

Power, pollution and ecological restoration assignment



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Power, Pollution and Ecological Restoration India is presently amongst the top ten power generating nations in the world and accounts to approximately 4% of the world's total electricity generation. India has the per person energy requirement of 0.7 kW approximately. [1] The following kinds of power stations (based on means of production) are presently meeting Indian power requirements: 1. Thermal Power 2. Hydro Power 3. Nuclear Power 4. Renewable Power Thermal based stations actually satisfy more than 60% of the entire country needs. Thermal power stations are based on coal, gas and oil.

Since independence these coal based thermal power stations have been enduring the burden of energy requirement in India. Renewable Power is still unable to contribute effectively, but with the development of technology their contribution has increased substantially. Following kinds (based on means of production) of renewable plants are presently producing electricity within the country: 1. Biogas Plants 2. Biomass Power 3. Solar Photovoltaic 4. Wind Energy 5. Small Hydropower 6. Energy from wastes. The following table gives the Installed Electricity Generation Capacity in India, 1997-2005 (in thousands of megawatts).

The data is based on statistics collected by carbon sequestration leadership forum [3]

Year	Hydroelectric	Nuclear	Geothermal/ Solar/ Wind/ Biomass	Conventional Thermal	Total Capacity
1997	21.65	0.00	1.27	59.64	82.56
2000	26.26	0.00	1.51	64.74	92.51
2003	26.26	0.00	1.74	65.77	93.77
2004	26.26	0.00	1.87	65.77	94.90
2005	26.26	0.00	1.81	65.77	94.84

Even though we are a developing country and our pressing needs has increased

the use of fossil fuels still in terms of Carbon dioxide emission we are far below many of the developed nations.

Carbon dioxide emission per capita in India is around 1 tonne against the world average of about 4 tonnes and of about 19 tonnes in case of some developed countries according to data by IEA. Still there is scope for improvement. In India we have reserves of low quality coal Lignite which are used in thermal power plants, they have high ash content and low calorific value, thus they attribute much towards the carbon dioxide emission in the country. Ecological Conflicts in Generating Plants A. Thermal Power Plant

The majority of electricity generators constitute the thermal power plants which consume fossil fuels. The fossil fuels are used to boil water which generates steam and that steam in turn rotates the turbine connected to the electric generator. The fossil fuels used have high constituent of carbon which when burnt produce carbon dioxide gas which is released into the atmosphere thus increasing the concentration of green house gases into the atmosphere. Also, it is known that particles as coal contain dilute radioactive elements which burnt release radioactive contaminations too into the air.

These radioactive contaminations are considered far worse than even the by-products of nuclear power plants whose radioactive residue is stored at one place. Coal is also known to contain heavy elements like mercury, arsenic which remains suspended in air. The other toxic fumes generated by these plants include Sulphur dioxide and nitrogen dioxide, perfect combination to cause acid rain. Besides requiring a huge investment, thermal power plants

have a huge dependency over the fossil fuels like coal, it also requires huge amount of water for cooling and generating steam.

Most of the thermal power plants are located near the river or huge water reserve. Thus, the hot water residue which is drained into the river disturbs the water ecology and habitat of species living in the water reserve. Besides this, they also have a major impact on the health conditions and environment of nearby surroundings. Major steps have been taken owing to the environmental impacts caused by the thermal power plants. Thermal power plants are allocated land area which is waste land or isn't in any use. And, the allotment is done taking care of any occupational hazard it might cause to the local residents.

If fishing is the main source of income for a local family then proper care is taken such that their source of income isn't affected by the plant. Air near the coal based thermal power plants is known to have huge concentrations of Sulphur dioxide, Oxides of nitrogen and SPM. In a case study studied below we will see the scientific reports which indicate that the people living 2-5 km near the thermal power plants are highly susceptible to respiratory disorders. The other emissions from these plants include carbon dioxide, ozone and mercury. Carbon dioxide is the sole cause of global warming in the earth atmosphere.

Ground level ozone, which is formed due to photolytic reactions of NO_x and its impacts are under study. Mercury vapor which is emitted into the air vapor can cause Minamata disease sometimes known as Chisso-Minamata. This is a neurological syndrome and develops because of high susceptibility

to mercury vapors. The major symptoms of which include: 1. numbness in hands 2. muscle weakness 3. lost vision and capability of hearing 4. major exposure can convert into insanity and patient can go into coma 5.

Congenital form of it can affect fetus. Fly ash is said to be the major cause of mercury pollution.

Chief constituents of Fly Ash are: [4] Chemical Components Percentage by Weight SiO₂ 51.4 % Al₂O₃ 22.1 % Fe₂O₃ 17.2 % Considerable proportions of following elements have also been found in fly ash: Element Concentration Be (Beryllium) 16.4 ppm Cu (Copper) 106 ppm Zn (Zinc) 578 ppm As (Arsenic) 40.4 ppm Cd (Cadmium) 2.6 ppm Hg (Mercury) 18 ppm Pb (Lead) 71 ppm U (Uranium) 21.8 ppm Water stream is used to drive out the ash from the thermal plant and preventing from air pollution. But, the residue containing ash is driven out into the water body which makes it unfit for human consumption and also disturbs the entire aquatic ecology.

Fly ash also contains Boron, which leaches out over a period of time. It affects primary productivity and affects the groundwater supply and increases turbidity in water. Yet, this is not the end if the fly ash is mixed into the soil it changes the soil properties owing to its alkaline nature. This adulteration causes the agriculture friendly species as earth worm to die and the treatment of the land before crop will require more chemicals whose impact is evident in the increased chemical concentration in the crop grown over the land. B. Nuclear Power Plant

Nuclear Power plant also works on the same phenomenon as a thermal power plant. Nuclear reactor exchanges heat with the water which converts

into steam and rotates turbine. But it also has added environmental concerns with it. A nuclear power plant rejects waste heat to a natural body of water which can result in undesired increase in the temperature of water and thus disturbing the aquatic life. The operation of the plant need to be strictly monitored because the unmonitored reaction can go out of control and disrupt the entire life form on earth.

Despite this, nuclear power plants are the most economical power plants. Unlike thermal power plants which suffer with toxic emissions nuclear power plants are safer, only residue being the heat coming out of the cooling towers. Nuclear power can be generated either via fission of heavy elements into smaller elements or through fusion of light weight elements to form heavy elements. Most of the nuclear power plants use fission of Uranium for generating the nuclear power.

Today most of the developing nations are banking on nuclear plants to meet their future energy demands especially because an atom of Uranium generates energy which is 10 million times the energy released by an atom of a carbon. These plants use Natural Uranium which has 99.3 % concentration of stable Uranium-238 and 0.7 % of useful Uranium-235 whose fission will produce the energy required in the plant. Before utilizing the directly available Uranium, enrichment of the ore is carried out; this increases the concentration of Uranium-235 from 0.7 % to a range of 4-5 %.

Power reactor contains core with number of fuel rods coated with oxides of Uranium. The Uranium-235 isotope absorbs neutrons and initiates fission reaction which liberates the required energy to heat the water which is circulating around the core in a cycle; it then rotates the turbine to generate

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electricity. Control rods are also there along with the fuel rods to control the rate of the reaction because each fission reaction produces three more neutrons which can make the reaction go out of control.

After due course of time, when the fuel rod contains maximum of the fission products and less initiator fuel the fuel rods are replaced by new ones, though that occurs after a long time. The major issue with the nuclear power plant is concerning the treatment of the radioactive waste which includes Plutonium, Thorium etc, which are also radioactive elements. There are plants in Europe and Russia which re-process the fuel rods and then are again re-used in the plants. Some countries are developing the re-processing plants locally instead of processing their rods in foreign land.

Initially the difficulty with the disposal of radioactive waste wasn't concerned a serious problem and so everyone thought of trivial ways of sealing and burying. But, it turned out to be a difficult task to handle the radioactive waste. [6] The planet water cycle is the main way through which radiation enters into the environment. Radiation is absorbed by the crop harvested over the local region and it is also consumed over by the marine species thus disturbing the marine ecology and contaminating the water body.

If humans consume the radiated crop or marine species of the local region then the radiation enters into human blood. Because some of the radioactive elements have greater half life the radioactivity can persist inside human body for a longer period of time causing great damage to cells and tissues.

[7] There are three main types of radioactive decay out of nuclear reactors:

1. Alpha decay 2. Beta decay 3. Gamma decay Radioactive wastes enter the

living species chain through following sources: 1. Protective clothing of people who remain in contact with radioactive elements. 2. Remains of animals that have been studied for susceptibility with radionuclide. 3. Appurtenances used in nuclear power plant like fuel rods, cooling water and tools. 4. Mill tailings from uranium-enrichment factories. 5. Old medical radiation equipment from hospitals and clinics. 6. Smoke detectors. Concentration of radiation inside human body is measured in rem, which stands for Roentgen equivalent in man. It measures the amount of radiation required to damage a living tissue. Doses below 100 rems are not significantly harmful to human life.

But, dosage above that can cause nausea, vomiting, headache and loss of white blood cells. Dosage above 300 rem can cause temporary hair loss; can damage nerve cells and cells that line the digestive tract. Higher doses like above 450 and 800 rems can damage white blood cells and reduce the concentration of blood platelets which can reduce the immunity of the body which can cause hemorrhage, thereby reducing the healing capability of the body. Higher doses can cause death within 2 to 14 days. C. Hydroelectric Power Plant Hydroelectric power plant and tidal are concerned as renewable sources of energy.

Hydroelectric plant is based on controlling the flow of water (by dams) which is then directed and used to rotate turbine. Hydroelectric Power Plant requires construction of a large dam; construction of a dam can disturb the aquatic life by restricting the motion of animals living inside. Perhaps more seriously, tidal power plant can reduce or increase the swing of tidal water which can affect the aquatic life severely especially those species which

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require a periodic cover of water. A hydroelectric power station slows down the flow of water which can lead to changes in sedimentation.

The sediments form the top part of the soil and are highly fertile. The top soil which is formed at lands due to deposition of sediments carried by the river from its matrix and deposited at low lying lands is favorable for agriculture. Moreover, dams can cause flooding due to any catastrophe or due to heavy rains during any bad season. Dislocation of resident people is amongst one of the major issues, settling them somewhere else with people being deprived from their source of living. Besides this the hydro electric project controls water flow thus inundating many forests and nearby areas and disturbing the marine ecology.

The case study of Tehri hydroelectric project will deal in detail with the impact of this project over all forms of living beings. Some of the major negative environmental impacts of a hydro electric power plant are: 1. Flooding 2. Diseases 3. Rainforest Destruction 4. Soil Erosion 5. Siltation 6. Habitat Destruction Despite the above mentioned negative impacts, hydroelectric plants have certain positive influences as well: 1. Water for Irrigation downstream. 2. Soil conservation 3. Navigation of rivers. D. Wind Power [8] Generating power by utilizing the wind energy is one of the renewable methods in generation of electricity.

Various countries have shown inclination towards establishment of such plants because they require less time to set up in comparison to the conventional thermal or hydro electric plants. In addition, they use renewable sources of energy for electricity and hence are eco-friendly. They

consume no fuel, and do not produce any toxic emissions or have any residue which can affect the living forms. They do not produce any toxic elements as Sulphur dioxide, Carbon dioxide or mercury vapors etc. into the atmosphere. During manufacture and concentration these plants requires steel, concrete and aluminum which will be made using fossil fuels.

The cost of which is returned in the starting 9 months of its operation. A wind farm can be set up at places where the wind force is fast enough to rotate the turbine which in turn generates electricity. The wind pattern in India is decided by the South west monsoon which arrives in the month of June and by the North East monsoon which comes during the last weeks of November or early December. The total wind mill capacity of India is believed to be around 45000 MW and the installed capacity as per 2006 data is 5300 MW.

Before establishing the wind mill, study is carried out for the wind speed, direction of wind. Places near the coast are avoided for the wind mills because they have unusual wind patterns. Instead, thermal induced wind patterns are preferred. And such locations where wind speed and direction is based on the temperature, comes first in the priority for site selection.

Preferred wind speed for optimum power generation is roughly around 40-50 km/hour. The average height of the turbine is 200 meters while the wings can span 80 metres. Their primary disadvantage is the lower load factor of these plants i. . they can't give significant contribution owing to changing wind patterns. The area requirement is very large, though the lying land can be utilized for other purposes as well. Earlier the wind turbines had

complaints of increasing noise pollution but with improved technology, various efficient turbines are being used which produce almost no noise.
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Although there have been allegations regarding the killing of birds due to the wind mills. But, death of birds is negligible compared to the death caused due to hunting and other reasons. Still, care is taken before installing wind stations.

If the span of wings is too low which make the animal species highly vulnerable to any mishap, the height is adjusted accordingly. The site is selected in such a manner that it doesn't disrupt human activity. E. Tidal Power [11] Tidal power is the more reliable form of renewable energy. Tides can be predicted more clearly unlike the case with solar and wind energy. Tidal power is generated because of the relative gravitational force between moon ??? earth pair and earth ??? sun pair along with the rotation of the earth. The magnitude of tide depends on the changing position of moon and sun relative o the earth. It is this gravitational attraction that causes tides in the sea. Stronger the tides greater is the amount of energy generated. There are two ways of harnessing the tidal power: 1. Tidal Stream: Tidal stream systems utilize the kinetic energy of moving water to rotate the turbines which then generate the power required. 2. Tidal Barrage: Barrages make use of potential energy due to difference in height of high and low tide. The differences in height develop the required potential energy to rotate the turbines. Barrages have certain environment issues.

Tidal Barrage permits the flow of tides into the barrage and the gates are closed when the tide stops coming in, trapping the water within the basin. As the tide recedes out, the barrage door is opened and the potential energy of the accumulated water forces the water to flow towards the sea. This force of water drives the turbine which generates electricity. Power can be <https://assignbuster.com/power-pollution-and-ecological-restoration-assignment/>

generated either way when the tidal water gathers in the barrage and also when the tidal water recedes back into the sea. Changes in water concentration can inundate shores.

Moreover, flooding caused due to water in the barrage can disturb the aquatic life. Fishes can be trapped inside the barrage. Proper care must be taken such that fishes are driven back to the sea with the receding water. The sea water turbidity can increase along with change in the sediment concentration (accumulation of sediments inside the barrage). Turbidity increases because of the exchange of smaller quantity of water and the sun's light which penetrates into the barrage water can increase the concentration of phytoplankton (food for aquatic animals).

In addition, salination of the water near the shore can increase because of the prolonged usage and water storage in the barrage. These issues need to be specifically addressed before establishing up a tidal power plant.

Comparing with tidal streams, barrages have more negative implications. In streams turbines are planted in the sea bed which might affect the aquatic life. But, specific observations haven't been made. Tidal power has various advantages over established power plants. Once established it requires very little maintenance and it is free, requires no fuel to drive the plant.

It produces no green house gases or other waste. Besides these advantages the major disadvantage is that the barrage occupies large tracts of ocean floor and can disrupt the ecology of major area both upstream and downstream. And it produces power only approximately 10 hours in a day. F.

Solar Energy Solar photo voltaic cells are an alternate form of tapping sun's

energy. It is environment friendly and like tidal and wind power it has only installation cost and low maintenance cost and also requires no fuel to initiate the power generation process.

It is believed and according to estimates that if the entire Thar Desert in India is covered by solar cells the energy generated will be enough to meet the energy demands of the entire country. A solar photo voltaic cell consists of two slices where one slice has positive electrical whilst other has negative electrical characteristics. The photon from sun strikes either slice and emits electron which then moves towards the oppositely charged slice and generates electric current.

The chief advantage of using solar energy is that it uses sun for power generation; which is a never ending source of energy and has no toxic emissions unlike thermal or nuclear plants. But, the major disadvantage is the use of lead-acid batteries to store the energy generated by the solar photo voltaic cells. The re-treatment of heavy elements used in these batteries is a cause of major concern. These heavy elements can cause highly toxic chemical pollution. G. Biomass Wood had been fuel for us since the very beginning of the mankind. Our ancestors used it to heat homes and cook food.

Wood still is used to generate electricity but its importance as energy resource has fallen down significantly. Instead other alternative sources have come up. Places where sugarcane is grown, sugarcane are fermented to make alcohol which is burned to generate power. Or in some place, the crushed cane and the pulp (“ bagasse”) are burnt to make steam. Other solid

wastes can also be used as fuel to generate heat. Some plants use “Bioconversion” to convert waste plant and animal matter into “biofuels” such as methanol, natural gas and oil. The working of plant running over biomass is similar to that of a thermal power plant.

Biomass is burnt which then heats water to generate steam. The generated steam is then used to rotate turbine which then generates power. Burning biomass produces many of the same emissions as burning fossil fuels.

However, growing biomass captures carbon dioxide out of the air, so that the net contribution to global atmospheric carbon dioxide levels is lessened. The following data indicates the amount of energy being generated in India by the renewable sources of energy. [17]

Country	Year	Total (TWh)	Hydroelectricity	Wind Power	Biomass	Photovoltaic	Geothermal
India	2007	137.1	122.4	14.7	—	—	—