The history of the abiotic natural resources environmental sciences essay

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2. 1 INTRODUCTION

Materials that occur in the nature under different environmental conditions are termed as Natural Resources. They are valuable in their natural (unmodified) form and their value is determined by the amount of material that can be extracted from them and the demand for the same. Natural Resources are extracted and purified as opposed to created. That is why mining, oil extraction, hunting and fishing are considered activities around natural resources, while agriculture is not. A commodity is usually considered as a natural resource when the key activities associated with it are extraction and purifying in contrast to manufacture. Thus, quarrying, extraction, fishing, and forestry are referred to natural-resource industries, whereasagronomy is not.

Classification of natural resources can be done by means of many various parameters.

On the basis of origin

Abiotic resources are acquired from land, water, and minerals.

Biotic Natural Resources:

Biotic resources are obtained from the biosphere either in the raw form or through cultivation. Petroleum having an organic origin isa biotic resource. Most of them are non-renewable in nature. E. g. fossil fuels, agricultural products, fruits, wax etc.

Abiotic Natural Resources:

Abiotic resources are procured from land, water, and minerals and are non-living in nature. air, water, land, Gold, Diamond, Silver, Bauxite, Nickel,

Copper, Iron Ore, Zinc, Lead, Sulfur, Chromites, Talc, Marble, Limestone, Platinum, Vanadium, Salt, Sand, Gravel etc. are all abiotic resource.

Basedon the degree to which they are development/processing

Currently Used Resources: presently used for human use. E. g., Coal, petroleum, etc. Potential Resources: untouched and untapped resources for future use. Hydrogen is one such resource.

On the basis of regeneration ability or continual supply

Recyclable resources –are those which can be recycled or the resources that can be replenished quickly through natural cycle. Examples - solar radiation, wind energy, water energy, biomass energy (solar energy stored in wood), agricultural products forests, wildlife, etc. If they are consumed at a rate exceeding their natural rate of replacement, the stock will eventually run out. Non-living renewable natural resources are soil and water. The resources, which cannot be replenished or replenished veryslowly, are non-renewable resources. They can be: Recyclable: These resources can be collected after use and can be recycled. Example- aluminum and other metals after being used is collected and recycled. Non-recyclable: cannot be recycled in any way. Example Coal, oil and natural gas and natural energy. Natural resources are natural capital converted to commodity inputs to infrastructural capital or wealthcreating processes. They include soil, timber, oil, minerals, and other goods taken more or less from the Earth. Both extraction of the basic resource and refining it into a purer, directly usable form, are generally considered natural-resource activities.

Tangible and non-tangible resource

A tangible resource is something that is physical in as much that we can touch or feel it. A non tangible resource, on the other hand is something that cannot be felt. Coal and Iron Ore for example are tangible resources, while the goodwill of a company or its brand value are examples of non-tangible resources.

2. 2 RENEWABLE AND NON-RENEWABLE RESOURCES

Renewable vs Nonrenewable energy

The sun alone can offersufficient energy for the world in just 40 minutes, if we have the appropriate technologies to harness it. Before the early 21st century nonrenewable resources were somewhatcheap to use. That is becoming less true as of 2013 due to its scarcity and high demand.

2. 2. 1 RENEWABLE ENERGY RESOURCES

1. SOLAR ENERGY

The Earth's most ubiquitousand potent energy source is the Sun, located 150 million kilometers away. Solar energy reaches the Earth in form of solar radiation for more than billions of years. This energy is then transformed into other forms of energy. Solar energy has powered life for many manyyears. A small fraction of this solar energy that strikes the earth every minute is sufficient enough to satisfy all our energy needs for the entire year only if we could harness it properly. Since it is a discontinuous source of energy, it can be supplemented with other source such as hydropower, thermal energy etc. the solar thermal collector box was utilized by the British astronomer John

Herschel in the 1830s. Electricity can be obtained from solar energy in two ways: i. Photovoltaic (PV devices) or " solar cells"- This technologyconverts the solar energy directly into electrical power. PV cell is the fundamental unit of the photovoltaic system. Each cell may vary from . 5 to 4 inches in size and generate 1 or 2 watts of power. Cells are electrically connected and packed into module which in turn is further linked to form array of panels. An array may vary from one to thousand modules depending on the amount of required power output. Solar energy reaches the earth surface as packets of energy called photons. Photons contain variable amounts of energy that correspond to different wavelength of the solar spectrum. Photons hitting a photovoltaic cell may follow three fates- they are either reflected back or they pass through or they are absorbed. Out of these three only the absorbed photons have the potential to generate electricity. PV cells are made of semiconductors, for instance crystalline silicon. With sufficient amount of energy absorption by the semiconductor, electrons are excited and dislodged from the atoms. Electron holes are forms when electrons move out of their position. Negatively charged electrons migrate towards the front surface of the cell and results in charge imbalance and voltage potential between the front and back surfaces of the cell. Electricity will flow when these two surfaces are coupled through an external load. Special treatment of the surface is carried out to make it more receptive to the free electrons. Solar incidence and other climatic condition govern the performance of photovoltaic cells. All of the world's electricity supply could be fulfilled by covering just 4 % of the world’s desert with photo voltaics. Almost all of the world's total electricity demand could be supplied by The Gobi Desert alone. Commercially, the efficiency of the available modules

varies from 5 to 15 %, though there is a constant effort to increase it by 30 %. Several building and houses have installed solar panels on their roofs. There are examples of photo voltaic power plants of 200 MW capacities in China, 48 MW capacities in Nevada, US and 97 MW capacities in Canada. Numerous such plants are in construction stage throughout the world.

Commercial applications with examples

The application included calculators, wrist watches, solar power driven water pumps, solar geyser, power communication equipments and domestic electricity supply. Solar water heatingThe roof is fitted with glass panels. Water is pumped through the pipes in the glass panels at the bottom. The pipes are painted with black color so that it can absorb more solar radiation. Convection in water will drive the hot water flow from the top. The water should be driven out of the panel to prevent the panels from freezing. Such heating save the electricity bills and is worthwhile in the places with abundant sunshine like Arizona and California. A more advanced type is the " Thermomax" panel comprised of a set of glass tubes. Each tube contains a metal plate coated blue which aid in absorbing infrared and UV radiation. The glass tubes should be vacuumed to minimize heat loss. The output is decent even on diffused sunlight. PICTURESolar power driven satellites orbiting the Earth, gives us with telephones, navigation facilities, satellite TV, weather forcasting and internet.

Advantages of photovoltaic systems are:

No need of heavy mechanical generators as sunlight is directly converted to electricity. Installation of PV arrays of any size can be installed quickly.

Minimal Environmental impact, no water required for system cooling.

Generate no by-products. Photovoltaic cells, like batteries, generate direct current (DC), usually used for small loads like electronic equipment. For commercial applications the direct current must be converted to alternating current (AC) by using inverters, solid state devices etc.

ii. Solar Thermal/Electric Power Plants

The solar energy is concentrated to heat and produce steam connected with a turbine coupled with a generator to produce electricity at variable scales. Solar thermal power generating plants served as the major source of electricity in 13 power plants in 2011. Of them 11 plants are in California, 1 in Nevada and 1 in Arizona. Three solar power plants are located in the Mojave Desert of California comprising Solar Energy Generating Systems (SEGS). The two SEGS plants at Harper Lake were the world’s largest solar thermal power generating plants in 2011. California’s, Solar One power stationlooks almost like a little the Odeillo solar furnace. The exception in this case being the mirrors, which are organized in rings around the " power tower". With the movement of the sun, the mirrors also turn to keep the sun rays focused on the tower. Oil is heated to 3, 000 degrees Celsius and this heat from the oil is used to generate steam. The steam then drives a turbine, turbines drives a generator with an ability to provide 10kW of electrical power.

The Indian Scenario

During the last three years, the Ministry of New & Renewable Energy has allotted 185 grid connected solar power plants with an aggregate capacity of 1172 MW under different schemes. 132 of these power plants with about 369 MW aggregate capacities have been commissioned up to 31. 01. 2013,

including 1 solar thermal power plant of 2. 5 MW capacity and 131 solar PV plants of 366 MW aggregate capacities. In case of the commissioned solar PV plants 131 plant of 366 MW capacity and 65 plants of 130 MW capacities are using indigenous solar cells / modules technologies. All 10 solar thermal power plants of 500 MW capacities are based on foreign technologies.

Advantages

No emission ofGHGs or other air pollutants. They have minimal impact on the environment even when they are installed on buildings. Solar energy is for free and requires no fuel. Produces no waste. In sunny countries, solar power can be used simplyto supply electricity to a distant place. Convenient for low-power usages such as solar powered garden lights and battery chargers. Cost effective.

Disadvantages

Sun does not shine at night and hence it will not work at night. Quite expensive to erect solar power stations, although with improvement of technology the cost is coming down. A large surface area is required to collect the energy at a practical rate as the sun does not deliver much energy at any place at any one time or a large area is needed to mount solar panels in order to get a decent amount of electricity. Can be unreliable at times. Amount of sunlight reaching the Earth's surface varies with location, time of day, time of year, and other weather conditions. Transmission remains a barrier that has to be breached.

2. WIND ENERGY

For years we are using wind for grinding grains, sailing ships and for irrigation. This kinetic energy can be converted to more usable forms of power in wind energy systems though wind energy is one of the least used resources. Winds results from uneven heating of earth’s atmosphere which again is due to the surface irregularities and earth’s rotation. It is the kinetic energy associated with atmospheric movement. The patterns of wind flow are modified by the physical features of the earth, water bodies and the vegetation. This flow when harvested with the help of wind turbines generates electricity. Wind turbines are used either singly or in clusters. Often small wind turbines called aero- generators are used to charge generators. Clusters of wind turbines are called ‘ wind farms’.

Types of Wind Turbine

Modern wind turbines can be of two types: The vertical-axis design or Darrieus model, named after its inventor, operates similar to the eggbeater-style. and the horizontal-axis variety. Most of the large contemporary wind turbines are horizontal-axis turbines. Wind TurbinesIn simple terms, wind turbine works opposite to a fan, where, the mechanical energy is converted to electrical energy. The wind in motion turns the blades, the blades turn a shaft (inside nacelle), and shaft is connected to the gearbox coupled with a generator to produce electricity. The output (around 700 V) is directed to the transformer which converts the electricity coming out to the right voltage (around 33, 000); appropriate for the distribution system or the grid system that transmits the power then. Devices to locate the wind direction and measure wind speed are fitted on top of the nacelle. With change in wind

direction, the motors change the nacelle and the blades to face the wind. The nacelle is also provided with brakes so that the turbine can be switched off at very high wind speeds to prevent damage. The informationis recorded by computers and send to the control centre.

Prospects in Wind Energy

80% of the world’s installed wind energy capacity is by five nations – Germany, USA, Denmark, Spain and India – account for. Germany is the highest producer followed by Spain, USA, Denmark and India. India's wind power potential is 45, 000 MW. The Government has fixed a goal of 15000 MW of wind power to be fitted during 12th Five Year Plan period; the expense for installing one MW wind power project is about Rs. 6 crores and high installation cost is a limitation. 18551 MW capacities from wind energy have already been set up in the country which isroughly 9% of the total installation power capacity in the country. The optimum sites for wind farm location are the coastal zones, the open plains, the mountain gaps, the rounded hill tops etc. But around 25 km/h of average wind speed is needed. Maximum wind farms in the United Kingdom are in Cornwall or Wale

Figure – Wind Farm

Wind energy per unit costs only marginally more than that of conventional energy (Rs. 4-4. 5 crores/MW, compared with thermal power costs of Rs. 3. 7 crores/MW). This difference is insignificant, when you consider the environmental costs of thermal energy. Above all, wind is an indigenous energy resource which we can use in unlimited amounts. Also, it can be produced locally. Fiscal and promotional incentives such asaccelerated depreciation, concession on import duty on specific components of wind

electric generators, exemption to excise duty are announced by the Government to foster private sector investment. IRDA _ the Indian Renewable Energy Development Agency along with other Financial Institutions provides loans for the installation of windmills. The Chennai based Center of Wind Energy Technology (C-WET) provide the necessary technical backup and is working in tandem with various other organisations to give shape to the Government’s move towards fulfilling its renewable targets. Among the Indian states, Tamil Nadu and Gujaratis ahead in the field of wind energy. Gujarat is followed by Andhra Pradesh. Uttar Pradesh and Jharkhand do not have any wind prospective site. Aurovillemultiblade windmill design has a high tripod tower design that has evolved from field experience over 20 years. Its double action pump boosts the output of water by approximately 60 % as compared to the old single action pumps. Suzlon is also a well-known name in this field. The state-wise wind power installed capacity is given as under.

Table - State-wise wind power installationSource-

Advantages

Wind farms require no fuel and hence it is free. No waste or greenhouse gas generation. The land underneath may be used for farming. Wind farms can attract tourists. A decent means of supplying energy to remote areas.

Disadvantages

Unpredictable and intermittent, some days may not be windy. Winds must have a speed above 12 to 14 miles/ hour to turn the turbines efficiently to generate electricity. Optimum areas for wind farms are often the open

plains, the coast, where land is expensive. Covering the landscape with these towers is at times unsightly and unaesthetic. Migrating flocks might get killed if the wind farms fall in the migratory route. Can affect television reception. Can be noisy as wind generators have a reputation for producing a constant, low, " swooshing" noise day and night. Aerodynamic designs in modern wind farms are much quieter. The small modern wind generators located on boats and caravans hardly makes any sound. Intention of most Indian companies toset up wind mills is for the tax breaks and not for the sake of clean energy.

Efficiency

Each turbine usually generates about 50 to 300 kilowatts of electricity. One light requires 100 watt of power supply. So, a 300 kilowatt (= 300, 000 watts) wind turbine could light up 3, 000 light bulbs of 100 watts. According to the U. S. Department of Energy, in 1990, wind power plants in Californiahave offset 2. 5 billion pounds plus of carbon dioxide emissionsalong with 15 million pounds of other chemicals that would have formed. Normally, 90 million to 175 million trees would be required to provide the air of same quality.

Cost Issues

Installation of wind turbines requires higher initial investment. 80 % of the cost is due to machineries and the rest is for site preparation and installation. But if we compare the wind generating systems with other generating technologies in terms of life cycle assessment, the cost for wind energy resource is much competitive due to no fuel purchase and minimum operational expenses.

Supply and Transport Issues

Wind energy is intermittent and does not always blow whenever we need electricity. We cannot store wind energy and also it cannot be harnessed to meet the peak demands. Suitable wind sites are often situated in inaccessiblelocations which makethe transmission a real headache. Wind resource development may also compete with other land, and thesealternative uses may be of more value than electricity generation. The landcan be used for grazing or farming on which the wind farms are located.

3. TIDAL POWER

Tidal energy a form of ocean energy is in use since the 11th century. It involves the construction of small dams along estuaries. It is almost like a hydro electric project where the dam is of much bigger size. To function efficiently a rise of 16 feet is required between the high tide and low tide. A barrage is built across which traps the approaching tide water. The stored water behind the barrage is let out when the tide drops. So, the water flows through the tunnels in the barrage with the ebb and flow of tide and this could be used to turn a turbine to produce power. Optionally, offshore turbines could also be used which operates like under water wind farm. Such type eliminates the possibility of environmental problems which the tidal barrage could possibly have and is also cheap to construct. Only 20 sites have been identified as potential power stations in the world. Severn, Dee, Soloway and Humber estuaries around Britain were identified as potential sites. Tidal reef almost like a tidal barrage was proposedacross the Severn estuary. The design is such that it does not hinder much of the water movements and so lessens the environmental consequences, such as storm

surges and flooding of low lying land. Migratory fishes could easily get through. Power could be generated for more hours as the mud flats could be exposed at low tide. It could be constructed in parts and so power generation could be earlier. Sections of it could be open during shipping.

OCEAN THERMAL ENERGY CONVERSION (OTEC)

It was in 1881 that Jacques D'Arsonval, a French engineer conceived the idea of using temperature differences in the ocean. The water gets colder and colder as we go deeper and deeper into the ocean. This difference in the temperature can be used to harness energy. A temperature gradient of 38 0 F is required between the warm surface and cold deep water to produce electricity. Such ocean thermal energy conversion is demonstrated in Hawaii and is very useful in supplying power for offshore mining.

Tidal Energy Prospects in India

India with a coastline, gulfs, bays and estuaries is potential enough to harness tidal energy for electric power generation. The Gulf of Cambay with a maximum tidal rage of 11m and average tidal range of 6. 77 m has a potential of about 7000MW. The Gulf of Kutch with a maximum tidal rage of 8m and average tidal range of 5. 23m have a potential of about 1200MW. The Gangetic delta of Sunderbans with a capacity of 100MW has a maximum tidal range of 5m with an average tidal range of 2. 97m. A demonstration tidal power plant of 3. 75 MW at Durgaduani Creek in the Sunderbans was sanctioned to the West Bengal Renewable Energy Development Agency (WBREDA), Kolkata. The project is being executed byNational Hydro Power Corporation Ltd. (NHPC). A special effort is made by the Govt. of Gujrat to study the possibility of tidal power projects under water without conventional

methods. AdvantagesAfter project completion, tidal energy is free. Requires no supply of fuel. No production of wastes or other pollutants. Reliable production of electricity. Maintenance cost is cheap. Tides are totally predictable. Offshore turbines have minimal environmental impact.

Disadvantages

Construction of barrages is usually expensive. Both the upstream and downstream is changed making it difficult for the birds to feed and fishes to migrate without fish ladders. Tidal power stations can generate power only for 10 hours a day, i. e., only when the tide is flowing. Few suitable sites are available for tidal barrages.

4. WAVE POWER

Waves in motion comprise kinetic energy and are the consequence as winds blow across the seas and oceans. The motion can be used to drive turbines and generate electricity. Energy can be obtained from the waves in a variety of methods. One may work like a reverse swimming pool wave machine. In a wave power station, the approaching waves may cause the water inside the chamber to bob up and down. This indicates that air is being forced in and out of the perforation in the top of the chamber. The rushing air in and out can turn any turbine placed in this perforation which in turn can turn the generator. The rushing air can be noisy but this can be reduced by fitting a silencer to the turbine. Other mechanism uses the up and down wave motion to push a piston inside a cylinder up and down. This piston can also turn a generator. Wave power stations are not frequent as because it generates small amount of power that can be used to power a small light house or a warning buoy.

Figure- Mechanism of wave power generation

Pelamis Wave Power

They used a long, hinged, floating tube called Pelamis which may rise up and down with the waves. Such movement bends the hinges which then pump hydraulic fluid to drive the generators.

Renewable Energy Holdings

They use underwater equipment on the sea bed near coastline. Moving waves crossing the top of such unit moves the piston that may drive the generators on land.

Advantages

Free energy, no fuel needed. No waste generated. More of less cheap operational and maintenance cost.

Disadvantages

Energy generation depends on the waves - sometimes you can get lot of energy, sometimes almost nothing. Requires suitable location, where waves are consistent andpowerful. Some designs may be noisy. Must be able to endure very irregular weather conditions.

5. GEOTHERMAL

The temperature increases as we go inside the earth and the temperature at earth’s centre is about 60000C. If the crust is thin the temperature can be 250 oC a few kilometers down. Temperature increases by about 3 oC for every 100 meters increase in depth. So it is very obvious that we will find heated rock hot enough to boil water at some distance below the ground.

Geothermal energy is the energy obtained from the stored heat inside earth’s crust. This form of energy was prevalent since the existence of the earth. The crust floats over the molten mantle known as magma. When magma gushes and forces out through the cracks and faults in the earth surface during volcanic eruption, it is called lava. If water comes close to or in contact with such hot rocks it starts boiling and quickly changes into steam. The temperature may be more than 300 oF. And when this hot water comes out through cracks it is called hot spring, such as Emerald Pool at Yellowstone National Park. Sometimes the hot water explodes in air to form a geyser like Old Faithful Geyser. When holes are drilled, the steam comes up which can then turn turbines to drive electrical generators. Natural " groundwater" may be present in the hot rocks or we have to drill holes to pump water down to them. Water is pumped down an " injection well", and comes back up the " recovery well" high under pressure. It bursts into steam reaching the surface. Geothermal power station was first built at Landrello, Italy, and the second plant was at Wairekei, New Zealand. Many such stations are in Iceland, Japan, the Philippines and the United States. geothermal heat is used to heat houses and electricity production in Iceland. Geothermal energy was limited to regionsaround tectonic plate boundaries. Globally, geothermal energy production has risen from 5800 MW to 8400 MW from 1998 to 1999.

Geothermal Energy Scenario: India and the world

Geothermal power plants worked in nearly 24 countries in 2010, and geothermal energy for heat wasinuse at least 78 countries. Presentlythese nations have geothermal power plants with a total capability of 10. 7 GW.

88% of this amount is produced in seven countries: the Iceland, Turkey, Philippines, USA, Indonesia, Mexico, Italy, New Zealand. Wineagel Developers in California, USA, produces 750 kW. The Yangbajain Geothermal Power Station in Tibet with a capacity of 25 MW ranks 10th in the world. India has a potential of 10, 600 MW though opinions may vary. Thermax, a capital goods manufacturing companyhas signed an agreement with Icelandic firm Reykjavík Geothermal. India’s first geothermal power plant is expected to emanate in Khammam district the state of Andhra Pradesh. The prospective sites in India are -•Puga Valley (J&K)•Tatapani (Chhattisgarh)•Godavari Basin Manikaran (Himachal Pradesh)•Bakreshwar (West Bengal)•Tuwa (Gujarat)•Unai (Maharashtra)•Jalgaon (Maharashtra)

Advantages

Do not produce any pollution, and does not add to the GHGs. The power stations do involve much space, so impact on the environment is negligible. No need of fuel. After installation, the energy is almost free. a little energy may be required to run a pump.

Disadvantages

Difficult to find prospective sites. Hot rocks of aappropriate type, at a depth to drill down is needed. Occasionallysuch site may " run out of steam’. Toxic gases and minerals may come out from underground along with steam, may be difficult to handle.

HYDROELECTRICITY

The power of water has been benefitting people for more than 2000 years. Water wheels were used to grind flour and later it was used to generate

electricity. At the end of 19th century the water turbines replaced water wheels and storage devices were constructed to regulate the flow of water. Hydropower is a renewable form of energy, economic, non-polluting and environmentally benign. In India such power is over 100 years old. With time the electricity requirements increased, technologies advanced and emphasis was given to the installation of big sized hydro power plants. In 1963, the hydropower had achieved a 50. 62% share out of the total set up capacity of power production in India. Principle of Hydropower generationHydropower can convert the natural water flow of water into electricity. The energy is created by descending water flow that turns the turbine blades coupled with a generator to produce electricity. The amount of electricity production depends on the volume of water passing through a turbine and the elevation from which the water drops. The flow and the head is directly proportional to the amount of electricity. A dam is built to trap water, much thicker at the base than the top to bear the load of water. Gravitational potential energy stored in the water and is let to flow through passageways in the barrage to turn turbines and drive generators. A station can be built next to a fast-flowing river so that the outgoing water flows normally. So, there can be dams to rise the head and control the water flow and reservoirs that may store water for future; while others generate electricity immediately using the water flow. Once built, water flow is free, power is cheap. More than fifty percent of the country's energy requirementsis met by hydropower in Switzerland and New Zealand. Hoover Dam, constructed on Colorado River, supplied most of the electricity need for Las Vegas city that time.

SMALL HYDRO POTENTIAL IN INDIA

Worldwide, Hydropower provides 17% of our electricity. This makes hydropower by and large the most important renewable energy for electricitygeneration. The total installed capacity of SHP is 47, 000 MW and the predicted potential is 180, 000 MW. The development of small hydro projects is strong in in Asia.

Classifications of Micro, Mini & SHP based on capacity

1. Up to 100KW – Micro Hydro Power2. 101Kw to 2000Kw – Mini Hydro Power3. 2001Kw to 25000Kw – Small Hydro Power

Strategy for SHP Development

SHP method was introduced in India after the installation of of the world's first hydroelectric project at Appleton, USA, 1882. The first SHP installation in the country is 130 kW plant at Darjeeling, 1897. Other SHP projects are located atShivasundaram in Mysore (2 MW), Galgoi in Mussoorie (3 MW), and Chaba (1. 75 MW) and Jubbal (50 kW) near Shimla. Many of these power houses utilize high head accessible at the sites. In the beginning, the development of SHP was limited to the hilly streams of the Himalayan region. Later, SHPs were installed on several canals on the Ganga. The major difficultyin SHP stations was that high voltage transmission lines were not laid that resulted in heavy line losses.

Advantages of Small Hydro Plants

It is a clean process of power generation. SHP's generate renewable energyapart from catering to the upliftment of the rural masses, more so in remote, inaccessible areas. Thye are a most cost effective option for power

generationThey provide a stable electricity supply even at remote areas and are a catalyst of economic development. SHPs resolve the low voltage problem in the remoteregions and helpdecreasetransmission and distribution losses. SHPalsohelps to provide water for drinkng, sanitation and rrigation. they also help foster economid development by aiding industrialisation. SHP’scall for minimum rehabilitation and resettlement apart from being environmental friendly. they also help in employment generation

The Indian Scenario

Earlier, the onus of controlling and running were separated between the Ministry of Power and the CEA (Central Electricity Authority). From 1989, Ministry of Non-conventional Energy Sources (MNES) is accountable for small and mini hydro projects. 15 States in India namely, Himachal Pradesh, Uttar Pradesh, Uttaranchal, Punjab, Haryana, Madhya Pradesh, Chhattisgarh, Karnataka, Kerala, Andhra Pradesh, Tamil Nadu, Orissa, West Bengal, Maharashtra and Rajasthan have publicizedtheir strategies for setting up of commercial SHP projects.

Estimated Potential

The expected potential of Small Hydro Power is about 15, 000 MW. The database for SHP projects generated by MNES comprises 4233 prospectivelocations with ancumulative capacity of 10, 324 MW. There is yet an undisclosedprospective of about 5000 MW sites in India.

Mini & Micro Hydro Power

CDM are the mainmotives for the development of mini and micro hydro power systems. In general micro hydro is pegged at less than 100kW

capacity, while Mini hydro ranges from more than 100 kW to less than 10 MW. Pico hydro is a very small scale power generation up to 10kW. The advantage of small hydro power plants is their cost effectiveness and reliability of providing clean electricity. Small and micro hydro power systems can be set up in river or streams with little or no negative environmental impacts and most of the systems do not require a dam or the diversion of water flows. Micro hydro power generation provides a good option for rural electrification and several such plants are in operation in developing countries serving rural communities. The power generation potential is proportional to the height (head) of water, flow rate and hydraulic efficiency of the turbine.

ADVANTAGES

1 Hydropower uses the velocity of flowing water and therefore meets the definition of renewable. 2 Hydropower possess unique operational flexibility that allows them to respond immediately to fluctuating demands for electricity and is the best source to support the exploitation of wind or solar energy. 3 Hydropower reservoirs collect rainfall thereby it can store and supply fresh water for drinking sanitation and irrigation. This fresh water storage protects aquifers, reduces our vulnerability to floods and droughts. 4 Hydropower is aenvronmentally friendly, renewable, cleansource of electricity as it produces very few greenhouse gases, no other air pollutants, and it does not generate any toxic waste by-products. 5 By offsetting carbon emissions from gas, coal and oil fired power plants, hydropower contribute to reducing air pollution and slows down global warming. 6 Hydropower facilities bring electricity, roads, industry and commerce to

communities, developing the economy, improving access to health and education, and enhancing the quality of life with little or no negative consequences. 7 Through flexible, reliable and efficient operation, hydropower ensures an effective electricity network, where the performance of thermal plants is optimized and air emissions reduced. 8 Water from rivers is a renewable resource that is not subject to fluctuations in fuel prices or supply constraints; therefore, hydropower fosters energy independence and security. 9 With an average life span of 50 to 100 years, hydropower projects are long-term investments that can easily be upgraded to take advantage of the latest technologies and normally pay back within a short period oif time. Hydropower is an electricity source with long viability and very low operation and maintenance costs that one generation bestows onto several subsequent ones. 10 Hydropower projects that grow and operate in an economically feasible, environmentally sound and socially accountable manner characterize sustainable development at its best; that is to say, " Development that meets the needs of the people today without compromising the ability of future generations to meet their own needs."

DISADVANTAGES

There are several constraints that affect the hydro power projects, such as: Land acquisition problems: hydro power projects face a plethora ofLand acquisition bottlenecks due to litigation problems, poor maintenance of land records, etc. Resettlement & Rehabilitation problems: as Reservoir schemes require evacuation of large extents of lands resulting in displacement of entire communities. Law & Order problems: Projects in some States face problems on account of insurgency, terrorism, etc. Difficult / Inaccessible

sites: in the remote areas infrastructure such as roadways have to be first constructed before work can commence. Power supply in remote areas also requires construction of long transmission lines with natural logistical problems. Geological Surprises: In the mountains geological surprises while tunneling consume large time and cost overruns. Delays in environment and forest clearances: getting environment and forest clearance is burdensome and involves inputs from concerned department of State and Centre which is becoming more and more difficult with rtising awareness making way for stringent legislations. Inter-State Aspects: Inter-State water disputes if any may unnecessarilytake away time. Funding of hydro power projects: hydro projects were chiefly funded by Government Agencies and hence limited number could be taken up.

HYDROELECTRIC POTENTIAL IN THE INDIA

The total capacity of our country as of June 2011 is 1, 76990 MW and hydro power supplies 38, 106 MW which is nearly 21. 5 %. As per 11th plan, 78, 700 MW additional capacitiesare envisaged from various conventional sources of which 15, 627 MW is from large hydro projects. ! 400 MW is expected to come from SHP projects. The central electricity authority plans an addition of 11, 897 MW in the 12th Five Year Plan. The total hydroelectric power prospect of the country is expected to be about 150, 000 MW.

7. BIOMASS ENERGY

Biomass is organic matter from plants and animals containing the stored energy of the sun; wood, manure and certain types of garbage are examples of biomass fuels. Biomass energy is reusable -- dead tree parts, branches, grass clippings, left-over crop residue, wood chips, and barks, twigs and

sawdust. It alsoincludes used tires and livestock manure. Biomass is a renewable energy because as long as lifeforms are there we will continue to get biomass energy.

Advantages

It is sensible to use waste materials. The fuel source is cheap. It Reduces dependence on the fossil fuels.

Disadvantages

Gathering fuel in sufficient quantities is difficult. Emission of greenhouse gases. It is not available all year round.

Converting Biomass to Other Forms of Energy

Biomass can be transformedinto other useable forms of energy, such as methane gas or transportation fuels, such as ethanol and biodiesel. Methane gas is the main ingredient of natural gas. Composting material can be used as manure thatcan help plants grow.

8. BIOGAS

Biogas is a biofuel, and refers to a mixture of methane and hydrogenproduced by bacterialdecomposition. The waste is digested in anaerobic conditions by bacteria, a process called " fermentation" at about 35-40oC. Some farmers may carry on such process in large tanks called " digesters" and may cover their manure ponds to capture biogas. The biogas can be utilizedto generate electricity or heat.

Advantages

It is sensible to use waste materials. The methane, a GHG can be used for electricity. The fuel is cheap. Low dependenceon fossil fuels.

Disadvantages

On combustion it emits greenhouse gases.

BIOFUEL

One way tobiomass utilization is ethanol production. Ethanol can be used in vehicles. Biofuels are possibly carbon-neutral, because the carbon dioxide which is emitted when fossil fuels are burnt is also taken in by the plants as they propagate. Vehicles are eitherpowered by bioethanol or biodiesel. Bioethanol is usually mixed with petrol, while biodiesel can be used as it is. Crops like corn and sugar caneare often usedforproduction of ethanol. Sugar cane left-over pulp, known as " bagasse" can provide power to the sugar mill, as well as sell the electricity to the neighbouring area. Biodiesel is produced from left-over food products like vegetable oils and animal fats. Biofuels are made from two main sources:

Biofuels from crops

Rapeseed can be processed into biodiesel. Sugar cane containing sugars that can be fermented into bioethanol.

Biofuels from algae

Microscopic algae can propagate and photosynthesizecan be used to make biodiesel. It caneasily be grown in transparent plastic tubes. Ethanol may also be made from waste paper, and biodiesel can be made from waste

grease and oils and even algae. Ethanol and ethanol-gasoline mixtures combust cleaner and have higher octane than pure gasoline, but higher " evaporative emissions" from fuel tanks and dispensing equipment is a limiting factor. These evaporative emissions contribute to the harmful, ground-level ozone and smog formation. Gasoline needs extra processing to reduce evaporative emissions before it is blended with ethanol. Compared to petroleum diesel, biodiesel combustion produces less sulfur oxides, particulate matter, carbon monoxide, and other hydrocarbons, but more nitrogen oxide.

Advantages

Less dependence on the fossil fuels. Carbon-neutralas compared toother fossil fuels.

Disadvantages

Requirement of larger area to grow crops for biofuels. Burning does produce carbon dioxide. Inconsistent supply of the materials.

2. 2. 2 NON-RENEWABLE ENERGY RESOURCES

Nonrenewable Energy Sources

A nonrenewable energy source is a type of energy source which is somewhat restrictedin supply. These energy sources may be copious, but, they cannot be createdor generatedrapidlythan they are used up. Apart from they being limited, their mining also has dire consequenceson our environment.

1. FOSSIL FUELS

Fossil fuels principally comprise of hydrocarbons. Fossil fuels involve of deposits of once living organisms. This may take centuries to form. Fossil fuels for energy provision are of three types; coal, oil and natural gas.

FORMATION OF FOSSIL FUEL

Fossil fuels were createdseveral hundreds of mya in the Carboniferous Period, a part of the Paleozoic Era, about 360 to 286 mya. In those periods, the land was covered with swamps, huge trees, ferns etc.; the water bodieswere filled with algae. After thedeath of trees and plants, they got submerged to the lowermostlevel of the swamps and transformed into a spongy material called peat. The peats remain covered by sand and clay for hundreds of years, which gradually turned into sedimentary rock. More and more rock stacked on top of rocks, exerting on the peat. The peat was pressed and pressed and ultimately, it formed coal, oil or petroleum, and natural gas. The formation of varioustypes of fossil fuels was largely depending on the combination of animal and plant debris, the span of time the material was buried, and what settings of temperature and pressure occurred when they were putrefying. Oil and natural gas were produced from aquatic organisms buried under ocean or river deposits. Extreme heat, pressure and bacteria combined to squeeze the organic material. Thick liquid called oil was formed first, but in hotter regions natural gas was formed. Coal formed in a similar fashion, from the dead residues of trees, ferns and other fauna that existed 300 to 400 mya. Coal was molded from swamps covered by marine water. The sea water contained considerable amount of sulfur; as it dried up, the sulfur was left over in the coal.

i. Coal

Coal is a combustible sedimentary rock comprised of hydrocarbon, oxygen, nitrogen and varying amounts of sulphur. Coal fall in three groups – anthracite, bituminous and lignite. Anthracite coal is the toughest and superior mostwith more carbon content; this gives it higher energy content. Lignite is the softest, low in carbon but high in hydrogen and oxygen content. Bituminous coal falls in between. The earliest recognized use of coal was in China and occurs throughout the world. There are over 861 billion tons of proven coal reserves, as per estimates, worldwide. This indicates that coal may last around 112 years at present rate of production. But, we have reached the specter of " Peak Oil" with our capacity to harvest more pointed off. Coal reserves are available in almost each and every country, with recoverable reserves in around seventy countries. The largestknown reserves are in the USA, Russia, China and India.

ii. Petroleum

Oil formed more than 300 mya andis in use for more than 5, 000-6, 000 years. The Dead Sea, near Israel was used to be known as Lake Asphaltites. The word asphalt was derived because of the lumps of gooey petroleum that were splashed up on the lake shorelines from underwater leaks.

iii. Natural Gas

Natural gas is aninflammable mixture, largely of methane and lighter than air. It is produced by the decay of methanogenic organisms in marshland, bog land, and landfills. Low temperatures are expected to produce more petroleum, and high temperatures are expected to produce more natural

gas. Natural gas is odorless and invisible. Before it is supplied to the pipelines and storage tanks, for safety, it is added with a chemical that gives a strong odor, generally smells like rotten eggs. Energy obtained bycombusting fossil fuels is converted to electricity. Heat released during the reaction further intensifies the reaction. Electricity is produced by converting mechanical energy (heat) to electrical energy in a turbine or generator. Most of the instance more electricity is produced than is essentially needed, since electricity cannot be stored. Electricity demands vary all through the year and the delivery must satisfy the peak load, which means the maximum possible demand within a year. If demands considerably exceed thecapacity of the power plant to generate electricity this may lead to temporary blackouts.

Environmental Impacts

Burning fossil fuels is accountable for global environmental issues that feature high on the political itineraryin present day’s context. Examples are greenhouse gas increase, acidification, pollution of air and water, degradation to land and ground-level ozone accretion. These environmental glitchesare mainly by discharge of pollutants that are inherentlyexistent in fossil fuel composition, such as sulphur and nitrogen. Currently, oil burning contributes to around 30% of all carbon dioxide emissions in air. Natural gas does not discharge as much carbon dioxide because of its methane structure in the mixture. The biggest emissions are from coal combustion. Coal also results in unintentionalunderground fires that are practicallyunmanageableand impossible to extinguish. Coal dust can alsoburst which makes coal mining a very riskyoccupation. Oil may

accumulate in soil or water in raw form, for instance during oil spills or wars. This has instigated many manmade disasters in the past. Fossilfuels are used to such extent because it is cheaper than any other type of reasonable alternative known to us.

Effect of oil spill in general

Oceanic mammals and seabirds face a great threat from floating oil because they have a regular contact with the aquatic surface. Oil smearingof fur coat or plumagesreduces the insulating capacity and can cause death from hypothermia, smothering, drowning, and consumption of deadlychemicals. Oil harmsthe wildlife through bodily contact, consumption, breathing and absorption. Oils are persistent in nature and exert long-term impacts on fish and aquatic life, interacting with the environment. Floating oil can affect the planktons, which can be algae, fish eggs, and the larvae of numerous invertebrates. Long term destruction to lower nutrient levels is hard to assess, but might pose ecological menaces in the Gulf of Mexico for years, groundedon its intervention with metabolism of thousands of species; Birds floating on the water or diving for fish through oil-slicked water are easily exposed. Oiled birds lose their flight ability, but rather ingest that oil while preening. Loggerheads and leatherbacks turtles are affected badly as they swim ashore for nesting. Turtle nest eggs may be spoiled if an oiled adult stays in the nest. Scavengers such as bald eagles, gulls, raccoons, and skunks feeding on bodiesand skeletons of polluted fish and wildlife are often exposed to oil.

USESOF FOSSIL FUELS

Gasoline is highly combustible, is the fuel source for traditional and hybrid vehicles, jet airplanes and racing cars. Diesel, obtained by refining fossil fuel is also usedin cars, trucks and trains to power their engines. Kerosene, a byproduct of crude oil is also used to drive heaters. Propane is used as fuel in cooking and heating, similar to natural gas. Benzene or benzolforms ingredient in medicines, synthesized vitamins, synthetic rubber, pesticides, solvents, dyes etc. The chief fuel source for thermal power plants is coal. Motor oil, petroleum jelly, hydraulic fluid is used to lubricate the machine parts. Plastic and polyester, produced in the process of refiningis used in making of containers, electronics components and building materials. Polyester is a multipurpose and tough component of modern clothing.

Advantages

High calorific value. Highly stable in nature as compared to other fuels. It has a vast potential to power the entire world. Coalisobtainable in abundance. Infrastructure for fossil fuel energy is entirely developed. Tried and tested type of fuel. Easy Transportation of liquid or gaseous fossil fuels. Cheaper source than non-conventional forms of energy. Electricity can be produced by simple combustion process.

Disadvantages

Over exploitation has caused in their considerable depletion. Largest emitters of greenhouse gases such as carbon dioxide and methane, responsible for global warming. Emissionof sulfur dioxide which cause acid rain. Threatens the ecological balance like mining may be a cause of

earthquakes. Non-renewable in nature. Formation of fossil fuels takes millions of years.

2. NUCLEAR POWER

Another most important form of energy is nuclear energy, the energy trapped inside each and every atom. Matter can be transformed into energy. According to Albert Einstein, E [energy] = m [mass] x c2 [c stands for the velocity or the speed of light. A nuclear power plant generally uses uranium as a " fuel."

Nuclear Fission

When an atom's nucleus is split apart, tremendous amount of energy is released in form of heat and light energy. This energy, when leased out in controlled manner, can be used to generate electricity. When it is leased out all at once, it makes a tremendous explosion like that of an atomic bomb. Nuclear power is produced by the process of controlled nuclear fission (splitting atoms). The word fission means to split apart. In majority of cases, nuclear fission reactions are used to heat water, the steam is further used to produce electricity. Uranium -235 and Plutoniumcan easilybefissioned. Uranium is dug out of the ground, processed into tiny pellets, loaded into long rods that are placed in the power plant's reactor. Uranium atoms are bombarded. In a chain reaction, particles set free by the splitting of the atom goesout and bombardanother uranium atom breakingthem in turn. Control rods are used to keep the fission regulated. This chain reaction gives out heat energy which is used to heat water in the reactor core. So, instead of combusting a fuel, nuclear power plants practice the sequence reaction of atoms breaking to alter the energy of atoms into thermal energy. This water

from the nuclear core is directed to another sector of the power plant. Here, in the heat exchanger, it heats extra set of water filled tubing to turn it into steam. The steam in this second set of pipes rotates a turbine to produce electricity. Below is a cross section of the interior of a characteristic nuclear power plant.

Nuclear Fusion

Another form of nuclear energy is called fusion. Fusion means union smaller nuclei to make a larger nucleus. We getsolar energy because of the nuclear fusion of hydrogen atoms into helium atoms. This in turn gives out heat and light and a spectrum of radiation. For instance, deuterium and tritium, react to form a helium atom and an extra neutron particle. Scientists have been attempting to construct a fusion reactor to generate electricity. But they have been facing trouble as they are trying to control the reaction in a contained space. The pluspoint of nuclear fusion is that it generatesa reduced amount of radioactive material than fission, and it has a longer fuel supplythan the sun. The current installed nuclear power capacity in the country is 4780 MW from twenty nuclear power reactors. There are seven nuclear power reactors, with a capacity of 5300 MW, under construction. The details are as follows:

Table - Current installed nuclear power capacity in the country is 4780 MW comprising twenty nuclear power reactors in six power plants.

Safety is accorded paramount importance in all phases of nuclear power plants from siting, design, construction, commissioning, operation & maintenance and eventual decommissioning. The operation of nuclear

power plants is carried out in accordance with the regulatory authority by trained personnel duly licensed by the Atomic Energy Regulatory Board (AERB).

2. 3 NATURAL RESOURCES AND ASSOCIATED PROBLEMS

1. Growing population - World population is over 7 billion at present. More number of people means more mouth to feed, more crops, more forests to be converted into croplands; more intensive farming, more use of pesticides and fertilizer to boost up the production and more and more soil deterioration in long run. A huge amount of water is diverted for irrigation to complement food production and a large number of trees and plants cut for use as fuel and fodder for animals. Human encroachment in forests becomes inevitable. Rapid means of transport and communication depletes natural habitats, rapid urbanization results in severe pollution and health problems.

2. Rapid pace of Industrialization – Production is always in anticipation of demand and ahead of it. Industries are working overtime to feed a growing population’s needs not paying heed to the fact that the resources that are used to feed this demand is finite. Wanton and at times even trivial needs are leading to the diversion of scarce resources which is creating a huge amount of stress on the eco system and the planet Earth. Industrialization, with mass production has thrown us into an orbit where our consumption has increased in tandem with our ability to produce without adequate thought being given to if at all production and consumption of such levels is required.

3. Uneven distribution of resource - Earth’s resources are distributed unevenly. Fossil fuels, minerals, agricultural resources – all show skewed

distribution patterns. While development around the pithead – where the resources are mined – is what should have been the natural result, the fact remains that the history of industrialization and economic development is also the story of how these diverse and scattered resources have been tapped by some nations to fuel their growth and prosperity. A trend reversal, with the South nations using the resources at their command to feed their pangs for development is perhaps playing out in the current – a trend that will become more pronounced in the days and years to come. 4. Over exploitation of natural resources- A new world order, conscious that the Earth’s resources have been pillaged for such long periods that there is a serious threat of them running out in the foreseeable future is now talking of sustainable extraction and optimization of resource use. However, the fact remains – most of the resources have been so wantonly over exploited – for example, " Peak Oil" which is today a chilling reminder – that we may soon have to cope with terms like rationing and search for alternatives as supply dries up. over exploitation may cause, Deforestation , Desertification, species extinction, migration, Soil erosion, depletion of oil, depletion of Ozone, increase in GHG emission, more energy consumption, aquatic pollution, more incidences of disaster.