Non-conventional sources of energy: an analysis

CONSERVATION OF ENERGY

Energy is a primary input in any industrial operation. Energy is also a major input in sectors such as commerce, transport, telecommunication, etc besides the wide range of services required in the household & industrial sectors. (A)

What Do We Mean by Alternative Energy?

The alternative-energy segment of the energy industry covers a broad range of sources. These sources range from well established technologies, such as nuclear energy and hydroelectric power, through high-growth segments such as wind and solar power. They also include less tried and tested alternatives, such as hydrogen-powered, fuel-cell technology for use in electricity generation (7)

Renewable sources of energy:

It is that energy which is renewed again &again. These include wood obtained from forests, petroplants , plant biomass agricultural wastes, wind energy, water energy, geothermal energy, these can reproduce themselves in nature & can be harvested continusiously through a sustained proper planning & management(B)

Non renewable sources of energy:

These are available in limited amount & develop over a long period of time. They are exhausted one day. these include coal, oil, petroleum, the common source of energy being organic in their origin also called fossil fuel.(B)

Conventional source of energy:

In most of the fuel wood was consumed for domestic purposes mainly in rural areas, very little of it was available to industrial sector. Coal already in use in industries become a highly priced source. It was then supplemented by mineral oil. Likewise the use of hydro-electricity become dearer the areas where running water ≠eded technology was readily available.

After 2nd world war nuclear power was developed. All these sources of energy. All these sources of energy are known as conventional sources of energy. Coal still occupies a central position. (B)

Non conventional sources of energy:

Non renewable of energy could exhaust one day. Most non renewable sources cause environmental pollution We must conserve non renewable sources by replacing with renewable sources. (B)

CONSERVATION OF ENERGY

Renewable sources of energy:

Non renewable sources of energy:

Conventional source of energy

Non conventional sources of energy

Sources of ener

Sources of energy:

1. Primary
2. Secondry

1: primary sources are those which we get from environment. Eg. fossil fuel, nuclear fuel, hydro energy, solar energy, wind energy.

2: secondry sources are those which are derived from primary energy resource. Eg. Petrol, electrical energy, coal burning . (A)

Conventional sources of energy:

Coal: The heat capacity can be converted into the electricity & gas , oil. therefore many thermal & super thermal powerstation are located on the coal fields to produce electric power to feeds regional grids.(A)

Oil : it was formed more than 300 million year ago. Tiny diatoms are the source of oil. Diatoms are the sea creature in the size of pin head. Diatoms are dead they fell into the sea floor. They buried under the rocks. The rock squeeze the diatoms & the energy in the bodies could not escape. The carbon eventually turned into oil under great pressure & heat. Oil &natural gas are found under ground between rocks & in areas where rocks are porous.(C)

Natural gas: It is lighter than air . It is made up of methane (made up of carbon & hydrogen atoms ch-4). It is found near the petroleum under the earth. It has no odour. it is usually mix with a gas that has strong odour like rotten eggs.(C)

NUCLEAR FUSION

If light nuclei are forced together, they will fuse with a yield of energy because the mass of the combination will be less than the sum of the masses of the individual nuclei. If the combined nuclear mass is less than that of iron at the peak of the binding energy curve, then nuclear particles will be more tightly bound than they were in the lighter nuclei, and that decrease in mass comes off in the form of the energy according to the Einstein relationship. For elements heavier than iron, fission will yield energy.

For potential nuclear energy sources for the Earth, the deuterium-tritium fusion reaction contained by some kind of magnetic confinement seems the most likely path. However, for the fuelling of the stars, other fusion reactions will dominate. (c)

NUCLEAR FISSION

The nucleus captures the neutron, it splits into two lighter atoms and throws off two or three new neutrons. The two new atoms then emit gamma radiation as they settle into their new states. There are three things about this induced fission

-the probability of a U-235 atom capturing a neutron as it passes by is fairly high.

-the process of capturing the neutron and splitting happens very quickly, in the order of picoseconds

-An incredible amount of energy is released in the form of heat and gamma radiation, when a single atom splits. The two atoms that result from the fission later release beta radiation and gamma radiation of their own as well. The energy released by a single fission Comes from the fact that the fission products and the neutrons, together, weigh less than the original U-235 atom. The difference in weight is converted directly to energy at a rate governed by the equation e= mc2 (C)

NUCLEAR REACTOR

(1)Light water reactor-We use ordinary water for colling and moderisation these are basic 2 types

1. boiling water reactor
2. pressurised water reactor

There are also high temperature gas called reactors which basically of l. w. r type (2): heavy water reactor: the most popular one has been Canadian deuterium uranium reactor. The design is difficult from that of lwr type. The fuel is arranged horizontally rather than the vertically as in l. w. r. (3): liquid metal fast breeder reactor: here we use liquid sodium as the coolent. There are 300 atomic power plant , operating in world. Max in use (83), Ussr (40), up (35), France(34), Japan 25, Germany 15, Canada 13 India is rich in atomic mineral. Uranium mines are located in singbum in bihar ∂s of bihar Most abudent source is monazite sands on the shores of kerala. Thorium is derived from these sands. Nuclear power corporation is engaged with the establishment of nucleus. Power plants: 6 nuclear power plants in operation generating 1230 mwe(single individual plant is 210-235mwe). (b)

Advantages

Nuclear energy has a number of positives going for it. First, it does not give off carbon emissions, earning it supporters in the environmental community among those concerned about global warming. second, once reactors are built, it is very cost effective to keep them running at high capacity and for utilities to address demand fluctuations by cutting back on usage of fossil fuels. Third, nuclear plants tend to last a long time and many existing plants have become more efficient over time, reducing their demand for uranium. and represent reliable sources of supply

Disadvantages

There are a number of disadvantages to the nuclear-power option. These include not only the safety questions but also some economic and supply-related questions that are currently being debated by those for and opposed to renewal of outdated power plants or an expansion of the sector. In terms of safety, two issues are regularly debated. First, the issue of nuclear waste and, second, concerns over potential terrorist attacks on nuclear power plants. The first objection may be overcome through the introduction of new types of power plants, such as the pebble-bed modular reactor. This type of reactor uses graphite balls flecked with tiny amounts of uranium, rather than conventional fuel rods. With the fuel encased in graphite and impermeable silicon carbide, the theory is that the waste should be relatively easy to dispose of. The terrorism fears are less easily addressed and may ultimately stall the construction of new plants in countries such as the U. S., where these worries are greatest. Among economic concerns is the question of construction costs. Although the cost of energy produced by existing nuclear plants is competitive, the upfront capital costs of constructing new plants are extremely high, calculated at $1, 300-$1, 500 per kilowatt- hour, or twice the amount it costs to construct a gas-fired power station(F)

Non Conventional energy source

SOLAR ENERGY

Two weeks of solar energy is roughly equivalent to the energy stored in all known reserves of coal. oil and natural gas on the earth. Solar energy may be directly used either by active solar system or passive solar system. Another potentially important aspect 0f direct solar energy involves solar cells or photovoltaic that convert sunlight directly into electricity. Two other type of solar energy are the solar power tower and solar ponds.(b) There are two main ways to harness the power of the sun to generate electricity: photovoltaic (PV), where sunlight is directly converted into electricity via solar cells, and solarthermal power. PV is a proven technology that is most appropriate for small-scale applications to provide heat and power to individual houses and businesses. Sunlight falls on a layer of semiconductors, which jostles electrons. This, in turn, creates an electrical current that can be used as a source for heat. Solar PV cells are already cost effective for powering houses and businesses in some regions. As with wind power, technological developments have reduced costs considerably over the last few years. Unlike wind power, however, largescale electricity production using solar energy costs about 22 cents per kilowatt-hour, significantly more expensive than its fossil fuel competitors and nuclear energy. Hopes to reduce these costs lie with newer technologies. Solar-thermal generated energy is only just emerging from the experimental stage to full-scale electricity production. Solar-thermal power concentrates the sun to heat up fuel such as gas or oil. The heat trapped within is then used to convert water into steam, which powers a conventional steam turbine to generate electricity. Fossil fuels are sometimes used as a back-up to heat the water in the boiler if the sun is not shining. There are three different methods for concentrating the sun’s rays:

- Parabolic Trough — This method uses long, parallel rows of glass mirrors in the shape of a trough to concentrate the sun's rays toward the " absorber tube" — usually filled with oil — to maximum effect.
- Power Tower — Similar in principle to parabolic-trough technology, the mirrors are placed in a circular pattern. At the center of the circle is a tower, at the top of which is a receiver filled with water, air, liquid metal or molten salt that moves to a power block and is used to power a steam turbine.
- Parabolic Disk System — In this system, dishes rather than troughs are used to concentrate the power of the sun. An example of this type of solar project is the 500-megawatt Solar Energy Systems plant being constructed in the Mojave Desert in California. By the end of 2006, the company expects to begin supplying electricity to Southern California Edison (SCE), but will not be fully operational until 2011, when it may account for as much as a 20 percent increase in SCE's electricity generation from renewables(F)

Advantages

In spite of its cost versus other sources of energy, solar power is attracting interest due to the following:

- Solar energy makes use of a renewable natural resource that is readily available in many parts of the world.
- The process used to generate solar energy is emission-free.
- Technological advances have reduced costs to a point that it can compete with fossil fuel alternatives in specific circumstances.

- The technology is scalable in that it can be used fordomestic heating purposes or on a larger scale for commercial electricity generation, as solar water heaters are an established technology, widely available and simple to install and maintain

Disadvantages

The biggest barriers to increasing solar power generation are the cost, the amount of land required for large-scale electricity production, and the intermittent nature of the energy source. In terms of the latter, thermal systems do not work at night or in inclement weather. Storage of hot water for domestic or commercial use is simple, needing only insulated tanks, but storage of the higher-temperature liquids needed to generate electricity on a large scale — or storage of the electricity itself — requires further technological development(F)

WIND ENERGY

In the country there are areas which are quite windy. Wind energy may be converted into mechanical & electrical energy. Now, wind has been utilized for pumping water in rural areas.

Wind energy is useful in remote areas helps in saving fossils fuels, would deliver on the spot small quantity of energy which is free pollution & environmental degradation. Gujrat is first to starts using wind power.

Advantages

There are a number of notable advantages associated with wind power:

- It is a clean, renewable energy source.

- There is no fuel component, so once built there is no a finite fuel supply or costs associated with such a supply.
- Wind power can be generated in remote areas, including out in the oceans.
- It is scalable in that it can be used to generate power in a local area or even at the individual property level, but can also generate large amounts of power that can be added to an electricity grid system..
- For land-based wind farms, once the wind towers are installed, the land area around them can be used for other purposes, such as agricultural use.

Disadvantages

As with any source of energy, there are some drawbacks to wind power. The most significant is that the wind to drive the turbines may be intermittent and that it does not always blow when electricity is needed. Wind energy may only be available 40 percent of the year in some areas versus 90 percent for a fossil-fuel powered plant. New blade design can overcome this problem to a certain extent, as can storing the energy in batteries, but because of these potential drawbacks, the site of the wind farm is key to its success and vice versa.(F)

OCEAN ENERGY (TIDAL ENERGY)

Tidal power generation depends on the harnessing of rise and fall of sea level due to tidal action. Small tidal power plants have been constructed in china & USSR. The most important application of tidal power is electricity generation.

In India sites exploitation of tidal energy are gulfs of kutch & kombay & sunderbans.

India could intensify work on ocean thermal energy conversion & wave energy. The country is already experience with exploiting tidal energy. The central electricity authority & Gujrat electricity board carried out site studies for establishment of tidal plants in golf of kutch. India has excellent OTEC potential & some of the best sites in world are known to be located off the Indian mainland & island of lakshdeep & Andoman & nicobar. Total OTEC potential in India is 50000mW which is about 150% of installed power generated capacity in India.

PRESENT USES

Tidal power has on a small scale been used throughout the history of mankind. It was not until twentieth century that large-scale tidal projects were considered. Today, sites suitable for the utilisation of tidal power exist in many places around the world.

DISADVANTAGES

-Not yet economically feasible.

-Problems with transportation of hydroelectricity.

-Technology not developed.

ADVANTAGES

-Renewable resource.

-No pollution.

-Produced 24 hours a day and 365 days a year.

-Peak output coincides with peak energy demand.(c)

Fuel cell

Production of electricity by thermal plants is not a very efficient method and is major source of pollution. It now possible to make such in which reactants sre fed continuously to the electrodes and products are removed continuously from the electrolyte compartment. Galvanic cell that are designed to convert theenergy of combustion of fuels like hydrogen, methane, methanol, etc. directly into electrical energy are called fuel cell.

One of the most successful fuel cell uses the reaction hydrogen with oxygen to form water. The cell was used for providing electrical power in Apollo space programme.

The water vapours produced during the reaction were condensed and added to the drinking water supply for the astronauts. In the cell, hydrogen and oxygen are bubbled through porous carbon electrodes into concentrated aqueous sodium hydroxide solution. Catalyst like finally divided platinum metal are incorporated into the electrodes for increasing the rate of electrode reaction.

Efficiency is 70%compared to thermal plant whose efficiency is 40%.(E)

A fuel cell that runs on pure oxygen & hydrogen produces no waste product. when a reformer is coupled to the fuel cell some pollutant are released(co2)but levels are typically less than conventional fossil fuel combustion in a power plant or an auto-mobile engine. fuel cell could be ideal zero emission power source for vehicle. Fuel cell busses could be tested in a Canada. The current from a fuel cell is proportional to the size of electrode & voltage is limited (1. 23). Tiny fuel cell running on methanol might used in cell phone, pager, toys, computer, now run by batteries.

Bio fuel: based on fuel derived from organic biomass from recently living animals or plants or their by products, has transformed from a niche alternative to fossil fuels (e. g., gasoline, diesel) to become a booming industry.

Any liquid that stores energy, which is typically utilized by an engine or generator, can be called a “ fuel.” The term “ bio fuels” encompasses a wide range of fuels, including vegetable oils, animal fats, ethanol, biodiesel (any oil or fat that undergoes trans esterification to more closely resemble mineral-based fuel), and syn fuel (fuel made from gasi fied organic matter, then liquefied to form fuel). The main common trait of all these fuels is that they are derived from organic biomass, rather than minerals.

Bio fuels are made using a fairly simple process that typically involves harvesting feedstock, or the raw materials (e. g., soybeans, sugarcane), crushing the feedstock, separating the dry matter from the oil, then re-crushing and/or further processing to extract as much oil as possible. The resulting oil can then either be directly consumed (e. g., by vehicles with specially designed engines), further processed (e. g., into biodiesel), or blended with mineral-based fuel before being delivered to the end user at gas stations and depots around the world (the most common blends in the U. S. are E10 (10% percent ethanol blend) and E85 (85% ethanol blend). Only some biofuels, most notably biodiesel, can be used in traditional internal combustion engines. Other biofuels, such as ethanol, must be blended with mineral-based fuel in order to be used in existing engines.

The most common inputs into biofuels vary by country. In the U. S., corn and soybeans are most prevalent, while Europe tends to use flaxseed and rapeseed, Brazil sugarcane, and Asia palm oil. Brazil is in many ways the pioneer of the biofuels industry, having introduced ethanol from sugarcane (and flexfuel vehicles capable of running on ethanol) over 25 years ago as method to reduce dependence on oil imports.

a fuel cell uses a catalyst to create a reaction between hydrogen from a fuel and oxygen from the air to generate electricity, with the only byproduct being water. Such fuel cells can be used for power generation and as a replacement for the combustion engine to run cars and other vehicles. Fuel cells have long been used in the U. S. space program, but until the past few years have proved prohibitively expensive for civilian use. Interest in fuel cells was reignited in the late 1990s, as companies began to make breakthroughs in technology. Large automotive manufacturers, such as General Motors and Daimler Chrysler, also started investing in fuel-cell companies and began to design concept fuel-cell powered vehicles. Development, thus far, has focused primarily on protonexchange membrane (PEM) fuel cells. This type of fuel cell uses a polymer membrane to separate two subcells, one fed with hydrogen and one with oxygen (through air). On the hydrogen side, the hydrogen breaks down into protons and electrons, and the protons migrate through the membrane into the oxygen side. The electrons, on the other hand, are forced to detour through wire connecting metal plates, resulting in a reaction that creates electricity. Other types of cells include the molten-carbonate fuel cell, which is the most efficient design but is very complex and only economical when generating more than 200 kilowatts. Westinghouse is developing a competing design, the solidoxide fuel cell, which operates at extremely high temperatures and has the added advantage that waste heat can be used to drive an auxiliary gas turbine.(F)

What are the Challenges to Large-Scale Hydrogen Production?

One of the biggest challenges to moving towards large-scale adoption of the “ hydrogen economy” is production of hydrogen itself. A question often raised is whether it takes more energy to produce the hydrogen than you get back when you either drive the car or use it to power a building. There are currently three ways to produce hydrogen:

- Natural gas, coal, wood and organic waste burn with air and steam at extremely high temperatures. When cooled, the resulting gases contain a significant amount of hydrogen.
- An electrical current is passed between two electrodes (anelectrolyzer) immersed in water. Hydrogen rises up from the negative electrode and oxygen from the positive electrode.
- Some bacteria reportedly produce hydrogen, but this method has yet to be exploited commercially

The first of these options has traditionally been the most cost-effective. That it still requires the burning of fossil fuels, combined with the rising price for natural gas, however, makes it less attractive as a long-term solution.

The second option is simple to establish and can be done on a small or large scale nearest the point where the hydrogen may be needed. However, it also has a major drawback. Although this method has a 98 percent efficiency rate, when you factor in the voltage of the fuel cell, you get back only 40 percent of what you put in

There are two powerful arguments for converting electricity into hydrogen, in spite of the inefficiency of the process:

- The first is the “ use it or lose it” principle. Electrical power itself cannot be stored in its pure form; it needs to be converted to something else. Just as surplus nuclear and gas-fired power stations may store unused power by using it to pump water back up inside a damper as part of an integrated electrical storage system in combination with a hydroelectric power plant, hydrogen can be similarly used to store unused electrical power.
- Second, electricity stored as hydrogen is versatile. Not only

can it be used for re-electrification, it also can potentially

be used as fuel for cars or for producing heat.

Why Fuel Cells?

Fuel cells directly convert the chemical energy in hydrogen to electricity, with pure water and potentially useful heat as the only byproducts.

Hydrogen-powered fuel cells are not only pollution-free, but also can have two to three times the efficiency of traditional combustion technologies.

- A conventional combustion-based power plant typically generates electricity at efficiencies of 33 to 35 percent, while fuel cell systems can generate electricity at efficiencies up to 60 percent (and even higher with cogeneration).
- The gasoline engine in a conventional car is less than 20% efficient in converting the chemical energy in gasoline into power that moves the vehicle, under normal driving conditions. Hydrogen fuel cell vehicles, which use electric motors, are much more energy efficient and use 40-60 percent of

the fuel's energy — corresponding to more than a 50% reduction in fuel consumption, compared to a conventional vehicle with a gasoline internal combustion engine.

In addition, fuel cells operate quietly, have fewer moving parts, and are well suited to a variety of applications.

How Do Fuel Cells Work?

A single fuel cell consists of an electrolyte sandwiched between two electrodes, an anode and a cathode. Bipolar plates on either side of the cell help distribute gases and serve as current collectors. In a Polymer Electrolyte Membrane (PEM) fuel cell, which

most promising for light-duty transportation, hydrogen gas flows through channels to the anode, where a catalyst causes the hydrogen molecules to separate into protons and electrons. The membrane allows only the protons to pass through it.

Comparison of Fuel Cell Technologies

In general, all fuel cells have the same basic configuration — an electrolyte and two electrodes. But there are different types of fuel cells, classified primarily by the kind of electrolyte used. The electrolyte determines the kind of chemical reactions that take place in the fuel cell, the temperature range of operation, and other factors that determine its most suitable applications. (7)