ENVIRONMENTAL GEOSCIENCES

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Lecture-54

Conservation of Non-Renewable Energy

Welcome to the SWAYAM NPTEL course on Environmental Geosciences. We are discussing the module ten. In the module ten, we have discussed the fossil fuels, conservation of non-renewable resources. Now, today we will discuss the lecture five in which we will discuss about the conservation of non-renewable resources. The important concepts will be covered in this lecture will be energy management, energy commodities and energy resources, demand for energy resources, energy conservation, aspects of energy conservation, need for conservation of non-renewable resource, energy conservation act, transition to sustainable energy.

Now, let us understand the energy management first. The fundamental goal of energy management is to produce goods and provide services both at the minimum cost and at minimum risk or adverse effect to environment. Energy management involves the strategy of adjusting and optimizing energy by using systems and procedures which can reduce energy requirements per unit of output while holding or reducing total cost of production from these systems. Whereas energy audit is a systematic approach to analyze the use of energy for decision making in the area of energy management. Energy commodities like gasoline diesel fuels natural gas coal electricity can be used to provide energy services for human activities such as lighting, space heating, water heating, cooking and motive power.

Energy resources includes the crude oil, natural gas, coal, biomass, hydro, uranium, wind, sunlight and geothermal deposits can be harvested to produce energy commodities. Energy economics involves the study of economically efficient provision and the use of energy commodities and resources as well as the factors that may lower the economic efficiency of energy commodities and resources. Among the various strategies that have to be adopted to meet this energy demand, the efficient use of energy and its conservation emerges to be the least costly preposition apart from being friendly to the environment. Now, Energy Commodities and Energy Resources. The energy commodities and

resources can be differentiated on the basis of physical energies embodied by them. The physical energy can be of the following kinds.

First is the chemical energy that is oil, natural gas, coal, biomass embody chemical energy. Mechanical energy. Wind, ocean waves and running water in streams have mechanical energy. Third is the thermal energy. Geothermal deposits, sunlight and oceans have thermal energy. Electrical Energy. Electricity has electrical energy. Nuclear energy, uranium, thorium and plutonium have nuclear energy.

The energy commodities and resources can also be classified on the basis of physical forms. First is the liquids, crude oil, refined petroleum products and water are liquids. Second is the solids, coal, biomass, wood and uranium are solids. Third is the gaseous, natural gas and winds are gases. Resources can also be classified on the basis of sustainability as renewable and depletable.

Now what's the demand for energy resources? Energy demand is derived from customer's need to use energy to obtain the desired services. Energy demand depends upon the following factors that is first the consumer's demand for desired services, consumer demand for desired services, Second, the availability and properties of energy conversion technology. And third, the cost of energy conversion technology used for energy.

Petrol as a fuel is needed by consumers to run automobiles, thereby converting petrol to mechanical energy for motive power, which is a desired service. The cost of energy or petrol depends upon the distance traveled. Hence, demand for petrol is derived from the demand by the consumer for the best mileage by the automobile. Similarly, a consumer purchases electricity to run air conditioner, refrigerator, television and so on. Hence, the demand for electricity is derived from the demand by consumers for the desired services such as cooling and preservation of food items by refrigerator, second, comfortable space by air conditioner, and third, entertainment and information by television.

In each case, efficiency of energy conversion by equipment also plays an important role in determining the requirement or demand of an energy. The fuel efficient cars are preferred by the customers on this account. Any increase in energy price tends to reduce the demand for a particular energy as well as energy services rendered by it. For example, high price of natural gas may motivate consumers to invest in home insulation instead of using natural gas for heating. Now, energy conservation.

Energy conservation implies reduction in energy consumption without compromising on quality or lowering the quantity of production. This means that by reducing losses and wastage, as well as by increasing the efficiency, it is possible to increase the production from a given amount of energy input. Energy has become the basic requirement of today's life. It is the backbone of present-day civilization. It is an indispensable component of industrial production, employment generation, economic growth, our environment, and comfort.

Our higher standard of living and higher per capita gross domestic product directly depend on higher per capita consumption of energy. However, higher per capita energy consumption means new facility for the energy generation, which is an expensive and long term option. But energy conservation is a cost effective and short term or immediate option. Since the available conventional energy resources are fast depleting and cost of energy is increasing, it is highly important that measures should be taken to conserve energy. It is estimated that ten to twenty percent energy can be saved without major investment in case suitable measures to conserve energy are taken.

Rich and developed countries have to contribute more in energy conservation by reducing their consumption of energy through self-discipline and strict measures. To implement measures for energy conservation, some investment has to be made, but this investment is very small compared to energy costs which may be saved through conservation. Energy saved or conserved may be considered as energy generated or earned without any cost. Now, aspects of energy conservation. When usable energy is conserved and it is not allowed to be wasted, this saving has direct impact on the economy, environment and long term ability of non-renewable energy resources.

Energy conservation can be achieved by reducing energy consumption. The reduction in energy consumption is possible by reducing energy losses and wastage using energy efficient means of generation and utilization of energy. Any movement for energy conservation can significantly reduce the need for fresh investment in energy supply system in coming years. Energy conservation using energy efficient means will not only reduce the need to create new capacity requiring high investment but also result in substantial environment benefits. The important aspects or benefits of energy conservation are first the economic aspects.

Energy conservation finally leads to economic benefits such as reduction in cost of production and new job opportunities due to new investment in more efficient energy

equipment and technology. The cost of energy forms a significant part of the total cost of the product. The cost of energy can be reduced using efficient energy technology. Any reduction in manufacturing cost helps in production of cheaper and better quality products. The manufacturer needs to be competent to produce quality product at minimum cost to survive in the competitive market.

Second is the environmental aspects. Energy utilization processes affects the environment to some extent. The extent of degradation or pollution of environment depends on energy conversion process, the efficiency of technology used for conversion. However, it is found that a part of energy in the form of heat escapes into the surroundings in every energy conversion or utilization process. Hence, whenever energy is generated and utilized, it is carried out at the expense of adverse environment effects.

Whenever we are conserving energy, we are in fact minimizing the degradation of the environment. Third aspect is the depletion of conventional energy resources. The conventional energy resources are derived from fossil fuels which are non-renewable and depleting resources and their consumption is also increasing. Owing to both depletion and scarcity, the prices of conventional energy resources are rapidly increasing. Their consumption should be reduced by abandoning wasteful practices in energy utilization so that the conventional energy resources can be conserved by all means for future generations.

Now need for conservation of non-mineral resource. The table gives us the data on the important mineral resources in India, the rate of growth of their utilization and their expected lifespan. The data is drawn from the Center for Monitoring Indian Economy, World Resources and the Limits to Growth. Here you can see, the mineral that is iron ore, then coal and lignite, then crude oil, then natural gas, then bauxite, then magnesium, copper, chromite, lead and zinc, and limestone. Percentage of world reserves have been given in this column.

Growth rate of the production in India is also mentioned in the column. Then here, static reserve index of India per year and exponential reserve index in India per year. Exponential reserve index in the world per year has been given. It is evident from the table that India has a very small proportion of world mineral resources with the exception of coal and lignite. If you will just concentrate in the column one.

In fact, mineral ability in India is considerably lower than even India's share in world land surface, which is two point three percent. India's mineral reserve share ranges from

zero point zero five percent to zero point five two percent. The sole exception is coal and lignite, that is six point seven percent. However, most of the coal reserves are of low quality and the reserves of cooking coal are very limited. It also appears that the growth of utilization of limited mineral reserves has been very high, if you will see in the column two of the table. With the exception of manganese ore, the rate of growth of production of minerals generally ranges from about two to five times the Hindu rate of growth, that is around three percent per year. Thus, it is evident that the growth of utilization of mineral reserves is several times faster than the growth of gross natural product, estimated at one point nine percent nineteen sixty five to ninety in India. The estimated lifespan of the Indian mineral resources based on the nineteen ninety six to ninety seven levels of use are presented in column three of the table.

It is evident that the balance life of the reserves ranges from sixteen to six seven eight years if their rates of use remain frozen at the nineteen ninety six level. However, India non-renewable resource reserves do not present an absolute limit to growth because non-renewable resources can be imported. Owing to this possibility, the column five of the table presents the exponential reserve index of the world mineral reserves. Column five of the table shows that the lifespan of the world reserves ranges from twenty five years to one thirty six and is generally higher than the Indian reserves. Thus, even after the exhaustion of domestic reserves, Indian economic growth can continue to be supported for some more decades by imports of minerals and oils.

Here is some analysis based on the data given in the above table. The first analysis is that the utilization of domestic mineral and oil reserves has grown several times faster than the GNP. At this rate of growth, the Indian NRR reserves may be estimated to have a lifespan ranging from nine to forty seven years. Even after the exhaustion of domestic reserves, Imports can continue to support India's economic growth.

However, even this mode of supporting economic growth may reach its limits between twenty five to thirty six years. These limits to growth suggest that the need for conservation of non-renewable resources like minerals and oils. Now we will understand the Energy Conservation Act. Recognizing the fact that an efficient use of energy and its conservation is the least cost option to maintain the gap between demand and supply, Government of India enacted the Energy Conservation Act two thousand one and established the Bureau of Energy Efficiency. The mission of Bureau of Energy Efficiency is to develop policy and strategies with a thrust on self-regulation and market principles

within the overall framework of the Energy Conservation Act, with the primary objective of reducing energy intensity of the Indian economy.

The Energy Conservation Act provides the institutionalizing and strengthening delivery mechanism for energy efficiency, services in country and the much needed coordination between various entities. Energy Conservation Act provides the legal requirement needed to enforce the energy conservation measures. The features of EC Act are, first, need to get energy audits conducted by accredited energy auditors and implement techno-economic viable recommendations. To lay down minimum energy consumption standards and labelling for identified appliances, equipment and norms for industrial processes for energy intensive industries. Formulation of energy consumption codes. Industries to comply with norms of specific energy consumption fixed. Industries to submit report on steps taken to comply with norms. Provision of penalties and adjudication. The evolution of a self-regulated system with the BEE acting as a facilitator so that the consumers would regulate on their own with a view to save energy.

Now transition to sustainable energy. As the world grapples with the challenges of depleting non-renewable resources, environmental degradation and climate change, the transition to sustainable energy has become a necessity. Non-renewable resources such as coal, oil, and natural gas have powered human civilization for centuries, but their excessive use has led to resource depletion, pollution, and global warming. To ensure energy security and environmental sustainability, there is a pressing need to shift from fossil fuels to renewable energy sources such as solar, wind, hydro, and bioenergy. These sources are not only abundant and replenishable but also significantly reduce the greenhouse gas emissions. The transitions to sustainable energy is not just an environmental requirement but also an economic and social opportunity. Some of the alternative energy and sustainable practices for conservation of non-renewable resources are, first the solar power.

Harnessing the sun energy through photovoltaic cells and solar panels reduces reliance on fossil fuels and provides a renewable, inexhaustible energy source. Second, wind energy. Utilizing wind turbines to generate electricity is a clean and efficient alternative that significantly cuts carbon emissions. Third is the hydroelectric power, generating energy from flowing water helps to reduce fossil fuel dependence while promoting sustainable development. Geothermal energy, tapping into Earth's internal heat offers a consistent and renewable power source with minimal environmental impact.

Encouraging public transport. Promoting the use of buses, trains and carpooling helps in minimizing the individual vehicle emissions and fuel consumption. Promoting electric and hybrid vehicles, transitioning to electric cars and hybrid models reduces reliance on gasoline and diesel, cutting down carbon footprints. Lastly the implementing fuel efficient practices which encourage fuel efficient driving habits such as maintaining proper tyre pressure and reducing idling helps in maximizing energy use while minimizing the waste. Now let us conclude the module ten.

We have discussed fossil fuels are energy sources formed from the remains of ancient plants and animals buried and subjected to heat and pressure over millions of years. They include coal, petroleum and natural gas which are central to global energy system and economies. These fuels are rich in carbon which is released as carbon dioxide when burned contributing to greenhouse gas emissions and climate change. Despite their environmental impact, fossil fuels continue to be widely used due to their high energy density, availability, and historical reliance on them for industrial and economic growth. Fossil fuels are non-renewable and finite, meaning that once depleted, they cannot be replaced.

Making the transitions to sustainable energy sources imperative for long-term energy security. Transitioning to renewable energy sources like solar, wind and hydropower reduces dependence on non-renewable resources and helps in mitigating the environmental damage. These are the books from where the module has been prepared. That is, Fuel, Energy and the Environment, Natural Gas, Non-Conventional Energy Resources, Energy Resources and System, Conservation of Non-Energy Resources in India, Energy Return on Investment, Fundamental of Soil Science, and then Geology of India. Thank you very much to all.