas stream is carried into contact with the scouring fluid, by showering it with the fluid, by compelling it through a pool of fluid, or by some other contact strategy, in order to evacuate the poisons.

CONCLUSION

Air contamination can be avoided just if people and organizations quit utilizing dangerous substances that reason air contamination in any case. This would require the suspension of all petroleum derivative consuming procedures, from mechanical assembling to home utilization of forced air systems. This is a far-fetched situation as of now. Be that as it may, we need to make rules which set stringent controls on modern and power supply assembling and dealing with. The directions are to be intended to additionally lessen destructive discharges into the Earth's environment.

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Sewage and slug disposable strategy in Delhi/NCR

Ritesh Kumar*

A matter of concern for whole country is sludge disbursement which is growing at a much faster rate. India has many points of concern like increase of population, urban planning and industrial developments worldwide. We need to regulate various forms & sludge needs to be adequately treated and environmentally managed to reduce the negative impacts of its application or disposal. Bio solids or sewage sludge is the byproduct of municipal wastewater, sewage effluent and effluent treatment plants. The treatment plants are generating huge amount of bio solids. The present review focuses on the different applications of bio solids or sewage sludge as in many countries the biosolids or sewage sludge are frequently using for various purposes like for biogas production, land filling, organic fertilizer, soil amendment, and to enhance the crop yield of agricultural crops. Therefore, bio solids or sewage sludge is in the consideration as a resource worldwide. Besides this higher content of different heavy metals and microorganisms are the important constraints for the application of bio solids or sewage sludge in the various fields. The paper focusses emphasizes on various applications and possible limitations for the use of bio solids or sewage sludge as a resource. Many efforts have been made on the possible pretreatment of bio solids or sewage sludge to make it more feasible for their applications.

Key words: bio-solids, microorganisms 'environmentally friendly

INTRODUCTION

Environmental pollution is one of the serious problems on our planet today faced by humanity and other life forms. Environmental pollution is defined as the contamination in the earth/atmosphere system of the physical and biological components to such an extent that adversely affected the normal environmental processes. Pollutants are naturally occurring substances, but in excess of natural levels they are as considered contaminants. The natural resources if are at a rate higher than natural capacity than it can result in pollution of water, air and land.

Types, effects and causes of pollution

Depending on the pollutants nature and also different pollution of environmental components, the pollution may be categorized as :

1. Water Pollution
2. Air Pollution
3. Noise Pollution
4. Soil/Land Pollution
5. Thermal Pollution
6. Radioactive Pollution

Air pollution is hazardous for the environment. A physical, biological and chemical change of the air occurs when dust, smoke and harmful gases enter into the earth atmosphere and make it tough for all living beings to live as the air becomes polluted. Burning of agriculture related activities, mining operations, fossil fuels, household cleaning products and exhaust from industries cause air pollution. People discharge enormous amount of chemical elements in the air every day. The effects of air pollution are frightening. It causes acid rains, global warming, eutrophication, heart and respiratory problems. A lot of wildlife class are enforced to change their habitation in order to live. Soil pollution is due to the presence of pollutants, contaminants and toxic chemicals in the soil in high concentration that has adverse effect on plants, wildlife, ground water and humans, waste disposal, industrial activity, acid rain, agricultural activities and accidental oil spill are the main reasons of soil pollution. This type of contamination affects the growth of plants, influence health of humans, changes the soil structure and decreases soil fertility. Water pollution is capable to lead our ecosphere on a path of ruin. Water is one of the important natural asset of the whole human race. No humanity will survive without water. However we never give importance to this gift of nature and spoil it without thinking. The key causes of the water pollution are: industrial waste, radioactive waste, chemical pesticides and fertilizers,

*Business Analyst TCS

accidental oil leakage, mining activities, marine dumping, sewage and waste water, animal waste, burning of fossil fuels, urban development, global warming and leakage from sewer lines. There is less water available for cooking, washing, drinking and irrigating crops. Environmental pollution is one of the major problems affected by activities of human that we should be stunned to see a tomorrow and promise our coming generation a healthy life. There are many environmental distresses for people around the world to address. We should always remember that pollution problems will affect us all so each of us has to do their duty to help reinstate environmental balance to this beautiful planet earth. We should learn about the major pollutants in the area to protect the air and water where we live. We should encourage people to stop contamination, we should tell people everything by educating them about this problem, and stop local polluters together. The people should be informed on the hazard of different types of pollution. People should identify the whole thing about all penalties of the environmental pollution in order to avoid the worst from happening. It is the duty of all human being to protect the air, water and soil to make earth a safe place to live in.

SEWAGE

Sewage is discarded water which is attained from industries, domestic etc. It consists of some pathogenic bacteria and chemical that is damaging to the environment if it is disposed in raw condition that is why should also be treated in same manner like the drinking water but it involves much higher process. When water is used it holds onto chemicals, dirt and germs. Sewers carry this water away from our industries and homes. Sewage treatment plants gather waste water, and remove many chemicals and solids particles. The output of the sewage treatment plant is no longer called sewage, it is known as reclaimed water.

Water Pollution in Delhi due to sewage: New Delhi is the India's national Capital. It is one of the fastest developing cities of the country. It does not have a proper sewage and drainage disposal system. In Delhi only 55% homes have proper sewerage connection and the remaining 45% household wastes goes in to the Yamuna river without treatment.

The pollution of Yamuna is due to the household which are not connected with sewerage system. The Government programmes and plans are not able to tackle the problem of growing production of sewage and waste water. In the organized and developed areas of Delhi the sewage treatment services are given up to a certain extent, the unorganized or the slums areas are not connected with any sewage treatment service it is because they are not in the jurisdiction of Delhi Jal Board (DJB).

LITERATURE REVIEW

Sewage is discarded water which is attained from industries, domestic etc. It consists of some pathogenic bacteria and chemical that is damaging to the environment if it is disposed in raw condition. Sewage sludge is a by-product after the treatment of sewage, it can be used as a manure for agriculture purpose (Singh & Agrawal, 2008). Sewage sludge can be disposed in ways such as for agriculture, land filling and dumping into sea (Werther & Ogada, 1999). Sewage and waste water can produce methane which can be used to generate electricity (Kartal, Kuenen, & Van Loosdrecht, 2010). Biofuel can be generated from sewage, it is generated after thermochemical valorisation processes (Manara & Zabaniotou, 2012). Pollution causes many changes in environment, it destroys the ecological system and causes many ailments (Dybern & Fonselius, 1981). Sewage pollution is one of the major source of water pollution, sewage consists of some pathogenic bacteria and chemical that is damaging to the environment if it is disposed in raw condition ((Environmental Pollution Centers, 2017). Marine pollution is caused when untreated sewage is disposed into the sea, it is harmful for living creature in sea (Frid & Caswell, 2017). Aquatic life is threatened by the waste disposed into sea by human being directly, it impacts the life sea animals and it is also destroying aquatic animal life (Islam & Tanaka, 2004).

Objectives

1. To find the problem behind untreated sewage in Delhi.
2. To find the solution of sewage problem in Delhi.

Outcome of Sewage Problem in Delhi/NCR: Improper waste water and sewage disposal have affected the atmosphere and the people of Delhi in following ways:

1. Out of order sewage treatment plants have added pollution to ground water, well water and river.
2. No proper drainages and untreated have resulted in unfavourable breeding atmosphere for flies, mosquitoes and insects.
3. Unprocessed sewage leads to foul smell and stinking water.
4. People get polluted water due to untreated sewage directly disposed in Yamuna river for washing clothes, bathing and cleaning utensils.
5. Farming around the Yamuna river has become toxic due to untreated sewage directly disposed in Yamuna river leading to various diseases.
6. The toxins have contaminated the soil and ground water.

Facts and figures of sewage treatment in Delhi

According to 2012 reports, in Delhi only 30% of the sewage is treated. In Yamuna river the sewage dumped is approximately on an average per day 3296 million litres. Daily 600 million gallons of sewage is generated in Delhi and the capacity of sewage treatment plants (STPs) in Delhi is to process only 512.4 million gallons of waste.

On November 11, 2012, the Supreme Court had declared that the water quality of Yamuna river is as gutter. Also Delhi does not have a proper sewer and drainage system. There are 30 sewage treatment plants located at 17 locations in Delhi, out of which only two are running within the capacity limit, 20 are running under capacity, five are running over capacity and three are non-functional.

The organization responsible for sewage treatment in Delhi

The Delhi Jal Board (DJB) is responsible for the development and maintenance of waste water and sewage management in the National Capital Territory of Delhi. As per DJB, the various categories of sewage system are as follows:

- Unauthorized regularized colony
- Planned colony
- Urban villages
- Resettlement colony
- Rural villages
- Unauthorized colony

Major problems in sewage treatment

- The growing population of Delhi is the major problem. It is difficult to provide the sewerage services to every house.
- Due to operational problems most of the sewage treatment plants do not perform effectively.
- Due to deficiency in the collection system the STPs (Sewage treatment Plants) is not fully utilized to its capacity.
- The large network of sewers and drains in the city is very old and is not working with full capacity.
- Slow flow of waste water sewage to STPs (Sewage treatment Plants).
- No effective sewage planning and management.
- DJB (Delhi Jal Board) had not planned properly for sewage treatment.

Other problems

- Insufficient infrastructure
- Lack of accountability
- Weak financial base
- Lack of political will
- No co-ordinating body
- Corruption

The solution sewage treatment systems

As per a report by the Delhi Government of 2013, between 2007 and 2012, Rs 3,132.50 crore have been spent in sewage treatment programmes in Delhi. In Delhi today, there is a deficit of 9,500 km sewage pipeline and an investment of Rs 25,000 crore is required to build these sewage pipelines. The DJB has spent around 1,634.18 crore in 2011-12 on the maintenance, operations and construction of STPs but of no relevant outcome.

The Government and the DJB should consider a decentralized system for its sewage treatment system. Decentralized sewage treatment also known as "Onsite wastewater treatment system" is one that treats sewage, discharges, wastewater at the location itself where the sewage is generated. For example, we still have the simple system of septic tanks and leach fields serving single homes in various towns and villages in India. Instead of sending the solid waste into a

STP(Sewage treatment plant) in a particular location, the water can be treated and returned to the ground on the same area.

A centralized STP collects sewage from different locations of the city and then treat it. But this system requires huge capital investment and is highly labour intensive which require regular maintenance , It make use of large amounts of electricity and in most cases is non-functional.

There foregoing for privatisation or decentralisation of sewage water treatment is one of the good solution. The resident welfare associations should responsible for maintenance and operation of the decentralised sewage treatment. In fact, many real estate developers in Delhi have already implemented this in the various townships and apartment societies located in Delhi. Decentralized small-scale sewage treatment systems are an efficient way of planning and upgrading Delhi's urban environment to a sustainable level.

CONCLUSION

The disposal of sewage is a biggest problem in developing countries .Untreated sewage water in the areas can infect the environment and cause diseases such as diarrhoea. People and Government should care for the environment . People should not drain waste water directly into sewage system. People should not move to

unorganised or illegal colonies where there is no proper drainage system. Government should monitor the sewage system in Delhi. Government should stop the settlement of unorganised or illegal colonies in Delhi. Government should take care of sewage treatment plant that they should be always up and running.

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A study on various measures taken to Protect and Preserve the Wildlife of India

Kritika Chawla*

Conserving the wildlife is challenging yet an important task to be undertaken, as many species are endangered and few are at verge of being extinct. Illegal trade and hunting of wild animals has worsen the situation. Humans have used wild animals for their own good, which has created a disbalance in the eco-system. All such has bought the need to strengthen the legal framework, strict rules shall be implemented, awareness of the importance of wildlife shall be communicated to masses in order to protect and preserve the natural heritage of India. As for the survival of mankind creating a balance between flora and fauna is essential. Having an understanding about the importance of why and how the wildlife is essential will bring awareness and responsibility to mankind in order to protect and preserve the wildlife of India.

Keywords: wildlife, illegal trade, natural heritage, legal framework, mankind.

Abstract: An effort towards understanding the wildlife of India, various species are at endangered levels as they are been hunted down for human's self interest creating a disturbance in the ecological balance leading to the overall disruption of the environment, causing a question of survival for the mankind in the long run.

INTRODUCTION

Animals and plants aren't just valuable for their own sake - they're also part of a wider natural environment that may provide food, shelter, water, and other functions, for other wildlife and people.

India is a very rich country in terms of bio-diversity. Almost all big mighty creatures roam its jungles. The country offers immense opportunities for wildlife tourism. The immense heritage of wildlife in India comprises of more than 70 national parks and about 440 wildlife sanctuaries including the bird sanctuaries. India has always been a fete for wildlife enthusiasts from around the world with its fascinating myriad of flora and fauna that has remained both unique and mysterious for nature lovers. They are essential for

the maintenance of ecological balance, and let's not deny the fact that the earth is a place to live in for all, but today on the contrary side mankind has forgotten this fact and is continuously expanding its grounds of existence and survival.

As an impact the breeding grounds for others have shortened, and such a situation is adversely affecting both the wildlife and city life. Frequent unwanted interactions between the two is witnessed where wild animals have been entering the city area or let's say the city area has spread its wings and has captured the forest area.

LITERATURE REVIEW

To review highlights of the major issues been faced by the wildlife in India in terms of wildlife extinction, endangerment, conservation and illegal trade. Though efforts have been put in to reduce deforestation, and increase habitat conservation, further putting a permanent stop at hunting and illegal trade of animals for their skin, bones and horns.

Another point of concern is the increased land and marine pollution, dumping of wastes in water bodies has adversely affected the marine life and improper disposal of non-bio degradable waste has also affected the survival of the wildlife in India. Strict laws and regulations need to be enacted upon to save the wildlife of India.

*Industrial Trainee at GAIL(India) Ltd.

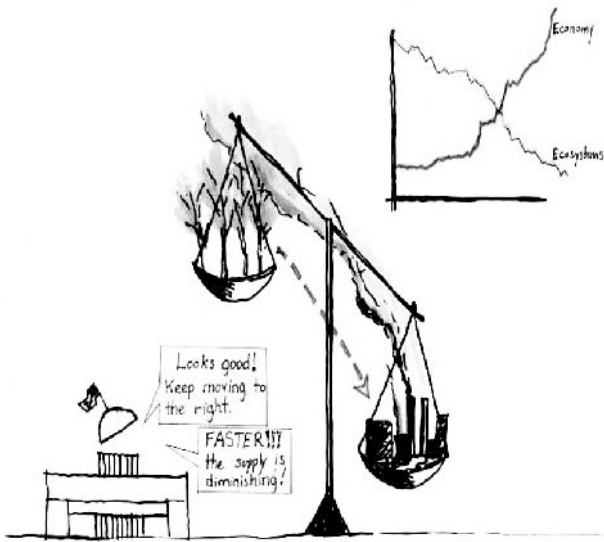


Figure 1: Disturbance in ecological balance

Source: <https://www.bing.com/images/search?q=ecological%20balance&cbir=sbi&imageBin=&qs=n&form=QBIR&sp=-1&pq=ecological%20balance&sc=8-18 &sk=&cvid = FB06EA51E3264DDCB3D3EFAC5053D85B>

in order to collect the relevant content and in order to know why understanding the importance of wildlife is essential, as an ordinary citizen the relevance of wildlife for his own survival is difficult to understand, but the concern for wildlife is however the concern for man itself. As All forms of life - human, animal & plant, are so closely inter-linked that disturbance in any one gives rise to imbalance for the others. Man's activities for development may have profound influence on the biosphere. Man has harnessed the environment to meet his diverse requirements, which nevertheless, should be done without disturbing the laws of nature. The human race can survive only by living in harmony with nature and explore it for optimum use. Various case studies and research papers were referred to conduct this study and efforts were made to identify the causes of threat to the wildlife and statistical references were examined to identify and analyze the downfall in the population of numerous wild animals and birds.

RESEARCH METHODOLOGY

The research is purely based on secondary data collection which includes research papers, news report, references to various websites were made

The ecologist considers all organic life on earth to be categorized in different topological levels in a closed system of living and non-living parts which is called as an eco-system.

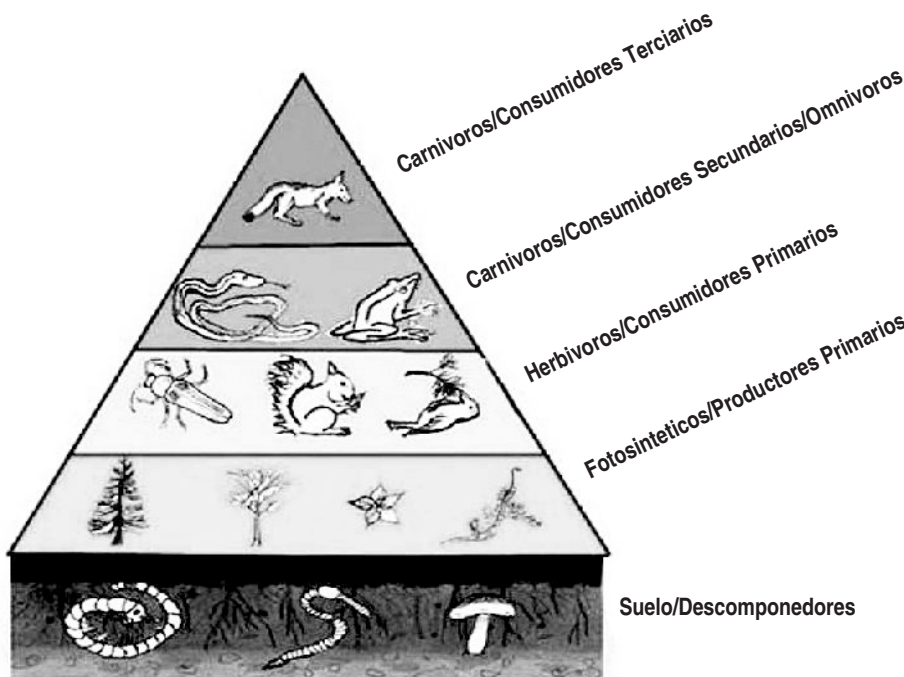


Figure 2: Food Web

Source: https://www.google.com/search?q=food+web&source=Inm&tbn=isch&sa=X&ved=0ahUKEwiew6HK1v_gAhXCheYKHamMAXcQ_AUIDigB&biw=1164&bih=548&dpr=1.65#imgrc=Sk6_xoQbihjiM:

Let's get a brief understanding of an eco-system:

- Primary producers: the ones who convert chemicals into organic matter with solar energy.
- Primary consumers- Herbivores
- Secondary consumers- Carnivores
- Decomposers

They all are linked together in food chains. Various food chains are joined at different trophic levels forming complicated food webs.

In order to be sustainable, any development require the renewability of the resources and life supports systems to be maintained in perpetuity. This, in turn, needs an understanding of the ability of species to adapt themselves to the changing environment and to integrate these considerations in the development of the planning process.

OBJECTIVES

1. Analyze and identify the need to protect and further conserve the wildlife.
2. Understanding the importance of wildlife to ensure the balance in the eco-system.
3. Identify the numerous threats to the wildlife.

4. Study the various possible measures that could be taken to protect the survival of the wildlife.

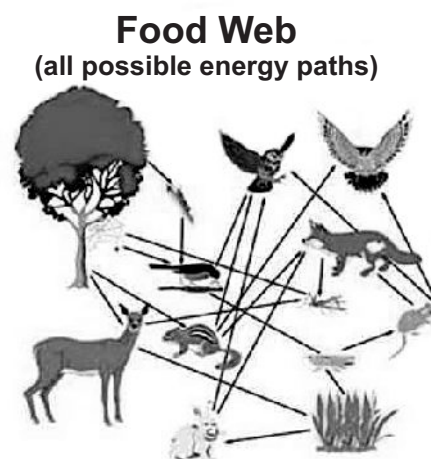
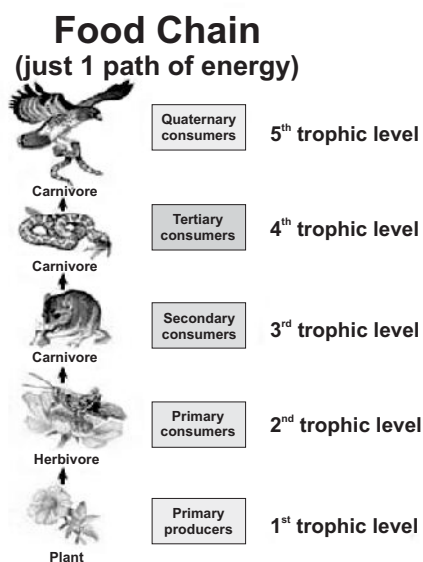
MAIN CAUSES OF EXTINCTION AND ENDANGERMENT OF WILDLIFE

- Game value: wildlife has a higher economic value than realized from the direct sale of its meat and hides. It is of recreational value to those who hunt or fish for sport. Many businesses cater to their needs as they are directly interacting with the wildlife for their own welfare.



Figure 4: Hunting of wild animals

Source:<https://www.google.com/search?biw=1164&bih=548>



The **arrow** points to the eater and shows the transfer of energy.

Figure 3: Difference between food web and food chain

Source:<https://www.bing.com/images/search?view=detailV2>

Aesthetic value: Wildlife deserves preservation due to its enchanting beauty and sheer appeal to the human spirit. Wildlife attracts a large number of tourists and serves as a principal source of foreign exchange, especially in countries like Kenya.

- Ethical value: As human beings, we should realize that plants and animals also have a right to live on this planet and thus proper ecological security should be granted to them. We should appreciate that any species of wildlife is a unique creation of nature and cannot be manufactured by man.



Figure 5: Accidents of wild animals

Source: <https://www.bing.com/images/search?view=detailV2&id>

- Cultural value: In various cultures of the world, wildlife has occupied a special place of veneration and preservation. The paintings and carvings in caves and other age-old historical places further stand testimony to the integral cultural association of wildlife with man.



Figure 6: carvings of wildlife

Source: <https://www.bing.com/images/search?q=wildlife%20carvings%20on%20walls&cbr=sbi&imageBin>

Scientific value: Knowledge gained from research on wildlife provides many spin-offs that are of direct value to humans. By way of illustration, they point to the fungus that produced penicillin, the bark of the yew tree that offers a treatment for some forms of cancer, and an Asian viper's venom that is used in a stroke-prevention medicine. Chemicals from sea sponges and some marine organisms might block arthritis inflammation and fight cancer. Plants and small creatures also benefit agriculture: farmers use insects, plants, and other animals as alternatives to synthetic chemicals for pest and predator control.



Figure 7: Trade of bones and other parts

Source: <https://www.bing.com/images/search?view=detailV2&i>

Ecological value: The existence of any component of our ecosystem is essential for the stability of the system. Animals and birds are indicators of the health of the environment. Eg. Birds like canary, with exceptionally high metabolic rates, can be kept inside coal mines to check the presence of CO₂ and other noxious gases; fishes serve as indicators of potable water. Statistics shows that the rate of deforestation in India is so high that around 7560 yards of forest area has been cut down for the development activities of the cities, which in turn has squeezed the home of wild animals and has overall affected the ecological well-being.

- **Commercial Value:** Wildlife is a potential source of useful products of global interest.
 - ❖ Wildlife as food: Wildlife resources constitute an important source of food for those people living in hills and forests. The commercial value of wildlife is best seen in the world's marine fisheries, yielding perhaps 70 MT of food.

- ❖ **Wildlife in medicine:** The medication used in the treatment of various ailments owes its origin to plants and animals rather than synthesized commercial chemical products. However, there is considerable variation in the purported therapeutic value of different parts, organs and secretions of wild animals, and such claims require thorough scientific study.
- ❖ **Trade in wildlife products:** Products of global trade interest include fur, wool, skin, horn, hoof, meat, ivory, bone, fats, bile salts, bone charcoal, bone glues, trophies, perfumes, cosmetics, medicines etc. Unchecked trade in wildlife products has considerably decimated the rare wild fauna.

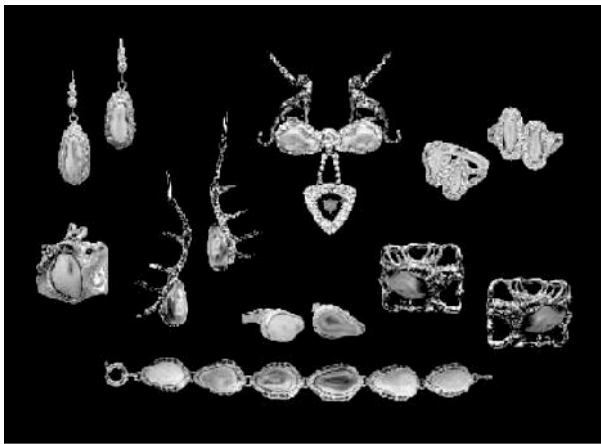


Figure 8: Trade as jewelry and antique pieces

Source: [https://www.bing.com/images/search?q=%20bones%20wild%20animals%](https://www.bing.com/images/search?q=%20bones%20wild%20animals%20)

Other factors: The rise in global warming/ climate change has worsened the habitat of many wild animals, there has been noticed a shrink in the habitat of polar bears due to rapid melting of ice bergs. Further climate changes has lead to water scarcity in forests of plain area.

EASURES TO BE TAKEN TO PROTECT THE WILD LIFE

Since we are now aware about the importance of wildlife, as it may not directly affect our life but it is of vital importance for the survival of all. Hence, we need to figure out the ways to protect and conserve the wildlife.

Developing a consciousness of protecting wildlife- as much of harm is caused to wildlife due to lack of awareness amongst the people for wildlife. one

should not lose the opportunity to come forward and speak about the issues on the wildlife as they can speak. Anyone can lend a hand by paying a serious attention to it. Documentary films made on some famous wildlife destinations such as Corbett National Park, Kaziranga National Park Assam, Bandhavgarh tiger reserve can be a tool for making the unaware aware about the facts of poaching.



Figure 9: wild animals

Help of media can be taken to spread the awareness for protecting and conserving the interest of wildlife, as the local media has access to broader areas at a given time. Tons of nature lovers and wildlife enthusiasts have started showing up themselves to save the endangered wild creatures. Moreover, they are raising voice, writing letters to the TV channels and sending emails to the government departments. Popular faces of India (celebrities, politicians, sportsmen) are involving themselves to promote the campaign and help various protection and conservation initiatives to reach masses.

- Forbidding punishment for Poachers, Poachers should be given severe punishment for assassinating or illegal capturing any wildlife species in national parks. Indiscriminate killing must lead to punishments. One must follow the conventions written by forest department; it reflects the demureness of a human being while visiting a forest, should dispose of garbage in the dustbin or carry with him/her to keep the environment clean and green, While entering a forest, a person must not perturb the serenity of jungle with the sound of the horn and While passing through the woods one must avoid getting down the vehicle as it could be dodgy.

- Involvement of government can add a lot to the administration and conservation of wildlife, ministry of environment, forest and climate change has continuously led numerous policies for the protection of forest and environment as a whole, norms have been laid to state the rules and regulations for entering the forest area and people are appointed for the post of forest officers and other designated posts who work together for the welfare of the forest and its wildlife.
- An increase in wildlife tourism is beneficial for the Indian economy, on the other hand increase in human foot steps in the wild has been disturbing factor for the flora and fauna, these uninvited guests cause fear and threat amongst the animals, adequate measures should be taken to control this kind of tourism, and minimize its impact on wild animals.
- Various wild life sanctuaries and bird sanctuaries have been taken care of as an initiative for the protection and conservation of extinct species or those who are at an endangered level, such sanctuaries are responsible for the protection and conservation of the wildlife. From the great Himalayan National park in the north to the Dandeli wildlife sanctuary in the south, rare and exotic species can be sighted in these sanctuaries.
- Medical facilities and health checkups shall be setup in the forests in order to keep a check on the health and breeding of the endangered species, Vets shall be assigned to various forest locations in order to provide medical aid in case of any need.

CONCLUSION

India has a rich heritage of wildlife, commences numerous wild life sanctuaries and bird sanctuaries for the protection and conservation of the lives in the wild. At present there are 400+ wildlife sanctuaries, 89 national parks and 13 bio reserves enacting as a home for tigers, lions, rhinoceros and elephants, species of deer and other attractive birds.

In fact, there are several species of animals and birds which are unknown to common people and can only be seen in sanctuaries or National parks. The unique variety of fauna in India attracts a lot of Wildlife enthusiasts from all parts of India and across the globe.

Around 24.4% of total area is covered by forests in India (ranking it to be the 10th in the world), according to a report by ministry, India has shown a slight increase in the spread of forest and tree cover. This proves out to be a positive sign both for the humans and the wildlife.

Animals and humans are the two sides of the same coin, both are equally necessary to maintain the eco-system and effectively complete the food chain. Strategies and action plans shall be implemented as an adequate measure to protect the wildlife.

Further conserving the wildlife is essential as it is a treasure of India, and our future generations shall also need to act actively for it and protect and preserve the natural heritage of India.

MAJOR FINDINGS

- The extent of illegal hunting is declining.
- Due to increased awareness the deforestation rate has witnessed a minor decline.
- Awareness regarding few species which were at the verge of becoming extinct are in the state of revival.
- National parks and bird sanctuaries are playing a major role in protecting and preserving the wildlife.

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Analysis of Energy Efficiency in India

Vaibhav Gupta*

Energy in the Past

The term 'energy' is the capacity to do work as coined by Thomas Young (1737- 1829). The two laws of thermodynamics describe the behavior of energy-the first law states that energy can be transformed from one form to another, but cannot be created or destroyed. The second law states that some energy is always dispersed into unavailable heat energy. History of human existence is related with ever increasing energy needs of man. In the ancient time only source of energy was muscular energy and replenished through the intake of food. Through his progress from primitive to modern technological man and demand of energy for cooking and warming newer pathways of energy flow in nature were discovered by converting wood into fire. In agriculture sector the grass was turned into muscular energy of livestock to plough his fields and to transport materials. Further progress led to the development of energy from wind and water. The advent of steam engine led to the industrial revolution and later on energy needs for the various sectors household, transport, industry and agriculture were met by the exploration of fossils-petroleum, coal and natural gas. For the millennia of human existence, it was available in plenty but in the present scenario the there is huge gap in demand and supply of energy.

INTRODUCTION

Energy in the Present Scenario

Energy is the prime mover of growth. It is not an end itself, but it fuels the economy and provides the basic infrastructure from extraction of natural resources to availability of technology. Energy is the most fundamental requirement of every society or nation as it progresses through the ladder of development. Energy is critical, directly or indirectly, in the entire process of evolution, growth and survival of all living beings. Achieving the goals of poverty eradication, improved living standard and increased economic output imply increasing energy. Energy has come to be known as strategic commodity and any uncertainty about its supply can threaten the functioning of the economy, particularly the developing. Of course, once a nation reaches a relative degree of development, the energy demands becomes more stable but today as a result of the structural and technological changes there is also change in use and availability of energy resources. In past the industrial revolution

was fueled by coal which was considered a concentrated fuel and led to increase in productivity and development than the wood fuels used earlier. But now the characteristics of modern global economy are distinct than the past, as today the major changes are:

- i) Increasing age of population in developed countries, so they shift more to techno advance products which leads to more increase in energy demand.
- ii) The developing countries in their race to development are emerging fast in the global scenario, which leads to increase in their labor participation, more investment; more productivity in developing countries all these further needs more energy.
- iii) Another change observed is the increase in urbanization in the developing countries which further accelerates the demand for energy.

If we look around us every step of progress has come with an additional demand for energy-cars, ships and aircraft to move, hospitals to give quality health care, production of more and better goods, irrigation for better farming. In fact, every element of our lives is increasingly going to become energy intensive-that is a necessary prerequisite for development. The three most basic drivers of energy demand are economic activity, population and technology as shown below in chart:

*Security Analyst, HCL Technologies

India's Energy Scenario

India an emerging economy is not free from the challenges discussed above, finds itself going through a phase of rapid ascent in economic empowerment. Industries are evolving at a significantly higher rate since liberalization. India has achieved rapid and remarkable economic development in past two decades and became the world's tenth largest economy in 2011 (World Bank,2011). With its relatively young population, India is expected to take over China as the world's most populous nation around 2025 (based on IEA population growth projection in WEO,2011). The country has thus achieved dynamic economic powers in the world, yet there exist contradictions and complexities that posit considerable challenges to the economy. India ranks 134 out of 187 countries in United Nations HDI due to poor performance in education and health indicators (UN HDI, 2013). Recent rapid growth reduces the number of people living in poverty, but failed to achieve balanced growth between rural and urban areas. For e.g. 37.2% of national population is below poverty line of USD 1.25 purchasing power parity (pop), whereas 26% urban population is considered BPL and 42% of rural population. So along with economic development India needs to alleviate imbalances in economic wealth and living conditions. Economic growth in India has led to alarming increase in the demand for energy. Despite the skyrocketing demand, access to energy is still preserve to small minority of the population and a large chunk of population still lack access to the modern sources of energy and depend on biomass and other sources of energy. Uneven access to energy has a direct impact on economic growth and represses poverty alleviation. Thus, India has to face the twin challenge of providing energy access to all the section of population and meeting the goal of economic growth. All this would need massive energy. The government of India aims to achieve a GDP growth rate of 9% in the 12th five-year (Planning Commission: Twelfth Five Year Plan Document) plan and maintain average growth rate of about 8% in the next fifteen years. In formulating its growth strategy, India has placed emphasis on growth of its manufacturing sector. The objective of Indian planners is to achieve accelerated growth in the industrial sector with a view to increase industry's share in GDP as well as India's share in world industrial output. However, energy being a vital component of production such an ambitious vision would

avertedly call for rapid increase in commercial energy demand at the rate of 5.2 per cent per year (Planning Commission: Twelfth Five Year Plan Document) in the near future. So, the biggest challenge to India today which is the third largest consumer of energy after U.S, China and ahead of Russia in the world energy consumption (2009, IEA), is the management of energy demand and supply because India does not possess the energy resources in abundance and to fulfill the target of 9% growth rate, India had to meet its development needs by available coal, oil, hydro and renewable energy resources and rely on the imports. Today, we have reached a point where not only future growth, but even current production and employment are threatened by the possibility of a cut back in the availability of imported crude oil and the oil products. Thus, it becomes necessary to reduce the vulnerability of the economy by increasing energy efficiency measures to contain the domestic demand for energy and reduce the imports at a reasonable level. The most conventional and traditional measure for energy efficiency is energy intensity (Energy input associated with a unit of GDP). The energy intensity of Indian economy is declining over the time. Declining energy intensity implies that energy required for per unit of output is decreasing.

Table-1

Period	Energy Intensity* (koi/US\$) **
1981	1.09
1991	.99
2001	.85
2011	.62

Source: Planning Commission, 12th Five Year Plan Document

*Energy intensity indicated as energy required to produce one unit of output.**Kilogram of oil equivalent (koi)Thus, we see that the energy intensity of primary energy has declined from 1.09 in 1981 to .62 in 2011.But the elasticity of income of commercial sources of energy has been higher than the energy intensity for total primary energy as a result of ongoing shift from non-commercial sources of energy to commercial sources of energy. Thus, there exists a wide scope for improvement in energy intensity through energy efficiency measures. India's per capita consumption is .58(toe/capita), compared of world average of 1.8,

OECD of 4.28, China 1.7 (IEA,2011). The low per capita energy consumption level indicates that India's energy demand still has a long way to reach saturation. Since economic reforms in 1991, India has experienced a major transformation of its energy mix as there is shift from biomass to other energy sources, particularly coal. The reduction of biomass consumption considerably coincides with India's economic development and urbanization over past decades. But still biomass and fuel wood are widely used in rural areas by low income households. In 2009, primary energy source was coal, followed by biomass, oil and natural gas.

Energy History

To understand the current state of India's energy sector, it is necessary to analyze the past events and policy decisions that shaped today's energy sector. Prior to independence in 1947 the production and consumption of energy was mostly British owned and had three principal characteristics (Edinger, 2013, Energy and Security in South Asia)

- a) Urban - rural population with divergent consumption patterns.
- b) A private sector which controlled energy production.
- c) Limited distribution of electricity resources.

More than 80% of population lived in rural areas and dependent primarily on non-commercial sources of energy. Coal was consumed primarily in electricity and transportation sectors; its production and use were limited to British private firms that left Indian firms with poor quality deposits and inferior technology and production methods. Domestic oil production capacity was also limited and the demand of oil for transportation, cooking, heating and lighting was met exclusively by imports. The inefficiencies of coal sector and the minimal production of oil spurred the government interest in developing its hydropower resources as there was no fuel cost and hydropower was cheaper to produce. But even then, the electricity distribution was minimal. Thus, the picture of energy sector before independence was very grave. Shortly after Independence, India's first Prime Minister, Pt Jawaharlal Nehru established the parameters for public and private sector involvement in Industry through Industry Policy Resolutions (IPRs) of 1948 and 1956. Because the private sector was too small prior to independence and it does not possess

the capability to support such a robust industrialization, so the responsibility to develop the energy industry was fell on the public sector. Despite of establishment of National Coal Development Corporation and expansion of Geological Survey of India, public sector production fell short of the target decided. Similar difficulties were faced in the oil sector too; despite of the exploration and the production facilities the public sector performance was very dismal. Sluggish production, coupled with increasing demand forced a significant rise in the import of the oil. In addition to the costly import bill, the Nation's balance sheet was further dwindling by heavy subsidies for petroleum and natural gas production. By mid-1980's India's electricity sector had also become grossly inefficient and unprofitable. Further by 1990's the LPG reforms were introduced and there was a dire need for private sector involvement in energy to reduce the import bill. To encourage the private sector participation the government introduced the New Exploration and Licensing Policy (NELP), which helped in bringing much needed technology, expertise and a significant amount of investment. At the start of the eighth five-year plan, the Planning Commission of India called for the construction of facilities to generate an additional 30,000 Megawatt (MW) by 1997. In order to reach the goal, a number of changes were made to existing electricity framework including the amendment to the Indian Electricity act allowing for great authority and autonomy to the regional dispatch center. Recognizing the importance of the coherent energy plan for economic, social and political development, In 2004 the Prime Minister Dr. Manmohan Singh commissioned an expert committee "to prepare an integrated energy policy linked with sustainable development that covers all sources of energy and addresses all aspects of energy use and supply including energy security, access and availability, affordability and pricing, as well as efficiency and environmental concerns" (Planning Commission, 2006). The committee was set up in 2004, the draft report was released in August 2006, and, the cabinet finally approved the report in December 2008. One of the salient features of IEP is the focus on ensuring transition to market economy where private companies compete on a fair footy with public companies ensuring level playing field to all players and also stresses on transparent and targeted subsidies and proper energy pricing to send right signal to producers and consumers. The report stated that

to sustain the growth rate of 8% a year and over 25 years the country's average annual energy growth would have to rise 4.3% a year in the most energy efficient scenario and 5.1% a year in a business-as-usual (BAU).

Current Energy scenario

India is the third largest consumer of energy after U.S, China and ahead of Russia in the world energy consumption (2009, IEA), and its need for energy supply continues to climb as a result of the country's dynamic economic growth and modernization over the past several years. India's economy has grown at an average annual rate of approximately 7% since 2000, and it proved relatively resilient following the 2008 global financial crisis. At the same time, India's per capita energy consumption is one-third of the global average, according to the International Energy Agency (IEA), indicating potentially higher energy demand in the long term as the country continues its path of economic development. In the International Energy Outlook 2013, EIA projects India and China will account for about half of global energy demand growth through 2040, with India's energy demand growing at 2.8% per year.

The current energy system of India is governed by coal. In total energy consumption largest percentage share is of coal followed by the other energy sources. If we look at the production side, we find that the compound annual growth rate of production of coal and lignite is more as comparison to other fuels of energy from the primary sources, we observe from the figure above that coal account for major share in rate of production followed by biomass, natural gas, electricity and crude petroleum.

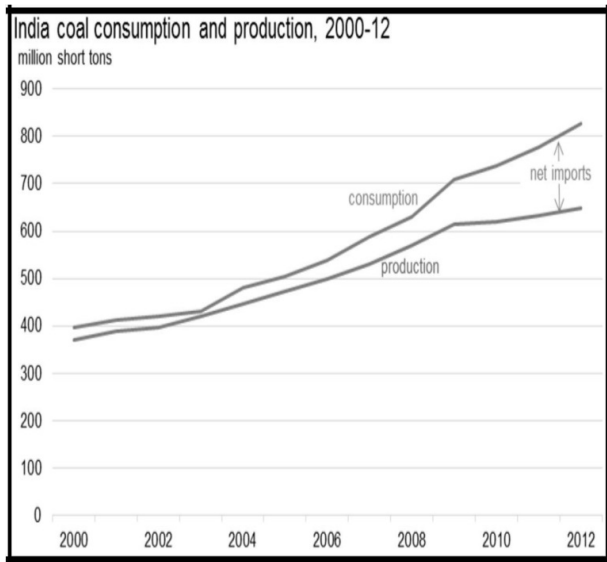
Coal: Coal is India's primary source of energy. The country has the world's fifth- largest coal reserves, and ranked third largest in terms of both production and consumption in 2012. The state retains a near-monopoly on the coal sector. The power sector makes up the majority of coal consumption. Coal is India's primary source of energy, and the country was the third-largest global consumer in 2012. Coal has remained critical to India's infrastructure and development trajectory than any other fuel source. Coal being an indigenous source of power, but its production was modest at the time of Independence because of lack of access to technology, expertise and adequate data. But as a result of the reforms introduced in the coal sector led to increase in

demand and supply of the coal. The government 2006 Integrated Energy Policy report stated that the coal blocks held by Coal India Limited that are not brought into production by 2016-17 should be made available to other eligible candidates for development. Along with this other reform include recommendations that Indian coal producers adhere to the international norm of preparing coal, introduction of independent regulatory body to oversee the competitiveness of auctions, construction of power generation facilities close to the coast. With the introduction of international expertise and advanced technologies, India's coal producers will gain access to hard to mine underground coal and will able to enhance cost competitiveness through the implementation of advanced processes such as in - situ gasification, which gasifies the coal underground making it cheaper to produce coal-based energy and technologically easier to capture 2 emissions. No doubt a number of reforms undertaken for development of coal but there is uncertainty regarding the reserves of coal deposits. A large amount of India's reserves of thermal and coking coal are found in forest sites and tribal areas, which the government is reluctant to exploit. Coal deposits are mainly confined to eastern and south-central parts of the country. The states of Jharkhand, Odisha, Chhattisgarh, West Bengal, Andhra Pradesh, Maharashtra and Madhya Pradesh account for more than 99% of the total coal reserves in the country. The State of Jharkhand had the maximum share (27.0%) in the overall reserves of coal in the country as on 31st March 2013 followed by the State of Odisha (24.7%) (Energy Statistics (2014). The unrest among the coal workers of Jharkhand, Bihar and West Bengal and some percentage of mining revenue is allocated to people affected by mining make it difficult for foreign investors to operate in India. Thus, despite the vast amount of untapped coal deposits, India is becoming more and more reliant on coal imports for its power and industrial needs

The figure given below shows the trend of divergence in production and consumption of coal and the gap is fulfilled by the increasing imports.

Petroleum: In 2009, petroleum consumption in India totaled to 3.11 million barrels a day (mob) of which 877,000 barrels a day was domestically produced. The remaining 70% came through imports. India's impressive economic growth during the last decade has intensified the

Figure 1: Consumption and Production of Coal

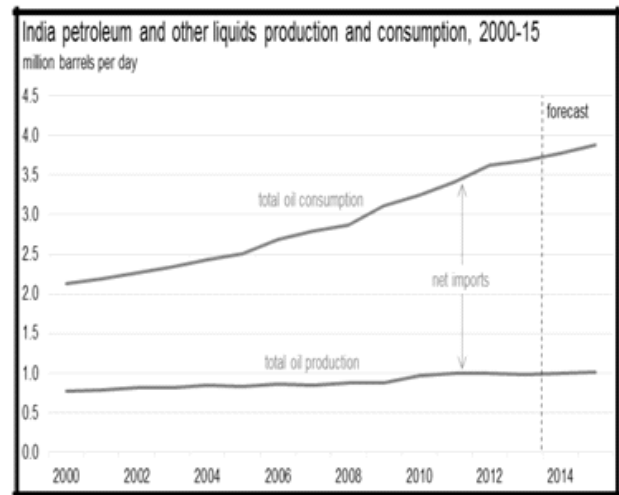


Source: U.S Energy

country’s thrust for oil. The International Energy Agency forecasts a demand increase of nearly of 4% a year over the next several decades, reaching 5.1 million barrels a day(mob) by 2025 and 7.5 mob by 2035. Another driver of growth in the demand for oil in India is the transportation sector where demand for both petrol and aviation fuel is sky rocketing. India has about 5.6 billion barrels of crude oil reserves, according to Energy Information Agency. The majority of India’s domestic oil production is from the offshore Mumbai High field and in the Onshore Cambay Basin in India’s North-West and Assam Abakan basin in India’s North-East. Despite the efforts over the past decade to encourage foreign investment in the domestic oil sector, including the NELP licensing rounds implemented in 1999, India’s oil production has not increased as quickly as its demand for oil. Gasoline and diesel prices have been depressed to a low level that discouraged the private sector investment and forced major state-run companies like Oil and Natural Gas Corporation, Oil India Limited and Gas Authority of India Limited to run finance starved projects. As a result, India’s domestic oil sector depends on aging and declining fields, while new fields have not developed owing to a lack of adequate exploration technology and seismic data

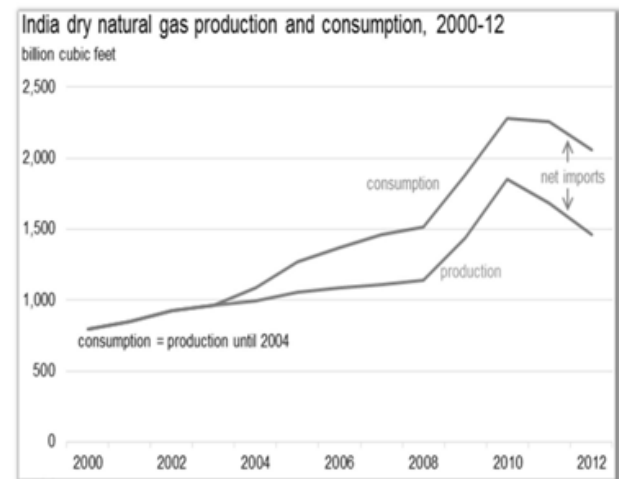
Thus, we see from the above figure that there is wide disparity in the consumption and production of petroleum in India. The dependence on the imports is continually growing which calls for necessary action to switch to other energy sources or design another measure.

Figure 2: Production and Consumption of Petroleum and Other Liquids



Source: U.S Energy Information Administrator, International energy statistics and short-term energy outlook, June 2014.

Figure 3:



Source: U.S Energy Information Agency, International energy statistics and short-term energy outlook, June 2014.

Natural Gas: India’s Natural gas sector presents a more optimistic story than its oil sector. Since the 1980’s, domestic natural gas production has increased steadily. In 2009 India produced about 1.4 trillion cubic feet (tcf) of natural gas while domestic consumption was 1.8 tcf. The remaining 400 billion cubic feet (back) was imported via liquefied natural gas shipments as India does not have any pipeline connection with foreign country. Natural gas mainly serves as a substitute for coal for electricity generation and as an alternative for LPG and other petroleum products in the fertilizer and other sectors. The country was self- sufficient in natural gas until 2004, when it began to import liquefied natural gas (LNG) from Qatar. Natural gas consumption has grown at an

annual rate of 8% from 2000 and 2012, although supply disruptions starting in 2011 resulted in declining consumption. In 2012, India consumed 2.1 trillion cubic feet (tcfg) of natural gas. LNG imports accounted for about 29% of 2012 demand.

Domestic production in India is concentrated offshore with Mumbai high field and the Krishna-Godavari (KG) Basin as the primary domestic production regions. The current Indian gas market is accounted by the power and fertilizer industries using 40% and 29% respectively. Because the fertilizer is heavily subsidized and the gas fired power sector is also subsidized it does not provide an incentive to gas producers to engage in exploration. In the oil sector NELP licensing round created interest in developing gas fields in India and led to discovery of the KG-D6 field in the KG basin off the eastern coast of India. The field 90% owned by the Reliance Industries Limited is the second largest gas producing field in India. Demand for gas is expected to increase over time. The bulk of increase in demand is from India's strategy for generating electricity and in India's transportation sector. Delhi is pursuing a path of power generation diversification and is vigorously supporting increased use of natural gas to displace coal and oil-fired generation, as natural gas is more efficient and cleaner than both coal and oil.

Shale Gas: The shale gas revolution that has swept the United States is gathering momentum in India. Through a process known as hydraulic fracturing-natural gas producers can now access previously unattainable reserves of natural gas trapped inside shale rock formations. In only few years' shales rock has transformed the United States from a likely major importer of natural gas to a self-sufficient natural gas consumer. And now producers in U.S are also cooperating with India and oil and Natural Gas Corporation (ONGC) completed drilling its first shale gas well in Damodaran Valley in West Bengal. The company has also announced other investments in shale gas production elsewhere in West Bengal and Jharkhand. In its 2013 assessment of global shale gas reserves, U.S, Energy Information Administration (EIA) estimates India has 96 trillion cubic feet (tcfg) of technically recoverable shale gas reserves.

Renewable Energy Sources

Hydroelectricity: Hydropower has played a significant role in India's electricity mix. The

government of India has expressed interest in reenergizing the hydropower sector, most notably through its 50,000-MW hydropower initiative launched in 2003. India was the world's seventh-largest producer of hydroelectric power in 2012, with 115 billion kilowatt-hours generated. India benefits from a tropical climate, which gives the country increased hydropower potential, particularly during the summer months. In particular, states with significant river systems such as Himachal Pradesh, Jammu, Kashmir, and Uttarakhand benefit from energy surpluses as a result of abundant precipitation during the monsoon period. But there are a number of obstacles in the growth of hydroelectricity. The melting of Himalayan Glaciers is placing strains on the availability of water supplies, in addition to this the scarcity of available land also creates political opposition to new projects as problem regarding the displacement of the population. Also, there is impact on local and regional flora and fauna including fisheries.

Nuclear Energy: As a part of its effort to diversify its economy from fossil fuels, India has pursued the development of both conventional and advanced nuclear energy technologies since early 1950's. While the capacity of nuclear power was expected to grow fivefold by 2030 and the signing of the nuclear deal has led to even more optimistic forecast of up to 63,000 Mega Watt (MW) of nuclear power by 2032(www.world-nuclear.org) . The U.S-India Agreement on Civil Nuclear Cooperation, which was signed into law in Dec.2008, provides India with access to the International market for civilian nuclear technologies. Since the signing, a no. of nuclear companies has entered into agreements with the Nuclear Power Corporation of India for the construction of nuclear reactors. However, in wake of Fukushima nuclear accident in northern Japan in March 2011, the achievements of these targets may prove more challenging as public opposition may be stronger. But in response to public concerns, India indicated that it will seek to establish a new independent regulatory to oversee the nuclear industry.

Solar Energy: In recent years, India has created a dynamic domestic solar power market, emerging as a formidable competitor in the international market. Recently New Delhi announced the Jawaharlal Nehru National Solar Mission, a mid and long-term commitment to the significant

generation of solar power. The mission proposes a solar generating capacity of 20,000 MW by 2022. While there is access to consistent and intense sunlight averaging 250 to 300 days a year encourages the growth of solar sector, but high cost threatens the industry's growth.

Wind Energy: With an installed capacity of 10.24 giga watts as of March 2009, India is the world's fifth largest wind power generator behind U.S, Germany, Spain and China. The Wind Resource Assessment Programmed a project of the center for wind energy potential, having set up 1050 wind monitoring stations through-out twenty-five states of India and with a plan to extend to include seven more. State Electricity Regulatory Commission have implemented a no. of presential tax schemes and accelerated depreciation to promote the installation of wind generation facilities within their territories.

Biomass Energy: It is another important fuel for India. Rural areas of India tend to rely on traditional biomass (including firewood, animal dung, and agricultural residue) for cooking, heating, and lighting because they lack access to other energy supplies. These sources can be burned directly to produce heat and electricity. Large parts of India rely on biomass as the primary fuel for cooking. According to the 2011 India census, 62.5% of rural households use firewood as the primary fuel for cooking, 12.3% use crop residue as the primary cooking fuel, and 10.9% use dung. By contrast, more than 3% of urban households use crop residue and dung, and only 20% use firewood as the primary fuel source for cooking. These uses can cause health problems from exposure to waste products and pollution or environmental problems when forests or crops are harvested unsustainably. On the whole, about 66% of India's total population used traditional biomass for cooking purposes in 2011, according to the International Energy Agency (IEA). Biomass is not as important for power generation, but its potential for electricity generation is high. Through increased application of currently available technology, it is projected that 16 giga watt of power could be produced from rice husks and other residues currently being left to rot.

Energy Planning Exercise in India

Until 1992 country's entire energy apparatus operated under the purview of the Power

Ministry. Subsequent restructuring of the sector lead to the formation of Ministry of Power, the Ministry of oil and Natural Gas, the Ministry of Coal, the Ministry of New and Renewable Energy and the Department of Atomic Energy. The main thrust towards framing the policies and programmed for the energy planning started in 1970's after the energy crisis, due to scarcity of fossil fuels, growing global climate concerns and finally for achieving cost effectiveness because of rising prices of commercial sources. As, India do not possess the energy resources in abundance so different initiatives were taken to save the country from energy crisis. While the early energy policy initiative in India revolved around on energy conservation and only recent concerns on climate change have capitulated policies to move faster towards energy efficiency. Till 1970's the planning exercise focused on puritanical ideals of development. The five-year plan focused on the goals of poverty alleviation and economic growth with importance to self-reliance in the economy. In 1970's the 'Fuel Policy Committee' (FPC) was constituted for assessing the energy demand and supply gap for next 15 years against the backdrop for growing concerns on scarcity of fossil fuels. In 1974 the committee submitted its report, at that time world oil market was going through major upheavals and the committee suggested various recommendations for substituting oil by coal, efficiency in electricity generation and special attention to hydro power generation. Then 'Petroleum Conservation Action Group' (PCAG) was formed in 1976 for creating awareness on the importance, methods and benefits of conserving petroleum products, promote R&D in the field and promote conservation of oil and substituting petroleum products by alternate sources of energy. The 'Working Group on Energy Policy' (WGEP) 1979 was formed to carry out comprehensive review of energy situation. It highlighted the need for integrated energy policy and demand management should form most important element of oil policy. The sixth Five Year plan (1980-85) marked the beginning of economic liberalization in Indian Economy and the Government of India instituted in 1981 'Inter-ministerial working group' on energy policy. It came with first concrete proposal for reduction in energy consumption in India and showed that there is immense scope of saving energy in Industry, transport and agriculture. The key outcome of the report was it proposed creation of an apex body to

initiate, coordinate integrate and monitor the progress and implementation of various energy conservation measures in India. Advisory Board on Energy (ABE) was set up on the eve of seventh Five Year Plan (1985-1989) to provide energy policy input directly to Prime Minister's Office. The ABE also made detailed projections of energy demand in different regions till 2004 under the assumptions of different macro-economic scenarios. In 1990's Government of India introduced an array of innovative initiatives and programmed aimed towards energy conservation. The Government declared 14th of December (every year) as 'The National Energy Conservation day' and 'National Energy Conservation Award' was started by Ministry of Power for industrial units which have taken exceptional initiatives on energy conservation. Eco-Mark was started in 1991 as part of the bureau of Indian Standards (BIS) was aimed at essentially labeling of environmentally friendly products. In 21st century concern on sustainable supply of conventional sources of energy increased to meet the growing demand for energy. It was realized that the path and policies pursued in context of energy use had led to inefficiency in production, transportation and utilization of energy. So, need was felt for developing alternate sources of energy to meet the rising demand, but it takes time to develop alternate sources of energy and make them commercially viable. So, India had to pursue the policies that aggressively promote the efficient use of energy resources. In 2001 the Energy Conservation bill was passed as an act by parliament. It stressed on energy consumption norms and required designated consumers. i.e. the energy intensive industries and other establishments notified so by the government, to adhere to these. It facilitated the creation of new body in the name of 'Bureau of Energy Efficiency. Since its inception, the BEE has been successful by providing greater thrust on promoting the idea of energy efficiency as a means of attaining competitiveness. Despite the perceptible focus on promoting energy efficiency, India continue to face barriers-one of the barriers was energy pricing keeping the electricity rates low to promote spread of electricity especially in rural areas. Low agriculture tariffs and high subsidies resulted in overuse of both ground water and electricity. The challenge was not only to ensure energy efficiency but also to provide clean energy created the need to develop an effective and comprehensive energy

policy. In 2006 'Integrated Energy Policy' was framed that involves a system of coordinated decision making and that brings various energy activities and decision making in a common framework. One of the goals of integrated energy policy was to ensure that technologies that maximize energy efficiency and demand side management are pursued. The policy lays strong emphasis on making the energy sector efficient and competitive. It argues for relative prices and taxes that reflect the true social cost of different fuels and forms of energy as the best way to encourage right choice of fuels and technologies; for competitive markets wherever possible; transparent and targeted subsidies when needed. The direction of Eleventh Five-Year plan was influenced by the integrated energy policy. One of the critical visions put forth by plan was to increase energy efficiency by 20 percentage points by 2016-17 (Planning Commission,2007). The impact of these all policies and programmed was that India was able to reduce its energy intensity by significant amount. But while calculating the energy intensity only the commercial sources of energy is taken into account, while a large part of population still relies on the non-commercial sources of energy. Thus, the challenge is to take into account both the commercial and non-commercial sources of energy into the energy intensity and provide the population with safer, clean and modern sources of energy. All this is possible only through the energy efficiency measures.

Energy Efficiency

The present energy scenario in India as examined above have the following features:

- i) The present energy system is coal dominated and because of high dependence on dirty fuels pollution is rising.
- ii) Since Independence the energy sector has been operating under the ownership of government sector, after 1990's private sector participation has been allowed to ensure level playing field but domination of public sector still continues.
- iii) There is skewed demand pattern as Indian energy consumption shows a large income bias.
- iv) There exists a wide gap in patterns of energy consumption in urban and rural India.

- v) The country still faces a significant access issue of providing clean energy to large section of population.

Thus, India needs a shift and break –away from the present unsustainable path at all levels and adopt energy efficient way of life. There exists a vast amount of literature that focuses on changing habits of energy consumption by different countries and also focuses on switching to another alternate, as the fossil fuels are limited and causes environmental hazard and growth cannot be sustained solely on basis of fossil fuels. Some of the notable studies are Rangarao (1974), Pendse (1980), Ghosh (1991), Mitra (1992), Goldemberg (2001), Russi Daniela (2007), all the studies focus on the issue of energy security and energy efficiencies. The challenge before the global economy is twin fold i.e. to keep sustaining the development path with environmental concern, and to make access clean and affordable fuel supply to the growing population. Today energy security is not just the oil security rather it encompasses another dimension like safe, affordable and clean fuel too. Moreover, it must be recognized that energy security does not stand by itself but is lodged in the larger relations among nations. (Daniel Yergin,2006). The energy modeling exercise done in developed countries cannot be adopted in the developing as both differ in nature, resources and many other geographical features. In this stage it is comfortable for the developing to transform the energy system. Now a country like India enjoys an advantage of renewable energy resources that can be easily tapped according to its geo-climatic conditions. But totally switching to renewable is an arduous task and it will take time, so the best solution for the emerging Indian economy is energy efficiency. It is necessary to look at the different concepts of efficiency. The most common efficiency concept is technical efficiency: the conversion of physical inputs (such as the services of employees and machines) into outputs relative to best practice. In other words, given current technology, there is no wastage of inputs whatsoever in producing the given quantity of output. This is the measure through which India will be able to sustain its growth of 9% and also be able to connect a large part of people to switch from non-commercial energy resources to modern and clean energy carriers. Energy intensity is the most common indicator used for measuring energy use efficiency

of the economy. The energy intensity has improved over a period from 1980-2007. i.e. over a period of 27 years (Balachander P et AL, Energy Policy,2010). The rate of improvement observed in energy intensity is higher if measured in current monetary units as compared to measure in terms of constant monetary units. In term of current rupees, the energy intensity has come down from 3.1MJ/Rs. in 1980 to 0.37/Rs. in 2007 exhibiting a reduction of nearly 88%. On the other hand, rate of reduction measured in constant terms is 20.5%. Thus, while reporting energy efficiency improvements in form of energy intensity one has to take into account the depreciation in monetary values. The energy intensity of India in 2007 was 0.77toe/thousand dollar at constant 2000 prices whereas Japan had an intensity of 0.1 toe/thousand dollars at 2000 constant prices, U.K had an intensity of 0.12 and U.S.A had an intensity of 0.2 toe/thousand dollars at constant 2000 prices (Bhattacharyya, 2010).

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Plastics : Degradation of Environment

Nupur*

Tarandeep Saini**

India is a developing country with mixed economy that requires a colossal measure of energy to accomplish industrial needs as well as every day social need of its citizens. Power plants that are coal based, fulfils major demand of energy required in the country. All the power plants requires coal as an essential fuel due to which India is intensely dependent on coal utilization but the utilization of coal at larger amount contaminates the Earth in a consistent way. Indian power sector being huge and utilizing large amounts of coal emits Carbon Dioxide in the environment. It is measured that half of the Carbon Dioxide emissions are because of power plants. This the reason why it becomes a major issue to be taken care of and appropriate measure have to be taken in order to reduce these emissions. A new technology termed as "Carbon Capture and Storage(CCS)" acts as a transforming technology that helps to extract and capture Carbon Dioxide from the coal fired power plants. Technology is new and complicated in India, due to which its adoption is less. India needs to lower its carbon intensity by 33%-35% by 2030 as per UN Framework Convention on Climate Change UNFCCs Paris Summit.

Keywords: Carbon Dioxide, Carbon Capture and Storage, Green House Gas, Power Plants, India

INTRODUCTION

Increasing attention has been paid to plastic waste by policymakers, scientists and therefore the media and possibly one in every of the foremost potent factors was the invention of the nice Pacific Garbage Patch by Charles Moore within the late Nineties.

This is often a layer of rubbish floating between California and Hawaii that has been calculable to span concerning three43 million 2km.

It's largely plastic and contains everything from giant abandoned fishing nets to plastic bottles to little particles of plastic. This sort of mass within the seas may be referred to as 'plasticsoup'.

Plastic continues to be a comparatively new material, which suggests the matter of plastic waste has solely recently been accomplished, as has data concerning its environmental persistence.

Even more modern is that the discovery of potential health and environmental effects, like the impacts of the chemicals contained in plastics.

In the last sixty years, plastic has become a helpful and versatile material with a goodvary of applications. Its uses square measure doubtless to extend with current developments within the plastic trade.

Within the future, plastic might facilitate address a number of the world's most pressing issues, like temperature change and food shortages.

For instance, plastics square measure employed in the manufacture of rotors for wind turbines and tunnels made up of synthetic resin will facilitate crops grow in otherwise unfavourable conditions.

As demand for materials with bound qualities will increase, the industry can aim to produce them. Meanwhile, increasing plastic production and use in rising economies appearance set to continue, and waste management infrastructure can need to develop consequently.

SOME IMPORTANT FACTS ON PLASTIC POLLUTION

1. Since the 1950s, around 8.3 billion tons of plastic have been produced worldwide. According to a report from the Guardian, an estimated 8.3 billion tons of plastic have been produced since the 1950s – that's equivalent to the weight of more than 800,000 Eiffel Towers.

*Student Amity Business School

2. In some parts of the world, using plastic is already illegal.

Kenya introduced one of the world's toughest laws against plastic bags in 2017. Now, Kenyans who are caught producing, selling, or even using plastic bags will risk imprisonment of up to four years or fines of \$40,000 (£31,000). Other countries that have banned, partially banned, or taxed single-use plastic bags include China, France, Rwanda, and Italy.

3. 73% of beach litter worldwide is plastic. According to National Geographic, 73% of all beach litter is plastic. The litter includes filters from cigarette butts, bottles, bottle caps, food wrappers, grocery bags, and polystyrene containers.
4. A million plastic bottles are bought around the world every minute.

A report by the Guardian found that 1 million plastic bottles are bought around the world every minute, and this number is set to increase by another 20% by 2021 if we don't act. The same report said more than 480 billion plastic drinking bottles were purchased in 2016 across the world – up from 300 billion a decade ago.

5. Worldwide, about 2 million plastic bags are used every minute.

This might seem like an unbelievable number, but according to Eco watch, between 500 billion and 1 trillion plastic bags are used worldwide annually. New Yorkers alone use 23 billion plastic bags every year, according to the New York City Department of Environmental Conservation.

6. 90% of plastic polluting our oceans is carried by just 10 rivers.

According to World Economic Forum researchers, just 10 rivers across Asia and Africa carry 90% of the plastic that ends up in the oceans. The study states that eight of these rivers are in Asia: the Yangtze, Indus, Yellow, Hai He, Ganges, Pearl, Amur, and Mekong. Two of the rivers can be found in Africa: the Nile and the Niger. The WEF added that the two things all the rivers named have in common is a high population living in the area, as well as a poor waste management system.

7. Plastic is killing more than 1.1 million seabirds and animals every year.

A study conducted by the University of Queensland in Australia, based on data collected since the late 1980s, found that Green sea turtles now ingest twice the plastic they did 25 years ago. Research from Plymouth University has found that close to 700 species of marine life are facing extinction due to the increase of plastic pollution.

8. The average person eats 70,000 microplastics each year.

That works out to about 100 bits of micro plastic over the course of just one meal, according to a study published in Environmental Pollution.

9. The average time that a plastic bag is used for is 12 minutes.
10. Over the past 50 years, world plastic production has doubled.

While increasing numbers of organisations and countries are banning plastic use and production, the world's leading plastic manufacturers are planning to increase production by almost a third over the next five years, according to the World Economic Forum. Increases at its current rate, according to National Geographic, by 2050 there will be 12 billion metric tons of plastic in landfills.

USES OF PLASTIC

1: *Polyethylene Terephthalate (PET)*

One of the plastics you are most likely to come into physical contact with on a daily basis, depending on how it is made PET can be completely rigid or flexible, and because of its molecular construction it is impact, chemical and weather resistant and a terrific water and gas barrier.

Common uses of PET

Soft drink, water, cooking oil bottles, packaging trays, frozen ready-meal trays, First-aid blankets, polar fleece.

2: *High Density Polyethylene (HDPE)*

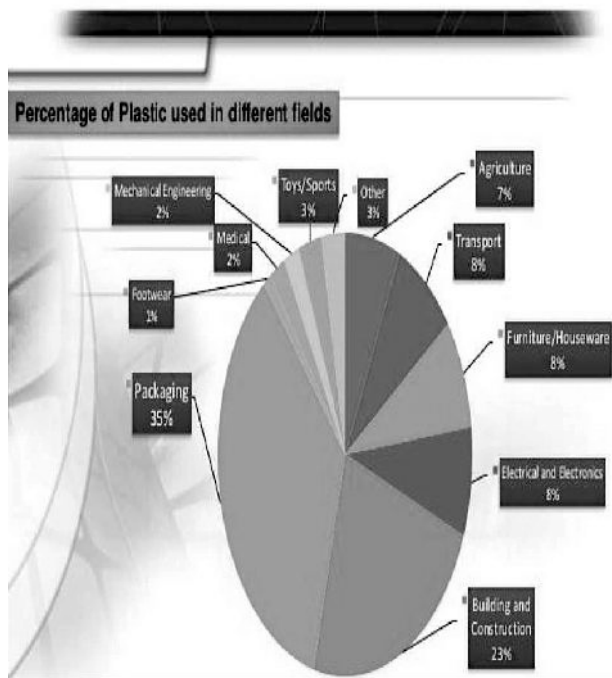
Incredibly strong considering its density, HDPE is a solid material that can tolerate high temperatures and strong chemicals. One of the reasons that HDPE is used so regularly is that it can be recycled in many different ways and therefore converted into many different things.

Common uses of HDPE

Cleaning solution and soap containers, Food and drink storage, shopping bags, freezer bags, pipes, insulation, bottle caps, vehicle fuel tanks, protective helmets, faux-wood planks, recycled wood-plastic composites.

3: Polyvinyl Chloride (PVC)

Cost effective to produce and highly resilient to chemical and biological damage, PVC is easy to work with and mould into shapes; making it an extremely practical material. In terms of properties, PVC is one of the most versatile. It can be used to create rigid, lightweight sheets, like Foamex, but it can also be used to make faux-leather materials like leatherette and pleather.



Common uses of PVC

Signage, furniture, clothing, medical containers, tubing, water and sewage pipes, flooring, cladding, vinyl records, cables, cleaning solution containers, water bottles.

4: Low Density Polyethylene (LDPE)

At general living temperatures LDPE is a highly non-reactive material, which explains why it has become one of the most common plastics in use at the moment. It can withstand temperatures approaching 100°C, and though it is not as strong as HDPE (its high density counterpart), it is certainly more resilient.

Common uses of LDPE

Trays, containers, work surfaces, machine parts, lids, '6-ring' drink holders, drink cartons, protective shells, computer hardware casings, playground fixtures (slides and the like), bin-bags, laundry bags.

5: Polypropylene (PP)

Strong and flexible, polypropylene is a very hard wearing plastic that, when melted, is one of the most effective materials for injection moulding. Having said that, it has quite a high tolerance to High temperatures, relative to other plastics, and is considered to be a food safe material.

Common uses of Polypropylene

Clothing, surgery tools and supplies, hobbyist model, bottle caps, food containers, straws, crisp bags, kettles, lunch boxes, packing tape.

PROBLEM OF PLASTIC

- Plastic is a polymeric material—that is, a material whose molecules are very large, often resembling long chains made up of a seemingly endless series of interconnected links. Natural polymers such as rubber and silk exist in abundance, but nature's "plastics" have not been implicated in environmental pollution, because they do not persist in the environment.
- Today, however, the average consumer comes into daily contact with all kinds of man-made plastic materials that have been developed specifically to defeat natural decay processes—materials derived mainly from petroleum that can be moulded, cast, spun, or applied as a coating.
- Since synthetic plastics are largely non-biodegradable, they tend to persist in natural environments.
- Many lightweight, single-use plastic products and packaging materials, which account for approximately 50 percent of all plastics produced, are not deposited in containers for subsequent removal to landfills, recycling centres, or incinerators. Instead, they are improperly disposed of at or near the location where they end their usefulness to the consumer.
- Dropped on the ground, thrown out of a car window, heaped onto an already full rubbish

bin, or inadvertently carried off by a gust of wind, they immediately begin to pollute the environment. Indeed, landscapes littered by plastic packaging have become common in many parts of the world.

- Studies from around the world have not shown any particular country or demographic group to be most responsible, though population centres generate the most litter.
- The causes and effects of plastic pollution are truly worldwide.



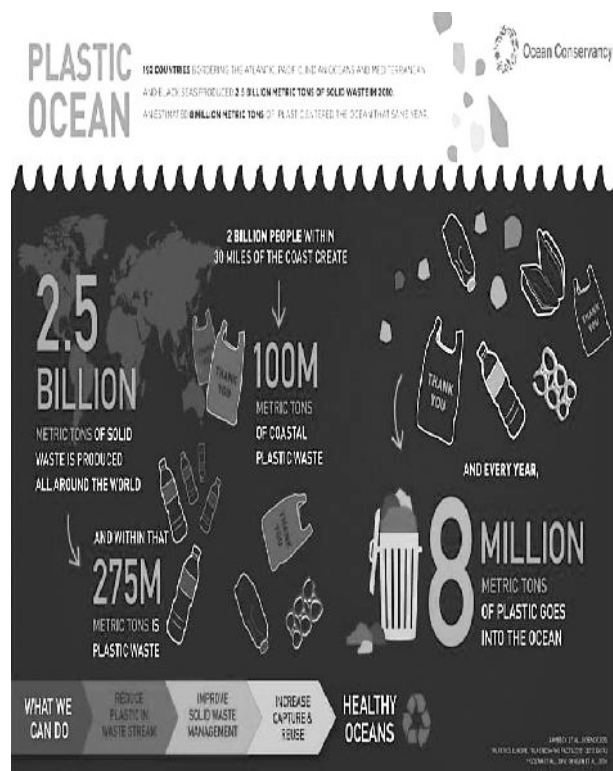
CAUSES OF PLASTIC POLLUTION

In the last decade, plastic has affected the health and lifetime of people at large terribly badly. Some incidents have attracted the eye of the full world and place an issue mark concerning the employment of plastic in lifestyle.

- Plastic, the surprise material that we have a tendency to use for everything and that pollutes our surroundings, is probably the foremost harmful of trash drop by mariners and ocean-goers within the sea as a result of it doesn't without delay break down in nature.
- In fact, the plastic that goes over the aspect these days should still be around in many years to flub the fishing tackle, boat propellers and beaches of future generations.
- Careless disposal of plastic will have dire consequences. A bag sounds like a tasty jellyfish to AN indiscriminate feeder just like the turtle, however plastic is undigested.

- It will choke, block the intestines of, or cause infection in those animals that consume it.
- A bag also can clog an outboard engine's cooling system. Lost or discarded monofilament cord will foul propellers, destroying oil seals and lower units of engines, or it will become an entangling net for fish, seabirds, and marine mammals.
- According to the Centre for Marine Conservation, over 25,000 items of cord were collected from U.S. beaches throughout the 1996 annual beach clean-up and a minimum of fortieth of all animal entanglements reportable during the cleanups concerned cord. Every day, additional and more plastic is accumulating in our oceans.
- Recreational boaters aren't the sole cluster that improperly disposes off plastic refuse stumped. Plastics additionally enter the marine atmosphere from waste product outfalls, bourgeois shipping, business fishing operations, and beachgoers.

In the middle stage, it's terribly versatile and might lean any form reckoning on temperature and pressure. In practices, urea, gas, polyethene, styrene, polycithylcholid, synthetic resin compounds and different substances are utilized in the preparation of plastics pollution.



Now-a-days the foremost standard plastic pollution is caused is vinyl resin (P.V.C.). Once any food material or blood is hold on within the same plastic containers then bit by bit the soluble chemical gets dissolved in them inflicting death thanks to cancer and different skin diseases.

Polyvinyl chloride has additionally been found to destroy the fertility of the animals and their metastasis system. Once mixed with water, it causes dysfunction and additionally damages bones and causes irritation to the skin.

Recently U.S.A. has prohibited the employment of P.V.C. plastic in house equipment and in food containers .

Republic of Indiaought to forthwith ban the employment of P.V.C. in water pipes, food and medication containers to avoid wasting the lives of millions WHO are already plagued by differing types of ailments.

EFFECTS OF PLASTIC POLLUTION

Since the event of plastic earlier this century, it's become a preferred material employed in a large type of ways in which.

Nowadays plastic is employed to create, or wrap around, several of the things we tend to get or use. The matter arises once we not need this stuff and that we must dispose off them, notably the throwaway plastic material employed in wrapping or packaging.

Plastics are used as a result if they're simple and low cost to create and that they will last an extended time. Sadly, these same helpful qualities will create plastic a large pollution downside. The cheapness suggests that plastic gets discarded simply and its long life means it survives within the setting for long periods wherever it will do nice damage because plastic doesn't decompose and needs high energy ultraviolet illumination to interrupt down, the number of plastic waste in our oceans is steady increasing.

The plastic rubbish found on beaches close to urban areas tends to originate from use onto land, like packaging material accustomed wrap around alternative product. On remote rural beaches, the rubbish tends to possess come back from ships, like fishing instrumentality employed in the fishing business.

I. Effect on Ocean Wildlife

This plastic can affect marine wildlife in two important ways; by entangling creatures, and by being swallowed. The bodies of almost all marine species, ranging in size from plankton to marine mammals, and including some of the wildest and most vulnerable species on the planet - animals that make nearly their entire living far from human beings - now contain plastic.

Sixty per-cent of 6,136 surface plankton net tows conducted in the Western North Atlantic Ocean and Caribbean Sea from 1986 to 2008 contained buoyant plastic pieces, typically millimetre in size.

Plastics turn up in bird nests, are worn by hermit crabs instead of shells, and are present in sea turtle, whale and albatross stomachs.

Over 260 species, including invertebrates, turtles, fish, seabirds and mammals, have been reported to ingest or become entangled in plastic debris, resulting in impaired movement and feeding, reduced reproductive output, lacerations, ulcers, and finally death.

Ingestion of plastic items occurs much more frequently than entanglement. At sea, plastic bags may often be mistaken for jellyfish, whilst on shorelines seabirds have been seen to pick up plastic items the same way they pick up cuttlefish bones. In the North Sea, almost all Northern Fulmars contain some plastic.

Microscopic fragments, in some locations outweighing surface zooplankton, revealed a significant increase in abundance when samples from the 1960s & 1970s were compared with those of 1980s and 1990s. When ingested, such small particles can also be carried from the gut into other body tissues.

Ingestion of plastic can lead to wounds, impairment of feeding capacity; blockage of digestive tract followed by satiation and starvation; and general debilitation often leading to death. Plasticizers and organic contaminants they typically sore and concentrate on plastics at levels far superior to the surrounding marine environment have been shown to affect both development and reproduction in a wide range of marine organisms.

Molluscs and crustaceans appear to be particularly sensitive to these compounds. Being an important food item for many species, plastics ingested by invertebrates then have the potential to transfer toxic substances up the food chain. The mechanism by which ingestion leads to illness and death can often only be surmised because the animals at sea are unobserved or are found dead ashore.

Once fouled with marine life or sediment, plastic items sink to the seafloor contaminating the sea bed. Deployment of a remotely operated vehicle submarine in the Fram Strait (Arctic) revealed 0.2 to 0.9 pieces of plastic per km at Hausgarten (2,500 m). On dives between 5,500 and 6,770 m, 15 items of debris were observed, of which 13 were plastic. The presence of plastic at shallow and greater depths may harm sediment wildlife such as worms, sessile filter feeders, deposit feeders and detritivores, all known to accidentally ingest plastics.

The hard surface of pelagic plastics also provides an attractive and alternate substrate to natural floating debris (e.g., seeds, pumice, and wood) for a number of opportunistic colonizers. The increasing availability of these synthetic and non-biodegradable materials in marine debris may increase the dispersal and prospects for invasion by non-indigenous species.

II. Plastic Bags Litter the Landscape

Once they are used, most plastic bags go into landfill, or rubbish tips. Each year more and more plastic bags are ending up littering the environment. Once they become litter, plastic bags find their way into our waterways, parks, beaches, and streets. And, if they are burnt, they infuse the air with toxic fumes.

III. Plastic Bags Kill Animals

About 100,000 animals such as cows, dogs and penguins are killed every year due to plastic bags. Many animals ingest plastic bags, mistaking them for food, and therefore die. And worse, the ingested plastic bag remains intact even after the death and decomposition of the animal. Thus, it lies around in the landscape where another victim may ingest it.

IV. Plastic Bags are Non-Biodegradable

And one of the worst environmental effects of

plastic bags is that they are non-biodegradable. The decomposition of plastic bags takes about 1000 years.

V. Petroleum is Required to Produce Plastic Bags

As it is, petroleum products are diminishing and getting more expensive day by day, since we have been using this non-renewable resource increasingly. Petroleum is vital for our modern way of life. It is necessary for our energy requirements - for our factories, transport, heating, lighting, and so on.

Without viable alternate sources of energy yet on the horizon, if the supply of petroleum were to be turned off, it would lead to practically the whole world grinding to a halt. Surely, this precious resource should not be wasted on producing plastic bags, should it?

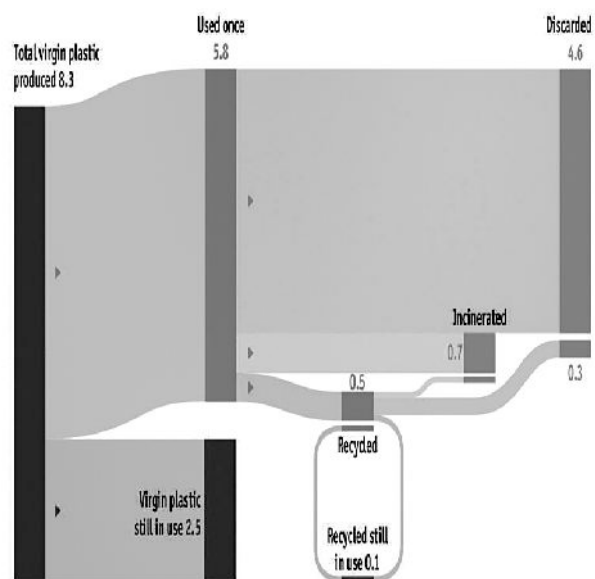
VI. Effect on Birds

Birds like chicks are often mistakenly fed plastics by their parents, when chicks are unable to eject the plastics, which cause death of chicks - either due to starvation or choking. Bottle caps and other plastic objects are visible inside the decomposed carcasses of some Laysan Albatross. The bird probably mistook the plastics for food and injected them while foraging.

VII. Effects on Human Beings

The end of all things

Global plastic production and use, 1950-2015, tonnes, bn



Source: "Production, use, and fate of all plastics ever made" by R. Geyer et al., Science Advances

Economist.com

The quality of the air we breathe, the water we drink or bath on, and the earth in which we grow our food has an immense effect on our health. A recent US Centre for Disease Control and Prevention Study found that about 93 percent of the US population has bisphenol A, a chemical that can be found in canned goods and in hard, clear plastic items (including baby bottles), in their body.

Bisphenol A (an endocrine disruptor) is a key monomer in production of polycarbonate plastic and epoxy resins. Polycarbonate plastic, which is clear and nearly shatter-proof, is used to make a variety of common products including baby and water bottles, sports equipment, medical and dental devices, dental composite (white) fillings and sealants and lenses.

The figure shows that as the plastic moves up in food chain, its concentration increases and when these fishes with huge amount of plastic are eaten by human cause diseases like cancer. Plastic plays the villain right from the stage of its production.

The major chemicals that go into the making of plastic are highly toxic and pose serious threat to living beings of all species on earth.

SOLVING THE PROBLEM

Given the global scale of plastic pollution, the cost of removing plastics from the environment would be prohibitive. Most solutions to the problem of plastic pollution, therefore, focus on preventing improper disposal or even on limiting the use of certain plastic items in the first place. Fines for littering have proved difficult to enforce, but various fees or outright bans on foamed food containers and plastic shopping bags are now common, as are deposits redeemed by taking beverage bottles to recycling centres. So-called extended producer responsibility, or EPR, schemes make the manufacturers of some items responsible for creating an infrastructure to take back and recycle the products that they produce.

Awareness of the serious consequences of plastic pollution is increasing, and new solutions, including the increasing use of biodegradable plastics and a “zero waste” philosophy, are being embraced by governments and the public.

SOME WAYS TO MANAGE PLASTIC POLLUTION

In the present era, the plastic use has become one of the integral part of our daily life. We cannot carry many of our daily activities without plastic in our use. Even though there are many advantage of plastics but the disadvantages can be reduced to some extent if we know how to deal with it. There are quite a few steps that can be taken to help handle plastic pollution.

- Eliminate plastic containers that are used for food, water, soft drinks, etc. Instead of plastic, go back to using glass, aluminium, and cartons (like those used for single servings of milk).
- Use cardboard boxes (like those used to hold 12-packs) instead of joined plastic rings (like those used for 6-packs).
- Eliminate plastic grocery bags and use paper bags or boxes.
- Use biodegradable plastics. More in the link below.
- Eliminate all those heavy plastic ‘wraps’ used for toys and such.

The five things I listed above, can make a significant difference in the amount of ADDED pollution. Lowering the amount of discarded plastic is much more difficult. Difficult, but not impossible.

- **Plastic Recycling**

Separating the plastic products from the garbage and at home and handling over this plastic for recycling can reduce the impact of environmental pollution due to plastic waste. Plastic recycling industry is now a billion dollar industry in developed economies. Recycled plastic is usually used for laying down roads in place of bitumen, bottles, benches etc. Buying recycled plastic also helps with plastic management.

- **Using Incinerations**

Plastic waste is being burned in incinerator centers located outside the city limits in developed economies and this practice is now being followed by developing economies as well. This technique eliminates huge volumes of plastic material but there are some concerns related with air pollution due to such burning but efforts are being made to improve technology to reduce such air pollution in future.

- **Prohibition on manufacturing/selling Certain plastic material/bags**

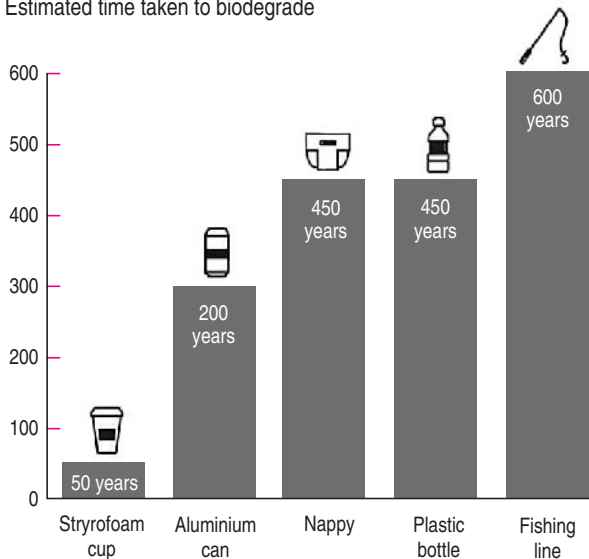
Some governments in the developed and developing countries has prohibited the manufacture and selling of plastic bags or material that contains more than the standard prescribed microns of plastic. By this way, the excessive dependence on plastic has been controlled to some extent.

- **Using Paper Bags**

Paper bags and other cloth materials as shopping bags for a customer can be useful. It is suggested to use paper bags and bags made with cloth material such as jute, cotton etc while going for shopping or for purchasing grocery items. In this way, we as individuals can rely less on the plastic bags while going on a shopping spree.

How long til they're gone?

Estimated time taken to biodegrade



Exact time will vary by product type and environmental conditions

Source: NOAA / Woods Hole Sea Grant

CONTROL OF PLASTIC POLLUTION

Plastic bags and bottles, like all forms of plastic, create significant environmental and economic burden.

They consume growing amount of energy and other natural resources, degrading the environment in a number of ways. In addition to using up fossil fuels and other resources, plastic products create litter, hurt marine life, and threaten the basis of life on earth.

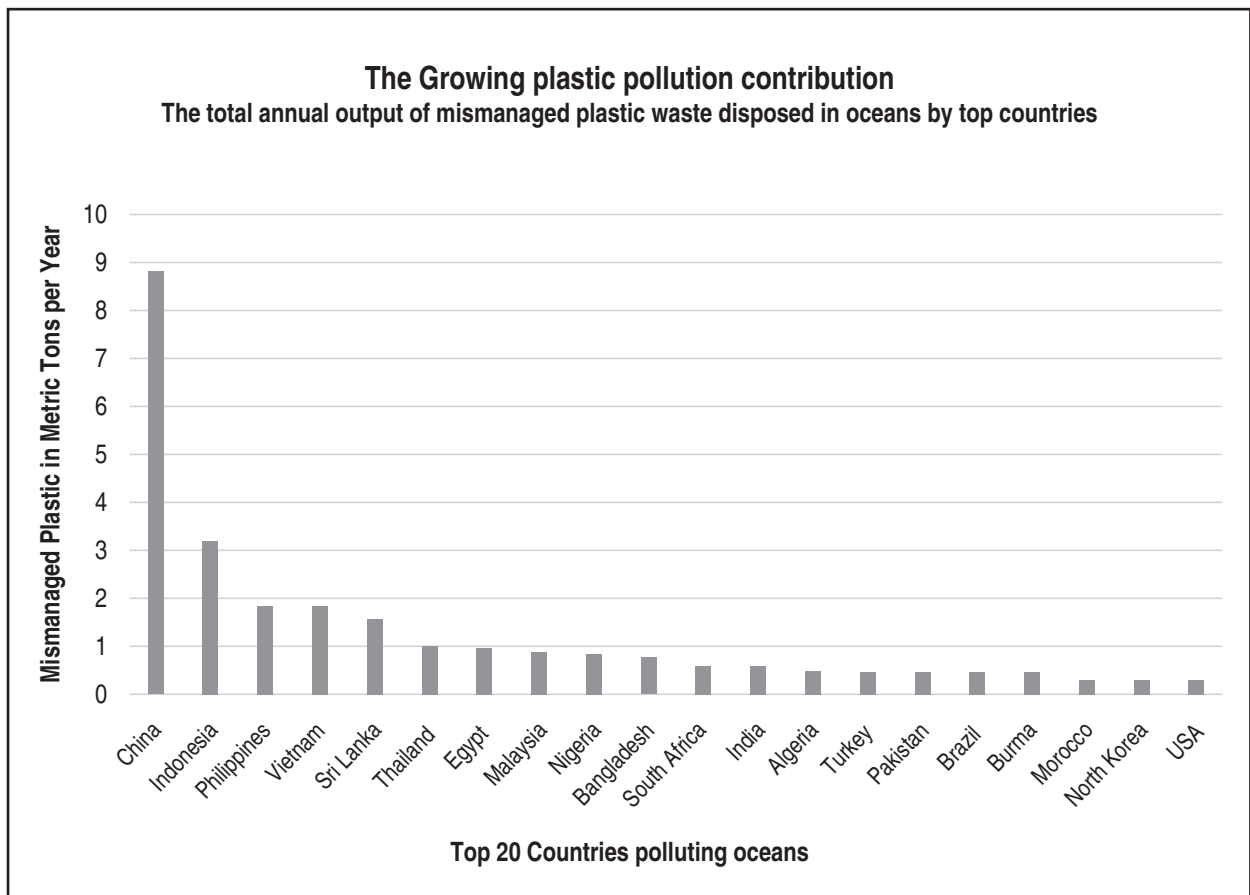
Here are some steps that we can take to reverse the tide of toxic, non-biodegradable pollution so that it may not overtake our planet.

- Put produce in paper, canvas, and other healthy-fiber bags.
- If a clerk throws your box of soap into a plastic bag, ask him or her to replace it in one of your bags. Give the clerk a copy of "Why I Don't Use Plastic Bags". Our experience has been that they appreciate this information.
- Use wax paper bags, cloth napkins, or re-useable sandwich boxes (e.g., tiffins, described below).
- Use only glass bottles or cans.
- Bottled water costs over 1000 times more per liter than water from your tap. Buying our most essential nutrient, water, from corporations represents an abdication of community control of the commons. If you have concerns about water safety, investigate a filter system such as Multi-Pure. Better yet, work with your water district to develop stricter standards for water purity.
- Pre-bagged produce not only uses wasteful packaging, but also tends to come from farther away, consuming more of our dwindling oil supplies in transport.
- Tiffins (stainless steel food containers) are a long tradition in India. They store food well, have longer life than Tupper Ware and its look-alikes (you've probably seen the fading, corroding, and chipping that occurs to these plastic containers), are more hygienic, and have a certain panache.
- Look for and reward earth-s friendly packaging choices, e.g. Buy greeting cards in paper boxes instead of clear plastic shells. Ask you florist for flowers wrapped in paper, not clear film use pens that re-fill instead of land-fill.
- Conscious consumption is not only good for the earth, it's good for you. "Mindfulness", says Thick Nhat Hanh, is the miracle by which we master.
- Support recycling schemes and promote support for one in your local area.
- Fishermen throughout South Africa should not throw away waste line, net or plastic litter - this causes huge suffering and many deaths.
- Practice and promote paper disposal of plastics in your home and at the beach. Always remember that litter generates litter. Never dispose off plastics in the sewage system.

- At the beach dispose off plastics and other litter in the bins provided. If these facilities are inadequate, contact the local authority responsible for this and lodge a complaint. Take your litter back home with you if there are no receptacles on the beach. Pick up any plastic litter you may see on the beach or in rock pools in the vicinity in which you are sitting or walking. Encourage young children to do likewise.
- In the street never throw plastic or other litter out of your car and do not drop it on the pavement or in the gutter.
- Set an example for others and encourage them to help. Plastics are not themselves a problem. They are useful and popular materials which can be produced with relatively little damage to the environment. The problem is the excessive use of plastics in one-off applications together with careless disposal.
- Plastic now pollutes every corner of Earth
- From oil use to ocean pollution: five facts about the plastics industry
- To clean up ocean plastics, increase focus on coasts
- Biodegradable Plastics Are Not the Answer to Reducing Marine Litter, Says UN
- Plastic Contaminates Ocean Sourced Table Salt
- Plastic Litter Taints the Sea Surface, Even in the Arctic
- 90 Percent of Seabirds Have Plastic in Their Stomachs
- The Race For Water Odyssey Arrives In Hawaii To Continue Its Fight Against Plastic Pollution In The Oceans
- Boyan Slat to Deploy 'Longest Floating Structure in World History' to Clean Ocean Plastic
- Great Barrier Reef Corals Eat Plastic.

MOST RECENT DEVELOPMENTS

- The surfers who invented a trashcan concept for the ocean



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Study on : Carbon Capture and Storage (CCS) in India

Jyoti Garg*

Tanya Bhattacharya**

Plastics are used so often universally that they became a significant part of our everyday lives. Sadly, once used, an oversized quantity of this plastic isn't restrained adequately and winds up in our oceans. The matter is therefore acute that it's a priority issue in guaranteeing higher management and protection of marine ecosystems. There's still a protracted thanks to attend increase public awareness regarding the adverse effects of plastic pollution on marine life. Achieving this could infix a way of individual responsibility and encourage the fixing of public and personal initiatives to cut back marine plastic pollution. Plastic pollution is of explicit concern in coastal areas of developing countries that lack applicable waste management policies.

However it additionally represents a significant threat to the world's oceans as an entire thanks to the slow degradation of plastic litter. The larger things generate supposed micro-plastics (particles smaller than 1-5mm in diameter), which might contact long distances through ocean surface circulation. These plastic fragments can act the aquatic surroundings for many years or centuries, because of their high resistance to natural degradation processes.

Keywords: Plastic Litter, micro-Plastics, ecosystem, Plastic Pollution

INTRODUCTION

Carbon Capture and Storage (CSS) is a process through which carbo dioxide can be extracted from various industrial processes. Such processes involve high temperature and burning of fossil fuels. carbon dioxide extracted from such processes are transported to a particular storage location where CO₂ is injected in the ground very deep so that GHG (green house gas) emissions can be reduced.

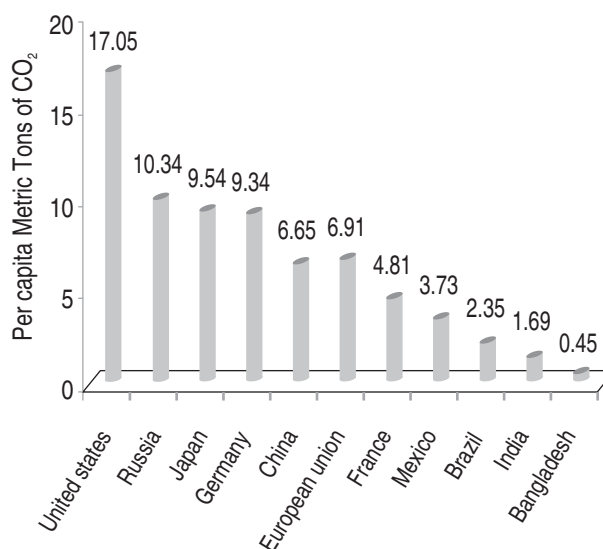
CCS is the best option to reduce emissions[1]. It would be troublesome and costly to handle environmental changes in future without this innovation. For a zero emission future, developing countries must incorporate this technology. India being a developing nation requires lots of energy for its transformation from rural to urban area. Keeping in minds, reduction of emissions India must use CCS for its better future[3].

In the ranking of power generation capacity, India is ranked number five. Carbon dioxide emissions are due to coal fired power plants and cement

production majorly. Global warming and different climate changes are due to green house gas emissions. The carbon dioxide release from different power plants and production sites contributes to GHG emissions.

In figure 1 given below, Per-capita CO₂ emission comparison is made among different countries.

In 2018, average carbon dioxide concentration reached up to 410 parts per million in earth's atmosphere. This is the major reason of global warming and also the reason for sea level rise.



* Associate at Frost and Sullivan, India

** Department of Corporate Consulting, Moody's Analytics Knowledge Services, India

The effects of global warming can be seen in our country by analyzing different sectors. These GHG emissions and raised level of carbon dioxide is affecting water availability, food security, agriculture land and social lives of people. An alarming situation is created in the country because of these effects and had waken up the government total appropriate actions regarding this issue.

LITERATURE REVIEW

India is developing at a rapid rate by increasing industrialisation. As discussed above industrialisation process involves coal as its primary source of fuel. It is very difficult for India to reduce its dependency on coal and gradually it will emit carbon dioxide affecting the climate. For the purpose of CCS research, "Indian CO2 Sequestration Applied Research(ICOSAR) Network" was established in 2007 by DST (Department of science and technology).

Corporations like NTPC and BHEL are doing research work for the same purpose.

The Oil and natural corporation in India is utilising carbon dioxide at Ankleswar oil field for EOR (Enhanced oil recovery).

India and its neighbouring countries are trying their best to implement Carbon Capture and storage technique to make environment better and also to control climatic changes. But each one of them are facing different challenges. In order to solve the issue, they are searching for best alternatives either to control carbon dioxide emission or to implement CCS.

CO2 EMISSION STATUS IN INDIA

Major carbon dioxide emissions are due to coal utilization, thermal power plants, fertilizer plants, cement plants and refineries.

Coal Utilization: Coal is the primary source energy in India. After USA and China, India is the largest coal producer. Approximately 7% of total coal reserves are situated in India. Coal demand is increasing day by day. Figure 2 describes the average annual demand of coal.

Thermal Power Plant : These plants use coal as their primary fuel. Coal emission through these thermal plants is increasing day by day. In 2011-12 it was 637.8 million tonnes, by 2015-16 it crossed 846.3 million tonnes.

Refineries : For Indian energy sector, there are approximately 23 refineries. During financial year 2015-16, 231.92 Mt total production of petroleum products were observed.

Figure 3 shows emission of carbon dioxide from Indian petroleum consumption from 2010-2016.

Fertiliserplants : Fertilizers are majorly used in agriculture. Agriculture is a prime profession in India, because of this fertilizer plants are accessed which produces large amount of carbon dioxide and is the cheapest source of CO2. Carbon dioxide emission is more than 0.1 Mt per year that is produced by ammonia manufacturing plants incorporated by fertilizer plants.

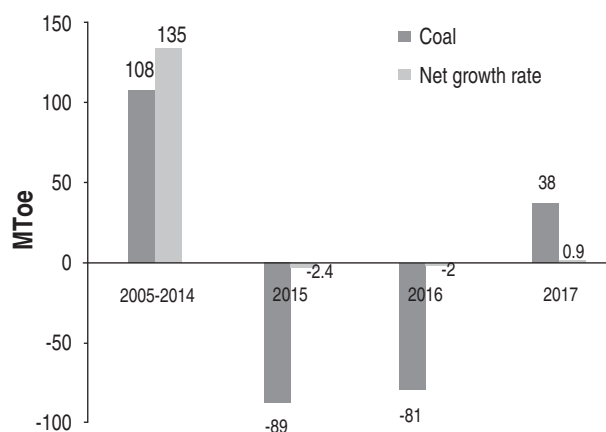
Cement Plant : Since 1950, around the world total cement production is more than 30 fold. These cement industries emits carbon dioxide that release GHG. In India, these type of carbon dioxide emissions have increased from 3.3% to 4.8%. These plant should also adopt CSS technology in order to reduce such dangerous emissions.

STORAGE POTENTIAL OF CO2

In the process of CCS, transportation and storage of carbon dioxide is the most important step. 100% attention is to be given to this step. Potential storage of carbon dioxide can be of two types basically that are ocean storage and geological storage.

Areas like coal fields, saline aquifers, satin water bearings, oil fields, sedimentary basins and gas fields comes under geological storage.

In India, "Deccan Volcanic Province" covers Saurashtra basin, Kutch basin, Deccan syncline. This Deccan volcanic province is largest sink of carbon dioxide that is stable.



Carbon dioxide stored in gas and oil fields is unable to escape for a longer period of time.

This makes oil and gas fields a better option of carbon dioxide storage.

Coal mines consists of coal having voids that helps in absorbing carbon dioxide, so it is also a vital option of carbon dioxide storage.

Sedimentary rocks in saline aquifers have dissolved salts that make it inappropriate for human consumption. This is also a good option for storage purpose.

LIMITATIONS

CCS (Carbon Capture and Storage) implementation in India is not an easy task. It involves lots of difficulties and hurdles.

For developing countries like India CCS is a promising technology to capture carbon dioxide and improve climatic conditions though it is very expensive.

Adopting new technology like CCS in India becomes difficult because of some political reasons and socio-economic reason. Some of the challenges in adapting CCS in India are :

1. *Storage Portfolio*

In India, there is not an adequate geographic resource to store carbon dioxide. Storing carbon dioxide requires large resources and field where CO₂ can be injected deep beneath the ground. Also not only fields are to be taken care of but transportation to that site is also a major issue.

Figure 4 shows the geographic resources of different countries that are storing carbon dioxide efficiently and same of India.

2. *Political factors*

India is a developing nation with a mixed economy. Poverty prevails in India that makes its economy unstable. India is a secular country and integrates many religion and culture all together. Each State has its own government that makes it difficult to take a collective decision for the betterment of the nation. This is a major issue and challenge in implementation of CCS in India.

3. *Financial Barrier*

As CCS is a costly technology to capture carbon dioxide and make environment better. CCS installation in India requires high initial investment that becomes a barrier.

4. *Less Access to information*

The cost and performance of CCS is not correctly known that makes a problem in decision making for the government.

5. *Enhanced oil recovery*

EOR is another option for capturing carbon dioxide that is efficiently used worldwide.

CONCLUSIONS AND RECOMMENDATIONS

In India, coal is used as the primary source of energy production. The type of current utilization pattern of coal can continue till 2030 without any problem. The use of coal will definitely lead to carbon dioxide emission in the environment. This gas leads to green house gas emission which adversely affects the climate. In order to reduce such emissions, the implementation of CCS that is carbon capture and storage technology will prove to be very helpful in protecting our environment. With such measures of protecting environment, we are giving a better bright future to our future generations. For successful implementation of CCS, it is important to overcome political barriers, analyze different geographic areas where gas can be stored and captured, collective decision had to be taken for the betterment of the country and environment. Such technologies can help India to become a developed nation but just appropriate decisions are to be taken.

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