

**ADM COLLEGE FOR WOMEN (A), NAGAPATTINAM**  
**PG & RESEARCH DEPARTMENT OF ECONOMICS**  
**SUBJECT : ENERGY ECONOMICS**  
**CLASS : II BA ECONOMICS**  
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**UNIT - I**

**NATURAL RESOURCES MEANING**

Natural resources are the resources that exist (on the planet) independent of human actions. These are the resources that are found in the environment and are developed without the intervention of humans. Common examples of natural resources include air, sunlight, water, soil, stone, plants, animals and fossil fuels.

**NATURAL RESOURCES DEFINITION**

Natural resources are naturally occurring materials that are useful to man or could be useful under conceivable technological, economic or social circumstances or supplies drawn from the earth, supplies such as food, building and clothing materials, fertilizers, metals, water and geothermal power. For a long time, natural resources were the domain of the natural sciences.

**CLASSIFICATION OF NATURAL RESOURCES**

- RENEWABLE RESOURCES
- NON - RENEWABLE RESOURCES

**RENEWABLE:** Resources that are available in infinite quantity and can be used repeatedly are called renewable resources. Example: Forest, wind, water, etc.

**NON-RENEWABLE:** Resources that are limited in abundance due to their non-renewable nature and whose availability may run out in the future are called non-renewable resources. Examples include fossil fuels, minerals, etc.

**CONVENTIONAL SOURCE OF ENERGY-**

This source of energy is natural energy resources, that has been used for many years to produce light, heat, food, and electricity. The energy is further divided into Commercial and Non-commercial sources of energy. This energy is non-renewable and is available in limited quantity apart from hydro-electric power. Few types of conventional energy are Coal, natural gas, electricity, thermal power, cow-dung, straw, etc.

**NON-CONVENTIONAL SOURCE OF ENERGY-**

This source of energy is available in abundance in nature as it doesn't get exhausted easily and are renewable. It is economical, eco-friendly and used for domestic purposes. Few types of non-conventional energy are wind, sun, biological waste, etc to produce power and heat.

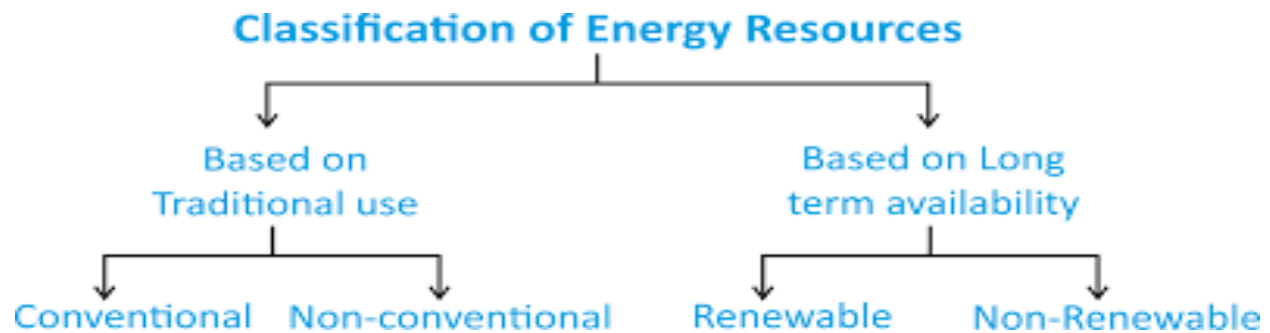
## MOST IMPORTANT NATURAL RESOURCES

- **Air:** Clean air is important for all the plants, animals and humans to survive on this planet. So, it is necessary to take measures to reduce air pollution.
- **Water:** 70% of the Earth is covered in water and only 2 % of that is freshwater. Initiative to educate and regulate the use of water should be taken.
- **Soil:** Soil is composed of various particles and nutrients. It helps plants grow.
- **Iron:** It is found as mineral silica and is used to build strong weapons, transportation and buildings
- **Forests:** Forests provide clean air and preserve the ecology of the world. Trees are being cut for housing and construction projects

## ENERGY RESOURCES DEFINITION

Energy resources can be defined as materials or elements that can be used to produce energy. Energy is a quantitative property, which produces an output or a force that can be analysed.

## CLASSIFICATION OF ENERGY RESOURCES



## IMPORTANCE OF ENERGY RESOURCES

- **Heavy industries:** melting, lifting, lighting, computers, etc.
- **Agriculture & fisheries:** water filtration and irrigation, tilling and harvesting machinery, etc.
- **Domestic Life:** gas and electricity for heating, cooking, cleaning, etc.
- **Fuels:** transport: gasoline, distillate fuels, biodiesel, etc.
- **Healthcare:** ventilation, equipment usage, etc.

## TYPES OF ENERGY RESOURCES

Renewable energy, Wind power, Nuclear energy, Hydropower, Coal, Hydroelectricity, Biomass, Natural gas, Electricity, Geothermal energy, Solar, Tidal energy, Power, Biofuel, Kinetic energy, Bioenergy, Electrical energy, Wave power, Biogas, Solar thermal energy, Gravitational energy, Oil, Heat, Gas etc.

## **CLASSIFICATION OF ENERGY RESOURCES**

- Based on usability of energy
- Based on traditional use
- Based on long-term availability
- Based on commercial application

## **EMERGENCE OF ENERGY ECONOMICS MEANING**

Energy economics as a separate field emerged with the energy turmoil of the 1970s. Many people were suddenly drawn into dealing with energy issues and felt a strong need for organizations exclusively dealing with their concerns.

## **NATURE OF ENERGY ECONOMICS**

- Natural resource economics focuses on the supply, demand, and allocation of the Earth's natural resources.
- Every man-made product in an economy is composed of natural resources to some degree.
- Natural resources can be classified as potential, actual, reserve, or stock resources based on their stage of development.
- Natural resources are either renewable or non-renewable depending on whether or not they replenish naturally.
- Natural resource utilization is regulated through the use of taxes and permits. The government and individual states determine how resources must be used and they monitor the availability and status of the resources.
- As a field of academic research, natural resource economics addresses the connections and interdependence between human economies and natural ecosystems.
- By studying natural resources, economists learn how to develop more sustainable methods of managing resources to ensure that they are maintained for future generations.
- Natural resource economics is studied on an academic level, and the findings are used to shape and direct policy-making for environmental issues. These issues include resource extraction, depletion, protection, and management.
- Natural resource economics findings impact policies for environmental work including issues such as extraction, depletion, protection, and management.
- An externality is a cost or benefit that affects a party who did not choose to incur the cost or benefit.
- A negative externality, also called the external cost, imposes a negative effect on a third party.
- When external costs are present, the market equilibrium use of natural resources is inefficient because the social benefit is less than the social cost. In other words, society would have been better off if fewer natural resources had been used.

- Positive externalities, also referred to as external benefits, imposes a positive effect on a third party.
- Assuming that natural resources are used and also sustained, the external benefits of goods produced by natural resources impacts the majority of the public in a positive way.

## **SCOPE OF ENERGY ECONOMICS**

The findings of natural resource economists are used by governments and organizations to better understand how to efficiently use and sustain natural resources. The findings are used to gain insight into the following environmental areas:

**Extraction:** the process of withdrawing resources from nature. Extractive industries are a basis for the primary sector of the economy. The extraction of natural resources substantially increases a country's wealth. Economists study extraction rates to make sure that resources are not depleted. Also, if resources are extracted too quickly, the sudden inflow of money can cause inflation. Economists seek to maintain a sense of balance within extraction industries.

**Depletion:** the using up of natural resources, which is considered to be a global sustainable development issue. Many governments and organizations have become increasingly involved in preserving natural resources. Economists provide data to determine how to balance the needs of societies now and preserve resources for the future.

**Protection:** the preservation of natural resources for the future. The findings of economists help governments and organization develop measures of protection to sustain natural resources. Protection policies state the necessary actions internationally, nationally, and individually that must take place to control natural resource depletion that is a result of human activity.

**Management:** the use of natural resources taking into account economic, environmental, and social concerns. This process deals with managing natural resources such as land, water, soil, plants, and animals. Particular focus is placed on how the preservation of natural resources impacts the quality of life now and for future generations.

## **UNIT - II**

### **INSTITUTIONAL ROLE OF ENERGY**

#### **DEVELOPMENT ROLE OF ENERGY IN ECONOMIC DEVELOPMENT**

Energy is a critical component of a country's economic development. It is widely utilized in agricultural and allied fields such as the manufacturing and delivery of fertilizers, insecticides, and farm machinery. It is necessary for homes for cooking, lighting, and warmth. Coal, Petroleum, Natural Gas, Uranium, and electricity are all fuel materials that may be used to create energy.

- India is among the top three nations in the world which are leading the global renewable energy growth
- India ranks 3rd globally for total renewable power capacity additions

- India is 3rd largest market in the world for new solar photovoltaic (PV) capacity
- The primary energy consumption (mainly coal, oil, natural gas, and biomass) of India is the third largest in the world
- India's industrial segment has 42% of the share in total energy consumption (2022)
- MSME sector can contribute approximately 20-25% of industrial energy consumption (2022)
- As per the Bureau of Energy Efficiency (BEE), national strategy plan - the industrial sector has the highest (60%) energy-saving potential by 2030
- Performance of the Energy Sector in India
- India ranks 4th globally in renewable energy installed capacity including large hydro, wind power capacity, and solar power capacity. India has set an ambition to expand the capacity of renewable energy to 500 GW by 2030.

### **ENERGY SOURCES CURRENTLY USED IN INDIA**

**Coal:** To this very day, our major share of energy comes from coal and other petroleum products, most of which are imported from other countries. It is a non-renewable source of energy and a source of pollution as well. The government is making efforts to decrease our dependence on the coal for power generation.

**Water:** There are various hydrothermal power plants in the country which supply power to numerous factories and households. The energy of high speed water is harnessed to spin the turbine that generates electricity.

**Nuclear:** Nuclear fission power plants are another major source of energy in the country. A nuclear power plant has a high potential to generate electricity. The energy generated from the process of nuclear fission (an atomic process in which one large nucleus is split into high-speed small nuclei) can be used to generate electricity.

**Wind and solar:** These are renewable sources of energy. Since, both wind and solar are present abundantly in nature, they can never get exhausted and hence, we can ensure a lifetime supply of energy through these.

### **ENERGY INTENSITY MEANING**

Energy intensity is defined as the amount of energy used to produce a given level of output or activity. Using less energy to produce a product or provide a service results in reduced energy intensity.

### **FORMULA**

Energy/GDP

## **ENERGY INTENSITY DEFINITION**

Energy intensity is a measure of the energy inefficiency of an economy. It is calculated as units of energy per unit of GDP or some other measure of economic output. High energy intensities indicate a high price or cost of converting energy into GDP.

## **INDICATORS OF ENERGY INTENSITY INDICATORS**

- Show how the intensity of energy use and its components are changing
- Help raise public awareness about how and why energy intensity has changed over the years
- Complement other provided inputs to policy and program analyses, including improved understanding of the impact of program and policy choices on energy intensity
- Improve understanding of the role of efficiency improvements in changing energy markets.

## **IMPORTANCE OF MEASURING ENERGY INDICATORS**

- Measuring energy intensity is an important tool for policymakers trying to decrease energy use without reducing economic activity levels.
- For example, if a manufacturing business uses lots of power but does not produce enough goods to justify that use, the measure of energy intensity would be useful information to have.
- This could help form public policy beneficial to the environment and the economy.
- Additionally, tracking changes in the economy's energy intensity enables one to observe how efficiently an economy produces more output while using less input.

## **FACTORS THAT AFFECTING ENERGY INDICATORS**

### **Price of Energy**

- The price of energy plays a huge role in the equation. When oil prices rise, so does the cost of electricity.
- While one might assume that higher oil prices will automatically lead to less consumption, there are other economic implications.
- Higher fuel costs can encourage more efficient transportation and production decisions.
- The effect of these changes on the country level is debatable, however.

### **Population and Demographics**

- A greater number of young people usually means more growth. It also means more new buildings and infrastructure in the form of roads, railways, and others.
- This all requires materials that require energy to produce.
- Similarly, larger populations are likely to mean increased electricity use for household appliances and home heating/cooling units.

## **Climate**

- Another factor is a country's climate. The colder it gets, the more energy people need to keep warm indoors and run heating units. The same goes for cooling in hot climates.

## **Technological Innovation**

- As time passes, efficiency can increase because of technological innovations.
- For example, the number of appliances per household may decrease as companies invent new appliances that use less electricity.
- New technologies could also lead to a decrease in the intensity of a country's transportation sector.
- For example, electric/hybrid cars will reduce the intensity because of lower fuel requirements to transport people and goods from place to place.

## **Economic Structure and Output**

- Given a fixed level of economic activity, an economy that produces more goods with a high embedded energy content will have a higher intensity than an economy that produces the same amount of goods using a lower energy content.
- For example, if one economy produced vehicles while another produced paper and pencils, then the vehicle-producing economy would have a higher intensity since vehicles require more energy to produce.

## **Economic Policies**

- Finally, some countries pursue policies specifically designed to encourage greater efficiency in electricity production and transportation use. This, in effect, will lower their overall intensity.
- These measures can include fuel taxes or environmental regulations, such as carbon caps or clean air standards for power plants.

## **Benefits of Reducing Energy Intensity**

### **Improved Energy Security**

- Reducing the consumption rate of domestic fuel resources (i.e., petroleum products) reduces dependence on foreign fuels.
- This improved energy security has many benefits, such as bolstering a country's economy, stabilizing international markets, and providing greater supply flexibility in times of emergency.

### **Decreased Demand for Oil Consumption**

- Reducing demand for petroleum products is another way of lowering its overall intensity. If a nation's economy requires less oil for production, then its oil consumption—and, thus, energy intensity—will decline.

- For example, the automotive sector of an economy switching to electric vehicles or fuel cells would significantly reduce the demand for petroleum products.

### **Decreased Environmental Impacts**

- Lowering overall intensity can also help reduce the environmental impacts associated with using certain fuels and resources.
- Reducing energy-intensive production across the board means high-carbon-emitting activities can also be scaled back. This would decrease the pollution related to producing energy resources, domestically and abroad.

## **HOW TO REDUCE ENERGY INTENSITY**

### **Transportation**

- As stated above, government policies can play a role in encouraging more efficient transportation use.
- These measures might include fuel taxes or emission standards for vehicles.
- Another option could include developing public transit systems. This would reduce intensity by cutting the number of cars on the road.
- Promoting ride-sharing could potentially cut down on transport emissions as well.

### **Industry and Housing**

- Manufacturing and construction activities require large amounts of energy to run and tend to be relatively energy-intensive.
- Encouraging greater use of renewable modes of power generation within these sectors would provide benefits, such as greenhouse gas reduction, increased energy security, and decreased environmental degradation.
- In general, it would be beneficial for countries with a lot of manufacturing or construction activity to encourage greater efficiency in these sectors. This is achievable through taxes on carbon emissions and/or energy taxes.

### **Electricity Generation**

- A country's mix of electricity-generating technologies is another important factor in determining its overall intensity.
- Some fossil fuel power plants have relatively high thermal efficiencies, while others have lower ones. Thus, switching from less efficient technologies (e.g., coal) to more efficient ones (e.g., solar thermal) can significantly reduce a country's energy intensity.
- Renewables also tend to be more efficient than conventional resources like natural gas or petroleum products.



- Finally, increasing the use of distributed generation can also reduce electricity intensity. These technologies rely on local resources and are, thus, less susceptible to transmission losses.

**Government Assistance**

- Governments can also work to reduce energy intensity by providing direct assistance for investment in more efficient technologies and processes.
- This support could entail subsidies, tax breaks, or other financial incentives. The government could then regulate the maximum level of energy intensity that any specific industry can attain.

**ENERGY ELASTICITY MEANING**

Energy elasticity is a term used with reference to the energy intensity of Gross Domestic Product. It is "the percentage change in energy consumption to achieve one per cent change in national GDP"

**ENERGY ELASTICITY METHODS**

- Principle of Virtual Work.
- Principle of Minimum Potential Energy.
- Principle of Minimum Complementary Energy.
- Hu-Washizu Variational Principle.
- Hellinger-Reissner Variational Principle.

**COMPARISON OF ENERGY SOURCES**

	<b>Energy Density</b>	<b>Land Require</b>	<b>Depend</b>	<b>Storage Device</b>	<b>Technology Advance</b>	<b>Cost/KW</b>	<b>Availability</b>
Renewable Energy	Very less	Very huge	On climate	Required	Good Proven	Moderate /high	Abundant
Fossil Fuel	Very high	Less	on fuel	No	Well Proved	Less	For next 200 years only
Magnetic Energy	High	Less	On magnet	No	New	Less	Abundant

**COMPARISON OF NATIONAL AND INTERNATIONAL ENERGY**

**NATIONAL ENERGY**

- National Energy day - October 22.
- THEME - to spread awareness about the importance of energy and the need of conserving energy by using less energy
- National Energy Conservation Day is celebrated every year with a special theme to make some goals and objectives more influential among the people.

- It is celebrated among people to send messages of the importance of energy conservation in every area of life.
- To promote the process of energy conservation, organizing many programs like discussions, conferences, debates, workshops, and competitions in the whole country.
- Encourage people to use less energy rather than excessive and extravagant energy.
- Encourage people to reduce energy consumption and use it efficiently.

## **INTERNATIONAL ENERGY**

- International Energy day - May 29
- Theme - Energy transition = Energy security!
- Raise Awareness
- Promote Sustainable Practices
- Advocate for Policy Change
- Foster Collaboration
- Inspire Action

## **ROLE OF INSTITUTIONS**

### **ONGC, OPEC, OAPEC, IEA, WORLD BANK**

#### **ONGC - FULL FORM**

Oil and Natural Gas Corporation.

#### **MEANING**

It is an Indian crude Oil and Gas multinational corporation, and its head office is located in New Delhi, India. ONGC is a public sector project which is under the administrative control of the Government of India's Ministry of Petroleum and Natural Gas. On August 14, 1956, the Indian government formed ONGC.

#### **HISTORY OF ONGC**

- After India gained independence, India's government recognized the importance of gas and oil for Indian companies to expand, so it decided to build the hydrocarbon sector.
- In 1955, a Department for Oil and Natural Gas was established under the Ministry of Natural Resources and Scientific Research to improve the country's natural gas and oil production.
- The Indian Parliament adopted the Industrial Policy Resolution in 1956 and included the oil and gas sector among the Schedule 'A' industries. The Oil and Natural Gas directorate has now been promoted to the Board of Oil and Natural Gas.
- ONGC was restructured as a limited enterprise under the Company Act, 1956. It has become a public service enterprise and has been renamed "Oil and Natural Gas Corporation (ONGC)".

- In 1999, ONGC and Indian Oil Corporation (IOC) agreed to buy joint stock to expand their domestic and international sector.
- ONGC formed ONGC Videsh Ltd. (OVL) as its subsidiary to enter the global market in the year 2002-03.

## **VARIOUS PRODUCTS OF ONGC**

- Natural Gas
- Crude Oil
- Motor Spirit
- Superior Kerosene Oil
- Aromatic Rich Naphtha
- LPG (Liquefied Petroleum Gas)

## **OPERATIONS OF ONGC**

ONGC operations cover convention, exploration and production. It has subsidiaries across the globe to spread its presence globally are described here

### **ONGC Videsh Limited (OVL)**

### **Hindustan Petroleum Corporation Ltd (HPCL)**

**Vision and Mission:** ONGC vision is to be popular in various aspects of growth, knowledge and excellence.

**Mission:** Owns commitment to safety, health and environment to ensure the quality of community life. Absorb high standards of ethics and business values. Developing growth aspects and increasing profit values. Keep maintaining its priority of business at domestic or international level for business opportunities.

## **OPEC FULL FORM**

Organization of the Petroleum Exporting Countries (OPEC)

## **OPEC MEANING**

It is a permanent, intergovernmental organization, created at the Baghdad Conference in September 1960 by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. Currently, it has 13 members.

## **HISTORY OF OPEC**

- Representatives from Venezuela, Iran, Kuwait, Iraq, and Saudi Arabia met in Baghdad.
- In the meeting, they discussed ways to increase the price of crude oil produced by them and the ways to respond to the unilateral actions of international oil companies.

- This led to the formation of OPEC, to get the best price possible from major oil companies.
- It was strongly opposed by the US, and Saudi Arabia, along with other Arab and non-Arab oil producers.
- Originally, Beirut or Baghdad was the initial choice of Arab nations for the headquarters of OPEC. But it was objected to by Venezuela. On the basis of neutral grounds, Geneva(Switzerland) was chosen.
- As Switzerland did not extend diplomatic assurances, it was shifted to Vienna(Austria) on 1st September 1965

### **OPEC COUNTRIES – OBJECTIVES**

1. Unification and coordination of petroleum policies among Member Countries, in order to achieve just and stable prices for petroleum producers
2. Ensuring of an efficient, economic and regular supply of petroleum to consuming nations and an adequate return of investment

### **OPEC COUNTRIES – FUNCTIONS**

Organization of the Petroleum Exporting Countries(OPEC) has a working methodology which is mentioned below.

- The OPEC Member Countries adjust their oil productions activities in order to bring stability to the petroleum market and help manufacturers get a good return on their investments. This policy is also designed to ensure that oil consumers continue to receive stable supplies of oil.
- Twice a year, the ministry of energy and hydrocarbon affairs meet twice a year to review the status of the international oil market and decide upon steps that will bring security in the oil market
- The Member Countries also hold other meetings that address various point of interests including that of petroleum and economic experts nad specialized bodies such as committees and panels in charge of the environment.

### **IMPLICATIONS**

- Rise in the global benchmark Brent by more than 5%.
- Inflationary pressures and fluctuations in global assets.
- Oil producers, other than OPEC, have also reduced their output.
- The oil market might move into a deficit.

### **IMPACT ON INDIA**

- Higher import bills and rise in inflation.
- Increase in current account deficit and weakening of the Indian rupee.
- A probable decrease in global investment.

- A task for the Monetary Policy Committee (MPC) to adjust the basis points.

## **OAPEC FULL FORM**

Organization of Arab Petroleum Exporting Countries (OAPEC)

## **OAPEC MEANING**

The Organization of Arab Petroleum Exporting Countries (OAPEC) is an inter-governmental organization based in Kuwait. OAPEC fosters cooperation among its 11-member Arab oil-exporting nations.

## **HISTORY OF OAPEC**

Kuwait, Libya and Saudi Arabia signed an agreement in Beirut on January 9, 1968, establishing OAPEC, and agreeing that the organization would be located in the State of Kuwait. By 1982, the number of members had increased to 11. In 1986, Tunisia submitted a request for withdrawal and it was accepted by the Ministerial Council.

## **AIMS OF OAPEC**

- Coordinate efforts and encourage cooperation among member countries in the various forms of economic activity in the petroleum industry
- Undertake research into production and manpower requirements in Arab petroleum projects;
- Establish a central research and documentation system.
- Promote and coordinate activities leading to: development of petroleum industry infrastructure in Arab countries
- Establishment of joint ventures in the Arab oil industry
- Dissemination of information on energy and economics.

## **OBJECTIVES OF OAPEC**

- OAPEC's primary objective is safeguarding the cooperation of numerous members in various aspects of economic activity within the oil industry as well as maintaining strong relations among themselves
- To provide legitimate means to preserve the members' individual and collective efforts within the industry
- Unite on-going efforts for the procurement of oil
- Provide access to consumer markets on fair and reasonable terms
- Provide conditions, adequate capital, and experience of investors in the oil industry.

## **IEA FULL FORM**

IEA – International Energy Agency

## **IEA MEANING**

International Energy Agency (IEA) was established during the oil crisis of 1973-1974. It is an intergovernmental autonomous organisation based in Paris. IEA has a major role to play in providing information related to the international oil market and taking action against any physical disruptions in the supply of oil. IEA also acts as a policy adviser for its 30 member countries as well as for the non-member countries, especially China, India, and Russia.

## **OBJECTIVES OF IEA**

- The International Energy Agency was established with an objective to coordinate the response of the participating states to the world energy crisis along with developing a mechanism for oil-sharing for use during supply difficulties.
- IEA mainly focuses on its energy policies which include economic development, energy security and environmental protection.
- These policies are also known as the 3 E'S of IEA

## **STRUCTURE OF INDIAN ENERGY AGENCY (IEA)**

The IEA consists of three main controlling bodies:

1. Governing Board
  2. Management Committee
  3. The Secretariat
- The **Governing Board** is composed of ministers of all the member-governments who are responsible for decision making. The Board is assisted by three standing groups dealing with emergency questions, long-term cooperation and the oil market.
  - The **Management Committee** deals with energy, research and development and the non-member countries.
  - The **Secretariat** is headed by the Executive Director. Apart from these, the IEA also maintains an import-monitoring system and a quick response mechanism.

## **BENEFITS OF IEA**

1. Providing access to India to participate in meetings of working groups, standing groups and committees that constitute the governance structure of IEA.
2. Allowing India to take lead in the geopolitical platform on climate and energy issues due to IEA's increasing role in combating climate change.
3. Helping India to take forward the International Solar Alliance framework to other countries through a greater partnership with IEA.
4. To help India in achieving its vision of ensuring 24×7 affordable and environment-friendly 'Power for All' with increased engagement with IEA.
5. To enable India in setting up its own robust integrated database on energy. With India as an associate member, IEA now formally covers 70% of the world's energy consumption.

## **WORLD BANK MEANING**

The World Bank Group is an international partnership comprising 189 countries and five constituent institutions that works towards eradicating poverty and creating prosperity.

## **FIVE DEVELOPMENT INSTITUTIONS UNDER WORLD BANK**

1. International Bank for Reconstruction and Development (IBRD)
2. International Development Association (IDA)
3. International Finance Corporation (IFC)
4. Multilateral Guarantee Agency (MIGA)
5. International Centre for the Settlement of Investment Disputes (ICSID)

## **HISTORY OF WORLD BANK**

- The original focus of the IBRD was the reconstruction of countries ravaged by the Second World War through loans.
- Gradually, there was a shift from reconstruction to development with a particular emphasis on infrastructure, power grids, roads and transportation, dams, etc.
- The other institutions such as the IDA, IFC, etc. were formed over the years and all five institutions (IBRD, IDA, IFC, MIGA, and ICSID) came to be called the World Bank Group.
- Currently, the group engages in multifarious activities through its institutions and funds.
- There is a special focus on developing and underdeveloped countries.
- The infographic above shows the brief functions and the year of formation of the five institutions.

## **MEMBER SHIP OF WORLD BANK**

- To join the World Bank Group, a country must first become a member of the IMF.
- To become members of the IDA, IFC, and MIGA, the countries must first become members of IBRD.
- Membership of the ICSID is subject to all the following conditions:
  - IBRD membership
  - Party to the Statute of the International Court of Justice (ICJ)
  - Invitation of the ICSID Administrative Council by a vote of two-thirds of its members

## **FUNCTIONS OF WORLD BANK**

The World Bank Group was established after World War II with the objective of rebuilding the countries damaged due to the war.

- With time, it encouraged the development of lower and middle-income countries and improved the standard of living there.
- It also focused on encouraging long-term capital investment.

- World Bank Group promotes investment in developing countries. It offered financial support, expertise and technical assistance.

### **PURPOSES OF WORLD BANK**

- It wants to create an environment that is a pro-investment.
- Also, it wants to improve the omic stability by reducing poverty.
- So, it is working towards achieving sustainable growth.
- Increasing the opportunities for jobs and business in member nations which are underdeveloped.
- Through investment, it plans to promote the socio-economic status of the society.
- Also, it wants to ensure that the judicial and legal systems are developed and individual rights are protected.
- Strengthening the government of its member nations by promoting education.
- Combating corruption and to ensure that there are adequate training opportunities and research facilities.
- It wants to provide loans with low-interest rates and interest-free credits

### **UNIT - III**

#### **ENERGY CRISIS MEANING**

Energy crisis: The fast depletion of the non-renewable concentrated sources of energy is known as the energy crisis.

#### **CAUSES OF ENERGY CRISIS**

1. Increasing population
2. Excessive use of non-renewable sources of energy
3. Use of less fuel-efficient machines
4. The affluent lifestyle of the people

#### **REMEDIES OF ENERGY CRISIS**

The remedies for energy crisis are to increase the production of coal and petroleum, use more non conventional sources of energy, increase water power generation and use substitutes for coal and oil.

#### **IMPACT OF THE ENERGY CRISIS**

- **Economic Impact:** High energy prices can lead to inflation, increased production costs, and decreased economic productivity.
- **Social Impact:** Energy shortages can cause disruptions in daily life, including power cuts, reduced heating or cooling, and limited transportation.
- **Political Impact:** Energy crises often trigger political tensions, both domestically and internationally, as countries compete for limited resources.



- **Environmental Impact:** In the face of an energy crisis, nations might resort to environmentally damaging energy sources to meet their needs, leading to accelerated environmental degradation and climate change.

### **TYPES OF ENERGY CRISIS**

- **Short-term energy crises:** These occur due to temporary disruptions in the supply chain. For example, natural disasters, war, or labor strikes can impact the availability of energy resources.
- **Long-term energy crises:** These crises occur when the world's energy resources are declining at a faster rate than they are being replaced. This often results from the overconsumption of non-renewable energy resources like coal, oil, and gas.

### **CAUSES OF ENERGY CRISIS**

- Increasing Population.
- Limited or No Renewable Resource Options.
- Poor Organization of Resource Distribution.
- Century Old Infrastructure.
- Waste of Energy.

### **CONSEQUENCES OF ENERGY CRISIS**

- The energy crisis has far-reaching effects on the economy, environment, and society.
- The high cost of energy has led to inflation, reduced productivity, and increased unemployment.
- Businesses and industries that heavily rely on energy have been significantly impacted, leading to closures, layoffs, and reduced economic growth.
- The energy crisis also has severe environmental consequences.
- The burning of fossil fuels leads to air and water pollution, which affects human health and the environment.
- The depletion of natural resources and environmental degradation have also resulted in the loss of biodiversity and ecosystem services.

### **REMEDIAL MEASURES OF ENERGY CRISIS**

- Increased regulation and restrictions on carbon emissions.
- Strengthening green and sustainable manufacturing and construction projects.
- Funding for research into hybrid and more sustainable technologies.
- Other initiatives.
- Transition to Renewable Resources
- Purchase Energy-Effective Products
- Enhanced Grid Access
- Controls for Lighting

## **ENVIRONMENTAL CRISIS MEANING**

Environmental issues are the harmful effects of human activities on the environment. These include pollution, overpopulation, waste disposal, climate change, global warming, the greenhouse effect, etc.

## **CURRENT ENVIRONMENTAL ISSUES**

- Climate Change
- Global Warming
- Ozone Layer Depletion
- Water Pollution
- Air Pollution
- Solid Waste Management
- Deforestation
- Overpopulation

## **SOLUTIONS TO ENVIRONMENTAL ISSUES**

1. Replace disposal items with reusable items.
2. The use of paper should be avoided.
3. Conserve water and electricity.
4. Support environmental friendly practices.
5. Recycle waste to conserve natural resources.

## **CAUSES OF ENVIRONMENTAL CRISIS**

- Climate change
- Deforestation
- Overpopulation
- Pollution (Water, Land and Air)
- Ozone depletion
- Acid rain
- Agriculture
- Biodiversity
- Overfishing
- Soil
- Environmental issues
- Garbage
- Noise pollution
- Natural resource depletion
- Solid Waste
- Land disturbance
- Methane emissions

## **CONSEQUENCES OF ENVIRONMENTAL CRISIS**

- Climate change including Global warming
- Acid rain, photochemical smog and other forms of pollution
- Ocean acidification
- Displacement/extinction of wildlife
- Resource depletion - forests, water, food

## **IMPACT OF ENERGY CONSUMPTION ON PRODUCTION**

### **Air Quality**

The release of GHG emissions in the air certainly causes climate change, but these and the other byproducts released from fossil-fuel-generated power can severely impact air quality.

### **Water Quality**

Power plants that burn fossil fuels also release heavy metals, such as mercury, which can enter our waterways and harm fish or other marine life. This also can impact our food supply, as the contaminated fish could find its way to our plates.

### **Land Use**

Land use is one environmental impact that spans all power generation, whether green or dirty. Power generation requires land, from building a coal-fired power plant to installing a solar panel or windmill farm. This can impact ecosystems and displace species that occupy that land, forcing them into smaller areas with more competition. Shrinking ecosystems can lead to portions of that species dying off.

## **IMPACT OF ENERGY CONSUMPTION ON ENVIRONMENT**

- 61% came from plants that burn fossil fuels (coal, oil, or natural gas), biomass, or municipal and industrial wastes.
- When these plants burn their fuel, they release a wide range of gases and toxins, such as carbon dioxide (CO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), and nitrogen oxides (NO<sub>x</sub>).
- They also release particulate matter (PM) and heavy metals.
- Environmental science shows that each of these byproducts impacts our environment negatively in various ways.
- For example, CO<sub>2</sub> is a greenhouse gas that can trap heat, leading to global warming, and SO<sub>2</sub> can lead to acid rain, harming plants and animals.
- The fact is, the more we consume, the more the electricity plants need to burn to meet our energy demands.
- This leads to them emitting more of these gases and other harmful byproducts into the environment and atmosphere.
- Our consumption level directly impacts the amount of emissions these plants put out.

## **UNIT - IV**

### **ORGANIZATIONAL STRUCTURE MEANING**

An organizational structure is a system that outlines how certain activities are directed in order to achieve the goals of an organization. These activities can include rules, roles, and responsibilities.

### **ENERGY SUPPLY MEANING**

Energy supply is the delivery of fuels or transformed fuels to point of consumption. It potentially encompasses the extraction, transmission, generation, distribution and storage of fuels. It is also sometimes called energy flow.

### **COAL MEANING**

Coal is a fossil fuel and is the altered remains of prehistoric vegetation that originally accumulated in swamps and peat bogs.

### **APPLICATIONS OR USES OF COAL**

- It is mainly used to generate heat and electricity.
- It is used in households and in industries to accomplish various tasks.
- It is the cheapest source of power fuel.
- The iron and steel industry depends heavily on fossil fuel for energy.
- It is also used to produce useful products such as coke, tar, and coal gas.
- This fossil fuel was responsible for the Industrial Revolution of the 19<sup>th</sup> century.

### **LIGNITE MEANING**

Lignite, often referred to as brown coal, is a soft brown combustible sedimentary rock formed from naturally compressed peat. It is considered the lowest rank of coal due to its relatively low heat content.

### **APPLICATIONS OR USES OF COAL**

Most lignite is used to generate electricity. However, small amounts are used in agriculture, in industry, and even, as jet, in jewelry. Its historical use as fuel for home heating has continuously declined and is now of lower importance than its use to generate electricity.

### **PETROLEUM MEANING**

Petroleum is referred to as “Black Gold.” This name itself is an indication of its importance to humans. Crude oil is considered to be the “mother of all commodities” as it is used to manufacture various products such as pharmaceuticals, plastics, gasoline, synthetic fabrics, etc

### **APPLICATIONS OF PETROLEUM**

- Liquefied Petroleum Gas or LPG is used in households as well as in the industry.

- Diesel and petrol are used as fuels for vehicles. Diesel is generally preferred for heavy motor vehicles.
- Petrol is also used as a solvent for dry cleaning, whereas diesel is also used to run electric generators.
- Kerosene is used as a fuel for stoves and jet planes.
- Lubricating oil reduces wear and tear and corrosion of machines.
- Paraffin wax is used to make candles, ointments, ink, crayons, etc.
- Bitumen or asphalt is mainly used to surface roads.

## **GAS MEANING**

Natural Gas is mainly extracted from the petroleum deposits deep beneath the earth. In fact, it occurs just above the layer of crude oil, as gases are lighter than oil. It is formed through the same process through which petroleum is formed

## **USES OF GAS**

- Natural Gas was used mainly for street and household lighting in the 19<sup>th</sup> and 20<sup>th</sup> century.
- Now, it has a lot more uses in the homes and industrial applications.
- It is used to turn turbines for wind and solar energy generation.
- This fossil fuel is used for the production of ammonia which itself is used for making fertilizers.
- It is a domestic fuel as well. It fires stoves in our houses and also runs heaters, ovens, boilers, etc.
- Compressed Natural Gas or CNG, that is gas stored at high pressure, is also used in some households for heating and cooking purposes.
- CNG is also a cheap and environment friendly alternative for a transportation fuel used in low load vehicles requiring high fuel efficiency.
- Liquefied Natural Gas or LNG is used to power vehicles such as off-road trucks and trains.

## **FEATURES OF GAS**

- Natural gas can be easily found and is abundant as it is available from nature.
- Natural gas is highly flammable due to high level of methane.
- Natural gas is colourless, tasteless, and odourless.
- The density of natural gas is lower than the density of the air which makes it lighter than air. So, in case of leakage, it can easily dissipate into the air.
- Natural gas is less corrosive due to high methane and low carbon composition.

## **ADVANTAGES OF GAS**

- Widely available
- Cleanest-burning fossil fuel

- Used in combination with other fuels to decrease pollution in electricity
- Made safer by adding artificial odor so leak is easily detectable
- Easy to transport

### **DISADVANTAGES OF GAS**

- Transportation costs are high
- Lack of infrastructure makes gas resources unavailable in some areas
- Burns cleanly, but still has emissions
- Pipelines impact ecosystems
- Flammable

### **HYDRO MEANING**

Water is a precious natural resource. All living things need water for their survival. We cannot imagine life without water. Let it be animals or plants they require water to complete their daily metabolic activities. Plants require water to synthesize their food from the process of photosynthesis.

### **DEFINITION OF HYDRO AND ITS USES**

Water is one of the natural resources, which are found in an adequate amount. It is an essential source for the existence of life on the planet earth. It is widely used for various purposes such as drinking, washing, bathing, cleaning, cooking, irrigation, and other industrial and domestic uses.

### **SOURCES OF WATER**

There are various sources of water. About 97% of the water on the Earth's surface is covered with water. The three main sources of water are:

- Rainwater.
- Groundwater – This includes water bodies like Wells and Springs.
- Surface water – This includes different water bodies like Reservoirs, Rivers, Streams, Ponds, Lakes and Tanks.

### **IMPORTANCE OF WATER**

- Domestic Purposes include bathing, cleaning, cooking, drinking, and washing.
- Agricultural applications include irrigation, farming, gardening, and frost control.
- Other Industrial Applications.
- Stay hydrated
- Lubricate Joints
- Regulate the body's temperature
- Transport nutrients and other waste in the body.
- Balance the loss of water from the digestive tract and body tissues.

## **PROPERTIES OF WATER**

- Water is polar in Nature
- Excellent Solvent
- Density Is Less In Liquid Form
- Cohesive And Adhesive In Nature
- Boiling And Freezing Points

## **ADVANTAGES OF WATER**

- Balancing water cycle
- Essential for agriculture
- Extreme health benefits
- Support marine life
- Hydroelectricity

## **DISADVANTAGES OF WATER**

- Water intoxications
- Polluted water effects
- Water cannon
- Natural calamities

## **THERMAL MEANING**

Heat is a form of energy which produces sensation of warmth and flows when there is a temperature difference between two bodies. The heat energy can be converted to other forms of energy like kinetic energy, mechanical energy etc

## **SOURCES OF THERMAL**

There are many sources of heat, but the following are the main sources of heat:

- Sun
- Chemical
- Electrical
- Nuclear

## **IMPORTANCE OF HEAT**

- **Cooking:** Heat is required for cooking food and cooking food is one of the basic necessities of life.
- **Warming:** In winters, heat is important for providing warmth to the house and for warming water.
- **Engines:** Various engines, such as rail engines, work on heat.
- **Electrical appliance:** All electrical appliances need heat.
- **Generate electricity:** Heat is used to generate electricity.

## **ADVANTAGES OF HEAT**

- On the construction side, plants that produce this energy are the most economical.
- You can convert a simple process into electrical energy.
- Heat is a renewable energy source. Because it can get generated in many ways.
- You can extend this time compared to fossil fuels.
- You can save more water and electricity.
- Their contribution to sustainable development at the social level is apparent.
- He loves the countryside that power plants usually don't see.

## **DISADVANTAGES OF HEAT**

- Constant greenhouse gas emissions seriously pollute it.
- Steam and heat emissions from thermal power plants. And, it can negatively affect the climate of thermal power plants.
- The water used for this is ultimately contaminated.
- Thanks to nuclear technology, a large amount of radioactive waste remains.
- The long-term production of this energy with fossil fuels. And It depends on the available fossil fuel reserves.
- It releases carbon dioxide pollutants.
- The space that stores energy not affected. As it does not reduce the amount of air there.
- The construction of a power plant takes several years.
- The movement of energy is complicated.

## **NUCLEAR MEANING**

Nuclear power is the use of nuclear reactions to produce electricity. Nuclear power can be obtained from nuclear fission, nuclear decay and nuclear fusion reactions.

## **ADVANTAGES OF NUCLEAR**

- Carbon-free electricity
- Small land footprint
- High power output
- Reliable energy source

## **DISADVANTAGES OF NUCLEAR**

- Uranium is technically non-renewable
- Very high upfront costs
- Nuclear waste
- Malfunctions can be catastrophic



## **ENERGY DEMAND MEANING**

Energy demand is the term used to describe the consumption of energy by human activity. It drives the whole energy system, influencing the total amount of energy used; the location of, and types of fuel used in the energy supply system; and the characteristics of the end use technologies that consume energy.

## **ENERGY DEMAND FROM AGRICULTURE**

Agricultural energy demand can be divided into direct and indirect energy needs. The direct energy needs include energy required for land preparation, cultivation, irrigation, harvesting, post-harvest processing, food production, storage and the transport of agricultural inputs and outputs.

## **ENERGY DEMAND FROM INDUSTRY**

Industrial energy consumption is still dominated by fossil fuels, in particular coal, and accounts for about a quarter of energy-related CO<sub>2</sub> emissions. As the global economy and population grow, so will demand for materials and goods, increasing the importance of understanding which technologies and strategies can support the sustainable manufacture, use and disposal of indispensable commodities.

## **ENERGY DEMAND FROM TRANSPORTATION**

The major transportation energy sources used in the United States are:

- Petroleum products made from crude oil and from natural gas processing, including motor and aviation gasoline, distillate fuels (mostly diesel fuel), jet fuel, residual fuel oil, and propane
- Biofuels
- Natural gas
- Electricity produced from many different energy sources

## **TYPES AND USES**

- Motor gasoline is used in cars, motorcycles, light trucks, and boats. Aviation gasoline is used in many types of airplanes.
- Distillate fuels are used mainly by trucks, buses, and trains and in boats and ships.
- Jet fuel is used in jet airplanes and some types of helicopters.
- Residual fuel oil is used in ships.
- Biofuels may be blended into gasoline, diesel fuel, and jet fuel.
- Natural gas is used to operate compressors to move natural gas in pipelines. Compressed natural gas and liquefied natural gas are used in cars, buses, trucks, and ships. Most of the vehicles that use natural gas are in government and private vehicle fleets.
- Propane (a hydrocarbon gas liquid) is used in cars, buses, and trucks. Most of the vehicles that use propane are in government and private vehicle fleets.

- Electricity is used by public mass transit systems and by electric vehicles.

### **ENERGY DEMAND FROM DOMESTIC**

Domestic energy consumption is the total amount of energy used in a house for household work. The amount of energy used per household varies widely depending on the standard of living of the country, the climate, and the age and type of residence.

### **FACTORS AFFECT DOMESTIC USES**

- Geographic location and climate
- Type of home and its physical characteristics
- Number, type, and efficiency of energy-consuming devices in the home and the amount of time they are used
- Number of household members

### **TYPES OF DOMESTIC USES**

- Electricity—all types of energy end uses
- Natural gas—space and water heating, clothes drying, cooking
- Heating oil—space and water heating, clothes drying
- LPG/propane—space and water heating, clothes drying, cooking
- Kerosene—space heating
- Geothermal energy—space cooling, and space and water heating
- Solar energy—space and water heating, electricity generation
- Wood (cord wood and wood pellets)—space and water heating, cooking

## **UNIT - V**

### **RENEWABLE ENERGY MEANING**

Energy is one of the major inputs for the economic development of the country. Any sustainable energy source that comes from the natural environment is a renewable energy source. Renewable energy is inexhaustible and a clean alternative to fossil fuels. In this article, we will learn about the types and sources of renewable energy.

### **DEFINITION**

Renewable energy is energy that is produced from natural processes and continuously replenished. A few examples of renewable energy are sunlight, water, wind, tides, geothermal heat, and biomass. The energy that is provided by renewable energy resources is used in 5 important areas such as air and water cooling/heating, electricity generation, the rural sector, and transportation.

### **TYPES OF RENEWABLE ENERGY**

- Solar energy

- Wind energy
- Hydroelectric energy
- Biomass energy
- Hydrogen and fuel cells
- Geothermal power
- Tidal energy

## **SOLAR ENERGY MEANING**

The Sun is one of the major renewable energy sources. The radiating light and heat from the sun are harnessed and converted into other forms of energy

## **DEFINITION**

Solar energy is defined as the transformation of energy that is present in the sun and is one of the renewable energies. Once the sunlight passes through the earth's atmosphere, most of it is in the form of visible light and infrared radiation. Plants use it to convert into sugar and starches; this conversion process is known as photosynthesis. Solar cell panels are used to convert this energy into electricity.

## **ADVANTAGES OF SOLAR ENERGY**

- **Clean:** It is considered to be the cleanest form of energy as there is no carbon dioxide emission like in the case of fossil fuels which is one of the causes of global warming.
- **Renewable:** There is ample energy available on earth as long as the sun exists.
- **Reliable:** The energy can be stored in the batteries, so there is no unreliability.
- reduction in utility costs.
- Free energy because it can be trapped easily.

## **DISADVANTAGES OF SOLAR ENERGY:**

- The production is low during winters and on cloudy days.
- Installation and the initial cost of the materials are expensive.
- Space consumption is more.

## **TYPES OF SOLAR ENERGY**

- **Passive solar energy** refers to trapping the sun's energy without using mechanical devices.
- **Active solar energy** uses mechanical devices to collect, store, and distribute energy.
- **Solar thermal energy:** This energy is obtained by converting solar energy into heat.
- **Photovoltaic solar power** is the energy obtained by converting solar energy into electricity.
- **Concentrating solar power:** This is a type of thermal energy used to generate solar power electricity

## **USES OF SOLAR ENERGY**

- **Water heating:** Solar energy is used to replace electric heaters and gas as efficiency is more with 15-30%.
- **Heating of swimming pools:** Solar blankets are used to keep the pool warm. The other way is by using a solar water heater to keep the water warm.
- **Cooking purposes:** Solar cookers are used for cooking food. Solar energy is used to heat, cook and pasteurize food. A solar cooker consists of an elevated heat sink such that when food is placed in it, it gets cooked well.

## **WIND ENERGY MEANING**

Wind energy is an important source of renewable energy. The landmass and water bodies by solar radiation generate air movement and cause winds to blow. This kinetic energy of the wind can be used to do work.

## **DEFINITION**

Wind energy is a renewable energy that harnesses energy generated by wind through the use of wind turbines that convert it into it into electricity. Wind technically comes from the sun as a byproduct of differences in temperature. Wind is generated from the uneven heating of the atmosphere, mountains, valleys, and the planets revolution around the sun.

## **ADVANTAGES OF WIND ENERGY**

- Renewable & clean source of energy
- Low operating costs
- Efficient use of land space
- Wind energy is a job creator

## **DISADVANTAGES OF WIND ENERGY**

- Intermittent
- Noise and visual pollution
- Some adverse environmental impact
- Wind power is remote

## **TYPES OF WIND ENERGY**

There are three major types of wind energy.

### **1. Utility-Scale Wind**

Utility-scale wind encompasses wind turbines that range in size from 100 kilowatts to several megawatts, where electricity is supplied to the power grid and distributed to the end user by electric utilities or power operators.

### **2. Offshore Wind**

Wind turbines that are erected in large bodies of water. These are generally larger than onshore turbines, and because the larger the turbine the greater the efficiency, they are able to generate more power.

### **3. Distributed or “Small” Wind”**

This applies to wind turbines below 100 kilowatts that are used to directly power a home, farm, or small business that is not connected to the grid.

### **USES OF WIND ENERGY**

- Generating electricity.
- Milling grain.
- Pumping water.
- Powering cargo ships (via kites)
- Reducing carbon footprint.
- Sailing.
- Windsurfing.
- Land surfing.

### **TIDAL ENERGY MEANING**

Tides are a regular phenomenon. They can be predicted over months and years in advance. This is why the energy from this massive movement of water can be harnessed and converted into a usable form of energy.

### **ADVANTAGES OF TIDAL ENERGY**

- Environment-friendly
- A highly predictable energy source
- High energy density
- Operational and maintenance costs are low
- An inexhaustible source of energy

### **DISADVANTAGES OF TIDAL ENERGY**

- High tidal power plant construction costs
- Negative influence on marine life forms
- Location limits
- The variable intensity of sea waves

### **USES OF TIDAL ENERGY**

#### **Tidal Electricity**

- The most important use of tidal energy is the generation of Electricity, called Tidal Electricity.

- The electric power generated from the tides is reliable as tides are predictable and uniform in nature.

### **Grain Mills**

- Tidal Energy has been in use for hundreds of years.
- Just like the Wind Mills, Tidal Energy was used for the mechanical crushing of grains in grain mills.
- To crush grains. Here, the movement of the turbines powered by tidal energy was used.

### **Energy Storage**

- Tidal Energy is also used to store energy in hydroelectric dams, which act as large energy storage.
- Tidal Barrages and reservoirs can be modified to store energy.
- Provide Protection to Coast During High Storms
- Tidal Barrages are capable to prevent damage to the coast during high storms.
- They also serve to create easy transport between the two arms of an estuary or a bay.

### **WAVE MEANING**

A wave is a disturbance in a medium that carries energy without a net movement of particles. It may take the form of elastic deformation, a variation of pressure, electric or magnetic intensity, electric potential, or temperature.

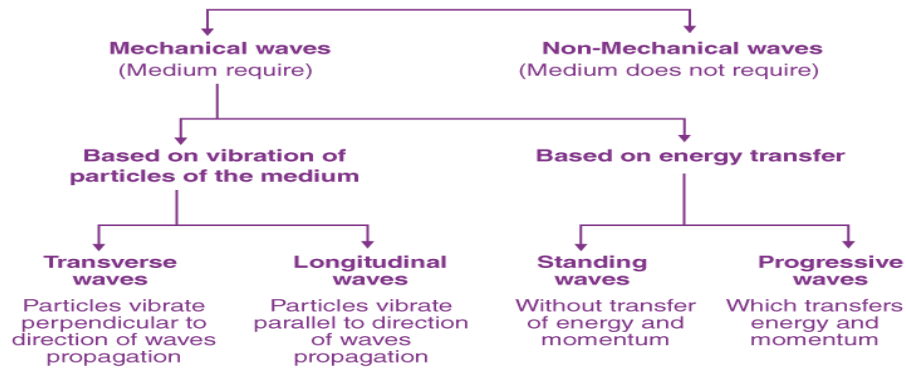
### **INTRODUCTION OF WAVES**

- Transfers energy.
- Usually involves a periodic, repetitive movement.
- Does not result in a net movement of the medium or particles in the medium (mechanical wave).

### **TYPES OF WAVES:**

- Transverse Waves
- Longitudinal Wave
- Electromagnetic Waves
- Mechanical waves
- Matter Waves
- Electromagnetic Waves
- Properties of Waves

### **MEDIUM OF PROPAGATION - WAVES**



## PROPERTIES OF WAVE

- Wavelength,
- Frequency,
- Time period
- Speed
- Amplitude

## ADVANTAGES OF WAVE

- Zero emissions
- Renewable
- Energy potential
- Reliable

## DISADVANTAGES OF WAVE

- Environmental effects
- High costs
- Scalability

## BIOGAS MEANING

Biogas refers to a mixture of gases produced by the anaerobic decomposition of organic matter such as agricultural waste, municipal waste, plant residue, food waste etc. Biogas consists of methane, carbon dioxide, a small amount of hydrogen sulphide, and moisture.

## ADVANTAGES OF BIOGAS

### Non-polluting:

Biogas burns without smoke; hence no harmful gas such as  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{NO}_2$ , and  $\text{SO}_2$  are evolved.

### Reduces Landfills:

The slurry produced after the production of biogas is used as manure in fields. The method of disposal is safe and efficient and hence no space is wasted in the form of landfills.

**Cheaper technology:**

Biogas plants require very little installation cost and become self-sufficient in a span of 3-4 months.

**Generates employment:**

Work opportunity for thousands of people is created, especially in rural areas.

**Renewable source of energy:**

It is considered as a renewable source of energy because the production is dependent on the generation of waste which is an endless process.

**DISADVANTAGES OF BIOGAS****Not efficient enough on a large scale:**

Since it is difficult to enhance the efficiency of biogas, it is not economically viable to use biogas on a large scale.

**Contains impurities:**

It contains many impurities that are difficult to control even after purification rounds. Biogas when compressed, to be used as fuel, proves to be highly corrosive to the container

**Unstable and hazardous:**

When methane comes in contact with oxygen, it reacts violently to produce carbon dioxide. The highly inflammable nature of methane makes it prone to explosions.

**USES OF BIOGAS**

- It is commonly used in rural areas as cooking gas.
- It can be used for the production of electricity.
- It can be used in instruments used for water heating, space (room) heating etc.
- It can replace compressed natural gas for use in vehicles.
- It can displace carbon dioxide in on-site CHP plants.
- It is being used in transport.
- For example, 'Amanda Biogas Train' runs on biogas in Sweden.
- Production of biogas produced a very useful dry solid byproduct which is used as manure.
- It is used in many states for street lighting purposes.
- It can be used in hydrogen fuel cells as well.

**BIOMASS MEANING**

Biomass is the fuel developed from organic matter waste of living organisms like plant waste, animal waste, forest waste, and municipal wastes.

**DEFINITION**

Biomass is defined as the fuel made from organic matter or wastes of living organisms that can be used as renewable sources of energy.



## **GENERATE BIOMASS**

- a) Scrap Lumber
- b) Woody construction and Forest debris
- c) Certain agricultural crops and wastes
- d) Manure
- e) Animal waste
- f) Ethanol waste
- g) Municipal solid waste (sewage sludge or other landfill organics)
- h) Landfill gas
- i) Other industrial waste (i.e. paper sludge from paper recycling processes)

## **USES OF BIOMASS**

1. Biomass is used as heating water.
2. Biomass is used as fuel to generate electricity.
3. Biomass is used as fuel in cooking and heating devices in many developing countries.
4. Biomass is used as fuel for transport.

## **ADVANTAGES OF BIOMASS**

1. Biomass is always and widely available as a renewable source of energy.
2. It is carbon neutral.
3. It reduces the overreliance of fossil fuels.
4. Is less expensive than fossil fuels.
5. Biomass production adds a revenue source for manufacturers.
6. Less garbage in landfills.

## **DISADVANTAGES OF BIOMASS**

1. Biomass energy is not as efficient as fossil fuels
2. It is not entirely clean
3. Can lead to deforestation.
4. Biomass plants require a lot of space.

## **HYDROGEN MEANING**

Hydrogen, like electricity, is an energy carrier that must be produced from another substance. Hydrogen can be produced—separated—from a variety of sources including water, fossil fuels, or biomass and used as a source of energy or fuel.

## **USES OF HYDROGEN**

1. Hydrogen with oxygen produce oxy-hydrogen flame which is used for cutting and welding.
2. Hydrogen gas is used as a fuel.
3. Hydrogen is used for hydrogenation of vegetable oil.

4. Hydrogen gas is used extensively in the manufacture of ammonia gas, which is used to produce fertilizers.

### **HYDROGEN PROPERTIES**

- Its use for energy purposes does not cause greenhouse gas emissions (water is the only by-product of the process)
- It can be used to produce other gases, as well as liquid fuels
- Existing infrastructure (gas transport and gas storage) can be repurposed for hydrogen
- It has a higher energy density than batteries so can be used for long-distance and heavy-goods transport

### **ADVANTAGES OF HYDROGEN**

- It's a Renewable Energy Source and Bountiful in Supply
- Numerous Sources to Produce Hydrogen Locally
- It is Practically a Clean Energy Source
- Hydrogen Energy is Non-toxic
- The Use of Hydrogen Greatly Reduces Pollution
- It's Far More Efficient Than Other Sources of Energy
- Used For Powering Space Ships
- A Sustainable Production System

### **DISADVANTAGES OF HYDROGEN**

- Hydrogen Energy is Expensive
- Storage Complications
- It's Not the Safest Source of Energy
- Tricky to Move Around
- It is Dependent on Fossil fuels
- Hydrogen Energy Cannot Sustain the Population

### **RENEWABLE ENERGY PROGRAMMES UNDER FIVE YEARS PLANS**

- First Five Year Plan: (1951-1956)
- Second Five Year Plan (1956-1960)
- Third Five Year Plan (1961-1966)
- Fourth Five Year Plan (1969-1974)
- Fifth Five Year Plan (1974-1979)
- Sixth Five Year Plan (1980-1985)
- Seventh Five Year Plan (1985-1989)
- Eighth Five Year Plan (1992 - 1997)
- Ninth Five Year Plan (1997-2002)
- Tenth Five Year Plan (2002-2007)

- Eleventh Five Year Plan (2007-2012)
- Twelfth Five Year Plan (2012-2017)

### **LONG OBJECTIVES OF FIVE YEAR PLAN**

- High Growth rate to improve the living standard of the residents of India.
- Economic stability for prosperity.
- Self-reliant economy.
- Social justice and reducing the inequalities.
- Modernization of the economy.

### **MILESTONES**

- Setting up of the Planning Commission: 15 March 1950
- First Five Year Plan: 9 July 1951
- Dissolution of the Planning Commission: 17 August 2014
- Setting up of NITI (National Institution for Transforming India) Aayog: 1 January 2015

### **ENERGY ISSUES AND POLICY OPTIONS FOR INDIA**

The energy policy of India is characterized by trade-offs between four major drivers: A rapidly growing economy, with a need for dependable and reliable supply of electricity, gas, and petroleum products; Increasing household incomes, with a need for an affordable and adequate supply of electricity, and clean cooking fuels; limited domestic reserves of fossil fuels, and the need to import a vast fraction of the natural gas, and crude oil, and recently the need to import coal as well; and indoor, urban and regional environmental impacts, necessitating the need for the adoption of cleaner fuels and cleaner technologies. In recent years, these challenges have led to a major set of continuing reforms, restructuring, and a focus on energy conservation.

### **POLICIES OF ENERGY**

- Electricity Act, 2003
- National Electricity Policy, 2005
- Tariff policy, 2006
- Integrated Energy Policy, 2006
- Rural Electrification Policy, 2006
- National Action Plan on Climate Change(NAPCC), 2008
- National Biofuel Policy, 2009
- Jawaharlal Nehru National Solar Mission, 2010
- Renewable Energy Certificates (REC)Mechanism, 2010
- National Solar Mission,2015
- National Offshore Wind Energy Policy, 2015
- Priority Sector Lending Programme, 2015
- Tariff Policy 2016 (amendment)