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Hydrogen Fuel, Biomass, Solar and Nuclear Energy Opportunity to Green Future

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Abstract

Any fuel derived from biomass is biofuel, and biomass is all sustainable and renewable materials of animal or plant origin that we can use to produce energy. Bioenergy is divided into two categories: traditional bioenergy, which is the traditional use of biomass through burning wood, animal waste, and coal. The second category is the modern bioenergy category and includes liquid biofuels that are produced from plants, such as sugarcane and corn, in addition to anaerobic digestion. For waste, and other technologies used to produce biodiesel, ethanol, etc., in addition to methane and hydrogen gases.

This fuel, which is classified as "bio," is obtained from the industrial analysis of crops, waste, and animal remains that can be reused, such as (straw, wood, manure, rice straw, decomposition of household waste, workshop and factory waste, food waste), which It can be converted into biogas by microbes with anaerobic digestion. The biomass used as fuel is classified into several types, such as animal, wood, and herbal waste, and biomass has no direct impact on its value as an energy source. It is currently noted that the types of Other types of renewable energy outperform that type of fuel in terms of carbon neutrality, due to the high use of fossil fuels in its production, in addition to the carbon dioxide resulting from the combustion of biofuels as well as other non-environmental gases.

Keywords: heat energy from the oceans, hydrological energy or water energy, biomass energy, wind energy, solar energy, nuclear energy.

Energy is derived from biomass and ethanol

Biomass is an energy source that played an important role for humans in the past and still does for developing countries. So, what is biomass energy and what is ethanol? What role do they play in meeting energy needs?

Biomass is an opportunity to achieve carbon neutrality

First: The concept of biomass energy and ethanol

Biomass includes all materials of plant origin, such as trees and agricultural products rich in starch or rich in sugars, as well as waste of animal origin, in addition to industrial and human solid waste, whose potential energy can be released through direct burning and fermentation...etc. Biomass is considered an important source. In many Arab countries, such as Tunisia, Sudan, Algeria, and Iraq, in addition to its being the basic energy in many developing countries, the living mass consists of 85% firewood, 13% animal waste, and 2% agricultural waste, and the largest part of it goes for home consumption in the countryside, such as cooking, heating, and warming.

Biomass energy from wood

Source: Data collected by research

Several methods are followed to convert living mass into usable fuel, whether in solid, liquid, or gaseous form, including extraction, fermentation, dilution, transmutation, etc. Among the products of these methods, we mention ethanol, which is considered one of the most important forms of alcohol extracted from grain fermentation, as it is extracted from cane.Sugar and starch, which is the first generation of what is known as biofuel. Among the leading countries in this field is Brazil, where it is used as car fuel by more than 60%. As for the second generation of biofuel, work is being developed to extract it from algae, to avoid using agricultural crops used for human food.

Biomass energy from wood

Source: Data collected by research

Hence, avoiding the reflection of increased demand on prices. According to a study conducted by a group of American researchers from the Agricultural Research Department of the United States Department of Agriculture in 2007, they found that the amount of fuel extracted from algae is 100 times greater than that extracted from regular biofuel crops such as sugar cane, and it does notIt only needs a small area to grow it, and what increases its importance is the possibility of increasing the volume of fuel extracted through genetic engineering.

Biomass energy from wood

Source: Data collected by research

The most important obstacle facing the production of second-generation biofuels is the high production costs. Ralph Sims, senior analyst at the International Energy Agency in Brussels, stated that the bottleneck in this process is the expensive technology required to produce algae fuel. The high costs of cultivating high concentrations of algae are an addition.The high costs of fuel extraction make algae more expensive than other biofuel sources.

Second: The importance of biomass energy

Among the first and most important types of energy that man has adopted and harnessed to meet his needs is wood. It played an important role before the discovery of coal and the steam engine and the introduction of other types of fossil fuels into service, whose low prices in addition to their high efficiency had a negative impact on the exploitation of living mass, especially in developed countries.In developing countries, it is still of great importance, especially in remote areas and remote villages, where it is still used for cooking and heating, as well as in some traditional industries, and in meeting agricultural needs, such as drying tobacco, for example.

Biomass energy from food

Source: Data collected by research

With the increase in environmental awareness and the increase in warnings from scientists about the possibility of running out of traditional sources, and then falling into a global catastrophe, the interest of countries, especially developed ones, in this type of energy sources has increased. This interest has been translated into the production of the second generation of biofuels, which scientists are betting on to solve part of the problems.Which the world is facing, especially after proving the effectiveness of ethanol in the field of transportation, and thus its effective contribution to reducing the volume of environmentally polluting gases emitted, and for this reason, they are making significant efforts to reduce its cost and make it competitive with other energy sources.

Economic estimation of biomass

In some European countries there is a growing market for digestives. In Denmark, the government program to study the economics of digesters concluded, after six years of experiments, that plants for producing biogas from waste are economical if they are built according to available technology, provided that the following three conditions are met:

- Gas will be sold at prices close to natural gas prices.

- The biogas plant produces heat and energy.
- To use organic materials from factory waste.

An example of the economics of biogas is the village of Pura in southern India, whose biogas production plant supplies methane gas to a 5-kilowatt generator used for lighting and running water pumps.

After four years of work, the cost of electricity was $0.25 per kilowatt-hour, and this price is somewhat high when compared to the price of electricity coming from the electrical network. But another study showed that the use of animal waste can increase the amount of gas and reduce the price by half, and about the energy extracted from wood, the economic estimate for planted wood is. In unusual farms in northeastern Brazil, where wood production is not ideal due to the lack of sufficient water, it turns out that wood can produce energy at a price of $1.4 per gigajoule, and this price is very low because of the accumulated experience in this type of agriculture and the low wages. Labor, and it is a much lower price than international prices, which in America may reach between $3.9 and $2.7 per gigajoule, and the price is expected to fall to between $2.7 and $1.9 per gigajoule in 2010.

Biomass energy technology in energy supply

Source: Data collected by research

As for forest waste, in Austria, wood residues and branches are available at cheap prices, equivalent to $5.95 per cubic meter of dry wood, or about $1.05 per gigajoule, because of the accumulation of forest waste.

Biomass energy in energy supply

Source: Data collected by research

As for generating electrical energy, the market for using biomass sources depends on the conversion efficiency that can be achieved with the presence of modern technologies.In the United Kingdom, the cost of a kilowatt-hour generated from landfill waste gas amounted to $0.085, while the cost of a kilowatt-hour of energy generated from solid waste was about $0.1. This cost fell in 1994 to $0.056 and $0.0576.These amounts are small compared to the cost of electrical energy generated by turbines powered by wood burners, which amounted to about $0.13 per kilowatt-hour.

As for ethanol produced in Brazil, the cost of its production varies depending on the region and site management. In the state of São Paulo, it reached $0.185 per liter, equivalent to $7.9 per gigajoule, and it could drop to $0.15 per liter after a short period.

In addition, the application of biomass technology for the economic generation of electrical energy and feeding it to the unified grid in Egypt is likely not soon to add some items necessary to operate the system such as: the cost of the land (non-desert), the availability of cooling water, and the required transportation and insulation systems. From the above it is clear that the use of biomass technology will remain limited to thermal applications and distributed generation in rural and remote areas and in cooking systems.

Biomass technology

Biomass technology varies depending on the purpose of its use and has a wide range of uses, including the following:

1- Biomass energy (bioenergy)

Direct combustion systems burn biomass in boilers to produce steam which is then used to produce thermal energy. There is a co-combustion technology where biomass is replaced by coal, and there are steam boilers that burn both fuels. Biomass can also be converted into gaseous fuel that is used instead of natural gas in combustion turbines.

2- Biomass fuel for transportation purposes (biofuels)

This type of technology is based on the production of liquid fuel used in transportation. This fuel is made from the biomass of cellulosic plants (fibrous materials, which are completely different from starchy grains such as corn.

These cellulosic plants could be used as an alternative to the petroleum used in internal combustion engines, and in the future, ethanol and hydrogen will play an important role as energy storage medium in fuel cells.

Biomass in Egypt

The sources of biomass in Egypt that are used to produce energy can be divided into non-plant biomass, plant fuel (plant energy), and municipal waste.

Agricultural crop waste

The outer shell of rice grains

It is clear to us that the amount of rice husk produced in 2017 was estimated at 1.6 million tons, and a percentage of this husk is used in rice mills as a source of energy.

Livestock dung

Based on the number of pets in Egypt and the percentage of waste generated by each animal, the estimated amount of cow and buffalo manure produced on livestock farms is estimated at approximately 187,000 and 34,000 tons, respectively.

Exotic plants

One of the most exotic plants available in Egypt is the water hyacinth. It is spread in many canals and drains other than agricultural areas in the Delta and the Nile Valley. These plants are found throughout the year, but they grow strongly in the summer and winter seasons. Clusters of hyacinths spread in the water at depths ranging between 40 and 200. Poison: Water hyacinth contains large amounts of water, which can be used in the production of biogas, whether water hyacinth is used alone or mixed with other types of biomasses. The area covered by water hyacinth is estimated at about 40 square kilometers in drains, sewers, irrigation canals, and lakes north of the Delta in Egypt. This area produces about 400,000 dried tons of water hyacinth annually.

Plant fuel

It can be fast-growing trees, traditional crops, or plants grown specifically for fuel production.

Solid waste of cities

Waste consists of 60% organic materials, 15% papers and cardboard, 30% plastic materials, 30% glass, 2% textiles, and 17% other materials. In other words, about 80% of these wastes consist of flammable or fermentable materials, which can therefore be used to produce bioenergy.

Disadvantages of living mass

Among the things taken from this source are the following:

- Increasing exploitation of living mass for energy production leads to an environmental imbalance.
- The methods of using biomass currently applied do not allow for renewal or sustainability because the quantities of firewood available are constantly decreasing due to the population converting forests into agricultural lands.
- The soil loses its specificity due to the use of animal waste as fuel instead of using it as fertilizer for the soil.
- Reduced net energy from ethanol

Biofuel generations

The First Generation

Plant seeds and grains have been used to produce biofuels, including corn, wheat, soybeans, sugarcane, rapeseed, barley, and others. The use of agricultural crops to produce fuel has been met with global protests and widespread objections, given that its production is at the expense of the global food basket and causes the conversion of much of the agricultural land designated for production. Food has been transformed into biofuel crops at the expense of the livelihood of the world's poor, and this has caused a significant rise in the prices of grains and vegetable oils.

The Second Generation

It relies on plant wastes, such as wheat stalks, corn, sawdust, hay, etc., from which cellulosic fuels, ethanol, biomethanol and biohydrogen are obtained. Despite the importance of using agricultural waste to produce fuel, it is criticized for depriving livestock of fodder, and agricultural soil of plant waste, which is an organic fertilizer that fertilizes it.

The Third Generation

Algae is used to produce biofuel; Because it contains a good percentage of oils, amounting to about 60% of its weight. Global interest in algae has increased because they do not compete with vegetable oils and agricultural crops intended for human consumption. In addition, algae do not add more carbon dioxide to the air, as what they consume during their cultivation and growth is approximately equivalent to what they emit when the biofuels produced from them are burned. In

addition, growing algae will not be at the expense of agricultural land, nor will it affect fresh water sources, as it can be grown using seawater or treated wastewater.

The Fourth Generation

This generation represents the latest global trend in biofuel production and depends on making a change in the genome of a microorganism, a bacterium called Mycoplasma laboratorium, so that it becomes able to produce fuel from carbon dioxide gas.

Projects in the field of biomass energy in Egypt

1- Research project: Developing an integrated mobile system for briquetting plant waste in the field (cotton firewood and rice straw), in cooperation with the Academy of Scientific Research and Technology.

The project aims to design and manufacture an integrated system for treating plant waste, such as cottonwood and the like, by converting it into high-density, regular-shaped briquettes that are easy to transport and store, while eliminating the pests and pathogens they carry, in addition to reducing the costs of storage, transportation, and handling of plant waste, and improving their properties as fuel for home ovens instead of Butane gas, or using it as an improved raw material for the manufacture of fodder, organic fertilizer, artificial soil, and charcoal, in addition to developing stoves and ovens suitable for making use of briquettes for home use in the countryside.

2- A research project to design and produce a small, clean wood charcoal system to produce good charcoal in cooperation with the Academy of Scientific Research and Technology.

The future of energy crops and biofuels

Second: Generating electricity from waste

Analysts believe that whoever initially thought of converting waste into fuel was a genius; It is a guaranteed source of biomass that will never run out if there is human and animal life on planet Earth. Animal manure and human wastewater can be used to produce biogas (renewable natural gas) via anaerobic digestion technology, which in turn can be used to generate electricity.

Although the use of these wastes causes some allergies; Recycling human and animal waste offers a huge advantage in reducing landfill pollution and provides a highly efficient and abundant source of renewable energy.

In 2022, Australia's first biosolids gasification plant opened in the suburb of Loganholme, south of Brisbane; This made it the first station in the Southern Hemisphere to convert human waste into renewable energy.

Third: Burning wood to generate energy

There is likely to be debate over the sustainability of a major form of biomass energy: burning wood for energy.

Biosolids gasification plant near Brisbane, Australia

Source: Data collected by research

It should be noted that carbon dioxide and methane gases are released when biomass is burned, which contributes to the rise in greenhouse gases.

Considering this, for this type of bioenergy to be renewable, wood pellet producers must reforest forest areas to ensure that the carbon dioxide generated by burning those pellets is reabsorbed by the newly planted trees.

Analysts point out that the matter may be difficult in many parts of the world; Trees are cut down illegally to meet the growing demand for woody biomass.

Fourth: Running the car with grass clippings energy

Due to the unprecedented rise in fuel prices in modern times, it is beneficial to run a vehicle using the contents of the lawn mower assembly can.

Although the process is not that simple; A biofuel called ethanol is already produced around the world, from crop sources such as corn, sugarcane, and grass. Ethanol can be used instead of gasoline in many cars.

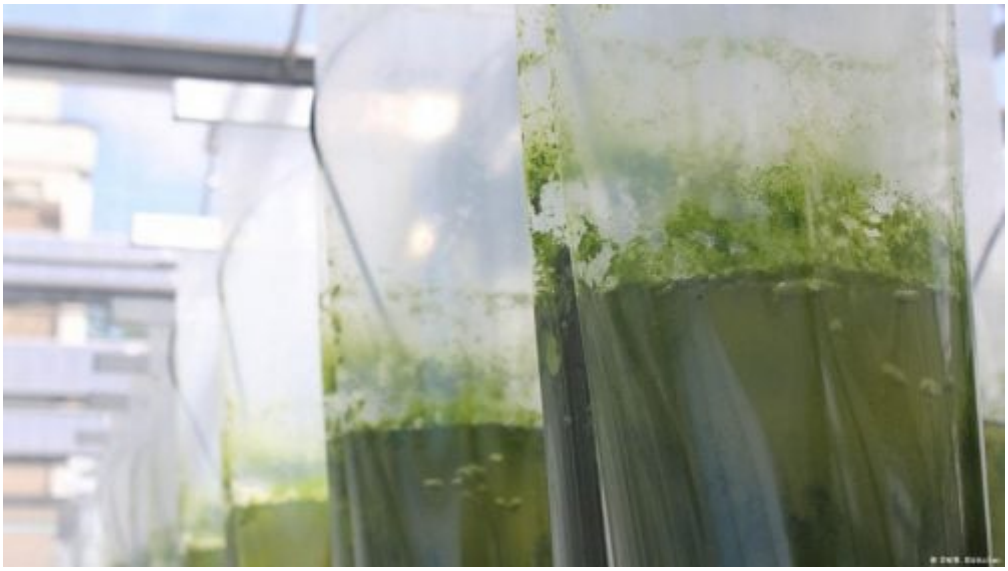
Another type of biofuel - biodiesel - is produced from vegetable oils and animal fats, according to a report seen by the specialized energy platform.

Biofuel use appears to be on the rise; The global biofuel market was valued at approximately US$110 billion in 2021, and the numbers are expected to reach US$201.2 billion by 2030.

Fifth: Using algae as fuel

Appearances can be deceiving, and this is not entirely true in the case of algae; The green goop has attractive properties when it comes to producing bioenergy.

The process of processing algae to extract fuel



Source: Data collected by research

Algae have the potential to produce a much greater amount per hectare of terrestrial biomass and can be grown on marginal lands; Therefore, they do not compete with other crops or foods.

Biomass a successful recipe for achieving carbon neutrality

In addition to not occupying a large space; The growth of algae is not affected by location, and it can live in the sea and in wastewater. Including wastewater, animal waste, some industrial effluents, and even on land surrounded by seawater.

When grown in wastewater, algae provide the added benefit of purifying water, as well as producing bioenergy suitable for biofuel production.

Algae is fast-growing, some species can double in size every 24 hours, and can be harvested daily.

When the future of bioenergy is considered, algae is something worth keeping Surveillance.

Conclusion

Bioenergy is very positive, and even necessary, if its investments are directed towards waste and waste management projects, and the use of inedible parts of the products that have been grown for food, and not by exploiting vast areas of agricultural land to produce biofuel at a time when humanity is suffering from limited resources, at a time when we have the choice to direct our efforts towards developing truly clean energies such as solar and wind energy.

Renewable Energy - More Secure Future

Abstract: The continuing electricity crisis has been one of the most serious negative effects on the national economy and has become a major political issue, undermining the credibility of the government despite the huge budget allocated to finance the sector without noticeable

improvement. Economic turmoil as well as lack of material supplies due to the lack of regulatory policies in the electricity markets, which necessitates the restructuring and restructuring of the electricity sector. Universal access to electricity is important for improving livelihoods and economic activities, so diversifying the electricity mix is imperative.

Introduction:

Renewable energy is a permanent and inexhaustible natural resource available in nature and constantly renewed as long as life exists. By exploiting renewable energy sources, we can benefit from non-renewable energies in important petrochemical industries instead of burning them as fuel and wasting them, as oil and its derivatives are now used in the manufacture of medicines, clothing, appliances, etc. Therefore, these two types of energy can be considered complementary to each other in serving humanity and combating poverty, hunger, and thirst.

The most important sources of renewable energy are solar energy, wind energy, tidal energy, waves, geothermal energy, waterfall energy, and biomass energy. We will briefly review some of these types, as follows:

First, solar energy: The sun is considered the source of energy necessary for life on Earth, and it is considered the main source of energy of various types, whether fossil or new and renewable. It is the most important source of new energy, as countries make many efforts through scientific research to develop methods for exploiting it as an alternative energy to oil and gas.

Solar radiation can be exploited in the following areas: -

1. **Thermal conversion:** It depends on the principle of dark bodies absorbing radiation and converting it into heat, which in turn raises the temperature of the dark body. This absorbed heat is used in many domestic and industrial uses, for example, water heating and heating. Heating water for domestic use is one of the most widespread applications of thermal conversion.
2. **Photoelectric conversion:** It depends on the principle of converting solar radiation directly into an electric current using the phenomenon of the photoelectric effect. This phenomenon is considered the basic image of the so-called solar cells, which are used in many practical applications such as wristwatches, calculators, and in operating transmission towers, telephone communications, and radio and television stations.It is also currently used to light some villages and roads.
3. **Wind energy:** where wind is converted into electrical energy by giant turbines. Wind energy is considered the most growing and fastest growing energy in the world in terms of new energies. Germany occupies the world's leading position in the field of exploiting wind energy. The global production of electricity generated by wind energy amounts to about (40) thousand megawatts, and Europe's share of it is about 75%.

Despite the widespread spread of wind farms, they suffer from some environmental problems represented by the large areas they require, as well as the noise resulting from the rotation of the fans, and finally the visual pollution that people living near these farms suffer from

4. Biomass energy, which is all types of plant-derived materials that can be used to produce energy, such as wood, herbaceous plants, agricultural crops, and forest residues. The sources of this energy are produced during the process of photosynthesis, which is when plant cells producecarbohydrates using water, carbon dioxide, and sunlight, and these carbohydrates are sources of energy.

Source: Data collected by the researcher

Figure 4: Biomass energy

The amount of electricity currently produced in the world from biomass is estimated at about 10 megawatts. The market for biomass technologies is currently considered relatively small due to the availability of oil and coal at reasonable prices, except for areas where biomass sources are very abundant.

5. Hydrological energy or water energy: It is the use of running water and waterfalls to produce energy, and it is considered one of the cleanest renewable energies and the most efficient for producing electricity.It has played an important and major role in the development of human societies all over the world, and currently about 19% of the world's electricity production comes from exploiting water energy.Although the expansion of its use may leave negative environmental impacts, such as the exploitation of good lands, which are usually close to watersheds, as well as evaporation, climate effects, sedimentation, etc., they will remain as one of the keys to the solution for producing electrical energy in the future, given the availability of sources of this electrical energy in areas.Many parts of the world, especially in regions with high population growth in Asia and Latin America, where the demand for energy is increasing.

Source: Data collected by the researcher

Figure 5: Hydrological energy or water energy

6. Earth's geothermal energy, which is the enormous heat hidden beneath the earth's crust, which is estimated at (200 - 1000) degrees Celsius, is considered an important source of new and renewable energy, and manifests itself through volcanic eruptions, hot springs, and some geological phenomena.It is based on the principle of drilling deep wells to release high heat that can be exploited to rotate turbines that run on steam. Currently, the contribution of this type of energy to electricity generation does not exceed 0.3%, and this energy is not promising globally.

It has negative environmental impacts like those resulting from fossil energy, and the gases resulting from this technology are hydrogen sulfur (H2S), hydrogen chloride, and carbon dioxide.

7. Ocean energy: It appears through four types of energies: -

- Tidal energy: The rise and fall of sea water levels can be exploited as an important source of renewable energy. Tides were used to generate energy in ancient history in Britain and France, where mills were available for grinding grain that operated with the flow of sea water during the tides. Now, it is used to generate electricity using turbines driven by water pouring from the tops of dams.
- Wave energy: It is of two types: -

The first: - It is the kinetic energy of waves when they move forward.

Second: - It is the potential energy of these waves in their vertical displacement whenever the wave passes over a certain point. The highest concentration of wave energy is between 40 to 60 degrees latitude in both hemispheres of the Earth (northern and southern), as well as the western coast of Europe and America.

- **Heat energy from the oceans:** The idea is to exploit the difference in temperature between the surface of the ocean in tropical areas, which is estimated at 25 degrees Celsius, and that at a depth of one km, where the temperature is about 5 degrees Celsius. The area of the oceans that can exploit the energy difference between its surface temperature and its depth is estimated at 60 million square kilometers. That is, the voltage available from this energy is equal to twice that available from tidal energy, wave energy, or wind energy.

- The energy of the difference in salinity was not given attention due to the high cost of the technology used in it.

Nuclear energy: After the attack with nuclear explosives on the cities of Hiroshima and Nagasaki and the end of World War II, it became clear at the international level the enormous potential of nuclear energy. Thinking then, whether in the Western or Eastern camps, turned to constructing giant reactors and developing them to adapt this energy to allow it to be used in civilian industrial fields to improve Human lifestyle and strengthening international peace. However, what happened is that in addition to working on peaceful applications of nuclear energy, the effort continued to use it again for military purposes by developing special reactors to propel military ships and submarines, and the operation of the first American nuclear submarine was announced in 1954.

Studies continued in the fifties and sixties on models of reactors in the United States of America, such as reactors in which the coolant, moderator, and fuel are mixed, as well as reactors cooled with organic liquids and other models, until they arrived at light water reactors: which are reactors that are practical to operate and economically possible. Thus, a completely new industry was launched at the global level, which is the manufacture of giant reactors to produce electrical energy.

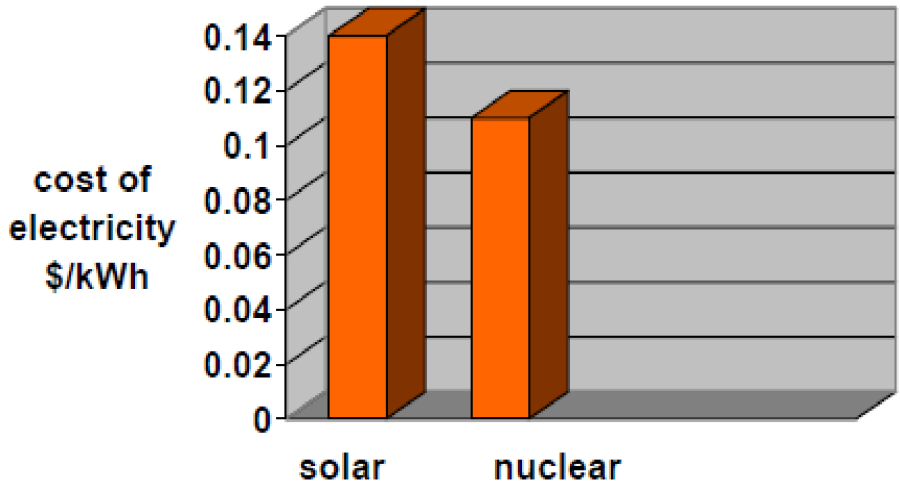
The Obninsk reactor in Russia, which was built between 1951 and 1954, is considered the first reactor in the world to operate on an industrial level. The Obninsk electrical station is considered the first nuclear power station to be established on the global level. Efforts have continued in the field of reactor design, development, and use in generating electrical energy throughout the past decades, and the number of nuclear power reactors has reached approximately 450 operating worldwide. France is considered the country most dependent on nuclear energy to generate electricity, as the percentage exceeds 75% of its electrical energy production.

Uranium is considered the primary fuel in nuclear energy, and it is expected that there will be an increase in demand for uranium in the future due to the increased demand for energy, especially electrical energy.

Comparing the solar energy option with the nuclear energy option

The figure below shows the price of a kilowatt-hour of electricity produced from a large nuclear plant with a capacity of 1000 MW and a medium solar plant with a capacity of 100 MW.

It appears from the figure that the price of the solar station's electricity is ($0.14/kWh) at the present time (noting that the total real cost of closing, removing, and cleaning the site from atomic radiation and other unpredictable risks is not included in the calculation) is higher than the price of the nuclear station's electricity. ($0.11/kWh) It should be noted that this situation is expected to change soon due to the increase in the production capacity of solar stations and the acquisition of more experience in design, operation, research and development.



Source: Darwish Muhammad Khamis, Imran bin Al-Halami

Figure 6: Electricity price comparison between a nuclear plant and a solar plant, 2008 prices

In addition to the enormous production capabilities, the new technology offered by concentrated solar energy versus photovoltaic panels or wind energy has another important advantage, which is converting radiant energy into heat to sustain the steam cycle in turbines and generators. It is also possible to store heat so that current is produced at night from the stored heat in contrast to photovoltaic panels. Thus, these stations become capable of carrying the base load, and thus able to meet electricity needs in a way that is not subject to the times of the day or seasons of the year.

It is possible for solar power generation plants to operate in a dual system, that is, with gas or biomass, and this is an important advantage over all other fluctuating renewable energy sources that are subject to wind, weather, or times of day and are therefore subject to great fluctuation and instability. It is possible to organize, and control concentrated solar power plants, and it also makes it possible to increase the share of other renewable energy sources.

For this reason, these plants are considered an “enabling technology”, and in addition, they provide a good climate balance because the carbon dioxide emissions that occur during production, installation, processing and in the operating phase during a period of up to 20 years on average will be re-supplied after three-to-three years. The first six months of the operating time of a clean solar station.

But concentrated solar energy technology requires a higher beam, and therefore it can be placed and built on the sun belt between 35 degrees north latitude and 35 degrees south latitude, where the desert is located. The mirrors necessary to collect solar energy will require large areas, which will also affect the choice of location, so the large desert areas of the Sun Belt are suitable for this task.

Costs of implementing a solar power plant project

The project is being implemented gradually through the implementation of solar energy stations that generate energy, as each individual needs about 1Kw of electrical energy, and therefore it is

necessary to provide 1 million kilowatts for one million individuals, i.e. 1000Mw, which means ten stations powered by solar energy, each with a capacity of (100Mw).

To settle one million Egyptians annually in the desert, ten stations can be established annually, each with a capacity of 100MW, up to fifty million during the next fifty years, as their number is expected to reach one hundred million.

That is, it accommodates about 50% of Egyptians. Since the solar power station with a capacity of 100 Mw occupies an area of 2 to 10 square kilometers and if only 10% of the area of the Egyptian desert is exploited in the electricity industry, the number of stations that can be established is a capacity of 10000 = (10 x 10 / 106) = ten thousand stations with a capacity of 100 Mw each. Mw100. If we know that the current electrical capacity in Egypt is ≈ Gw23, and the energy generated through the project constitutes Mw1,000,000 = Gw1000 on an area of only 10% of the Egyptian desert. (One million megawatts = one thousand gigawatts). The capacity that can be created on only 10% of Egypt's desert is estimated at more than forty times the current capacity. Accordingly, the door to investment in this industry and its export to the European Union can be opened through national planning, as Algeria is currently doing.

Project financing

The costs of establishing a 100 MW solar power station are estimated at approximately $400 million, meaning that the costs of establishing ten stations annually are approximately ($4 billion). This amount can be covered by half of the annual Suez Canal income!!! This is in addition to the possibilities of obtaining many facilities from banks. And international bodies and manufacturers because this project provides clean and alternative energy to environmental pollution... etc. with the possibility of manufacturing many of the components of these solar stations locally, which reduces their costs... as Mexico does.

Financing stages

The project can be planned to be implemented over the next fifty years in three stages:

- The first stage: during the first ten years, 0-10 years.
- It requires 100% financing.
- The second stage: during the next twenty years, 10-30 years.
- It needs 50% financing, and the rest is paid from the revenues from exporting electricity.
- The third stage: during the last twenty years, 30-50 years.
- Financing rate 0%.

The project will depend on itself to finance this stage through the revenues from exporting electricity in the previous stage.

Economic feasibility of the project

If only 10% of the desert area in Egypt is exploited to establish solar-powered electricity stations for the purpose of export, after local consumption within fifty years, we find that the value of the

electrical energy to be produced is estimated at approximately 1000 Gw x 5000 hr/year, so it will be the minimum average annual production. In fifty years, 106 x 5 ≈ gigawatt-hours.

Assuming that the selling price of a kilowatt-hour is between $0.2 and $0.1, depending on the circumstances, and considering the possibilities of fluctuations in economic conditions, currency rates, and the decrease in their purchasing value...etc., we find that the minimum value of electrical energy sold annually in the worst conditions About $100 billion ($100 billion). This is close to the value of the current annual production of Saudi oil.

Economic feasibility of solar power plants

As we mentioned before, solar energy can be converted into thermal energy using solar collectors, and this thermal energy can be used as a high-temperature heat source to operate steam or gas turbines, as is the case in traditional power plants that use fossil fuels. We can also convert solar energy into direct electrical energy using solar cells. Since the Arab world needs both water and electricity, and not just electricity, the solar stations expected to be built in the future are likely to be dual stations for electricity generation and water desalination, as is the case with traditional stations operating at the present time.

Water desalination processes are divided into processes that require electrical energy only (desalination of water using reverse osmosis membranes) and processes that rely on both electrical energy and thermal energy (desalination of water using distillation methods). Therefore, dual stations can be designed in one of the following three ways:

1. A field of concentrating thermal collectors with heat storage tanks (CPS) that supply thermal energy to drive steam or gas turbines to generate electricity and reverse osmosis units that use a portion of the main station's electricity.
2. A field of concentrated thermal collectors (CPS) with heat tanks that supply thermal energy to steam or gas turbines to generate electricity and several steam distillation units.
3. A field of solar cells (PV) with electricity tanks and several reverse osmosis units use part of the electrical energy produced.

Many researchers have compared the economics of the three stations mentioned above and concluded that the third method, which uses solar cells (PV), is uneconomical at the present time due to the high price of solar cells, especially for small production capacities. Therefore, we will focus our considerations on the first and second methods, which use thermal sensors (CPS).

The economics of dual solar stations depend on the cost of producing steam from the solar collector field. This cost, in turn, depends on several factors, including:

1. Capital cost of solar collectors.
2. The strength of solar radiation at the location where the station is planned to be established.
3. Lifetime of the station
4. Interest rate on loans

It is expected that the cost of producing steam from solar collectors will decrease in the future with the increase in the production capacity of solar collectors because of the increasing spread

of solar stations. To compare this cost with the cost of thermal energy resulting from fossil fuels (crude oil), we calculate the cost of producing the equivalent of the energy contained in a barrel of oil using solar energy.

We note here that a barrel of crude oil contains 1600 kilowatt-hours of thermal energy kWh. The following figure shows the cost of producing the equivalent of a barrel of oil with solar energy (a solar barrel) and the extent to which this cost will change in the future with the increase in the areas of the sensors that are created. (The left vertical coordinate is shown in this figure Solar energy price per barrel of equivalent (solar fuel cost, $ per barrel). The right vertical coordinate shows the area of the created detectors. The horizontal coordinate shows the years. To calculate the price of solar energy, the following assumptions were used:

1. Capital cost for parabolic solar collectors = $250 per square meter ($/m2.
2. The power of solar radiation at the site where the station is planned to be established = 2400 kilowatt-hours per square meter per year (kWh/myear).
3. Lifetime of the station = 25 years.
4. Interest rate on loans = 5% per year.

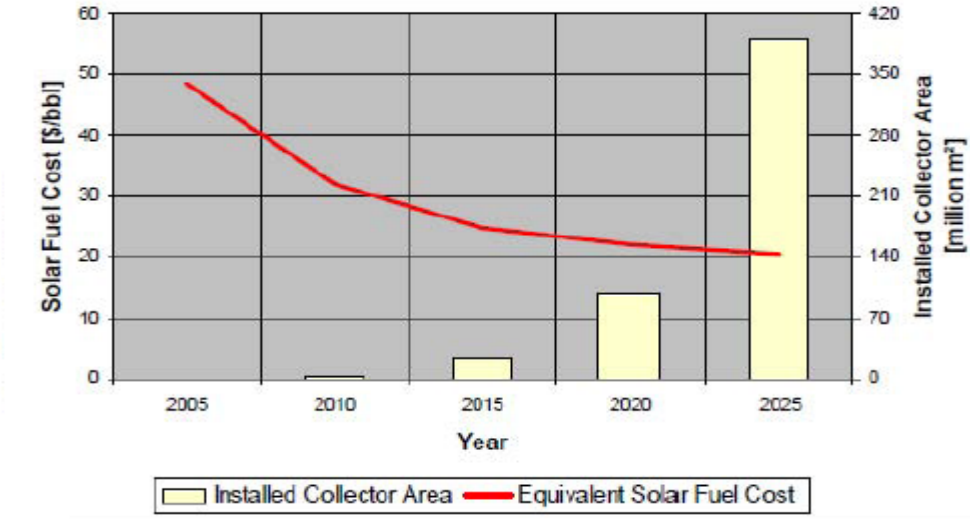


Figure 7: Solar fuel price in dollars per barrel equivalent

It is clear from the figure above that the price of solar thermal energy is less (at present) than $40 per barrel equivalent, and this price is close to half the price of a barrel of crude oil at the present time (about $80 per barrel). It is expected that this price will continue to decline as the construction of solar stations spreads and as installed capacity increases.

Future prospects for hydrogen fuel

Introduction

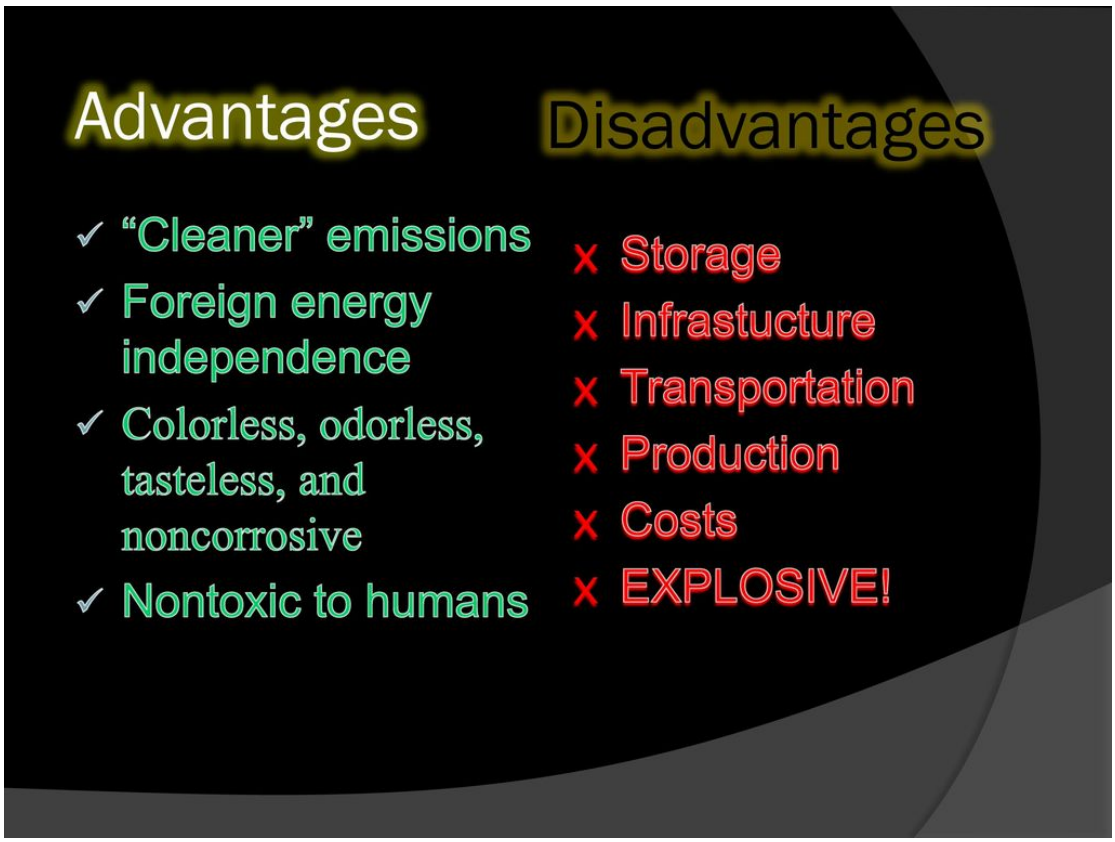
Hydrogen represents a new source of clean energy, as it is considered a candidate to change the face of the energy industry because it does not produce any carbon emissions. The use of hydrogen as an alternative source of energy has become at the top of the attention of many

countries recently, as it is one of the important sources of clean energy. This is due to its importance in reducing carbon emissions and limiting the phenomenon of climate change, as hydrogen can be used as a fuel in several sectors such as industry, utilities and transportation, which can be produced through several methods, and the most common methods today are natural gas reforming and electrolysis, and the methods include Other processes that operate with biological processes and solar energy, and hydrogen energy is usually used to generate electricity or even as fuel in hybrid and electric cars.

Hydrogen fuel energy

Hydrogen is considered one of the new energy alternatives, and it could be the fuel of the future because its combustion does not usually cause any environmental pollutants and because the heat content of its combustion is approximately three times the heat content of the same mass of petroleum fuel. In spacecraft, it is burned to propel jet engines.It can also be burned with oxygen in a combustion chamber, producing high heat that can turn water into steam to drive turbines to generate electrical power, in addition to the possibility of using it in internal combustion engines for cars. Like natural gas, it can be burned and the resulting heat used for heating.

Hydrogen Fuel Advantages and Disadvantages



Source: data collected by researcher

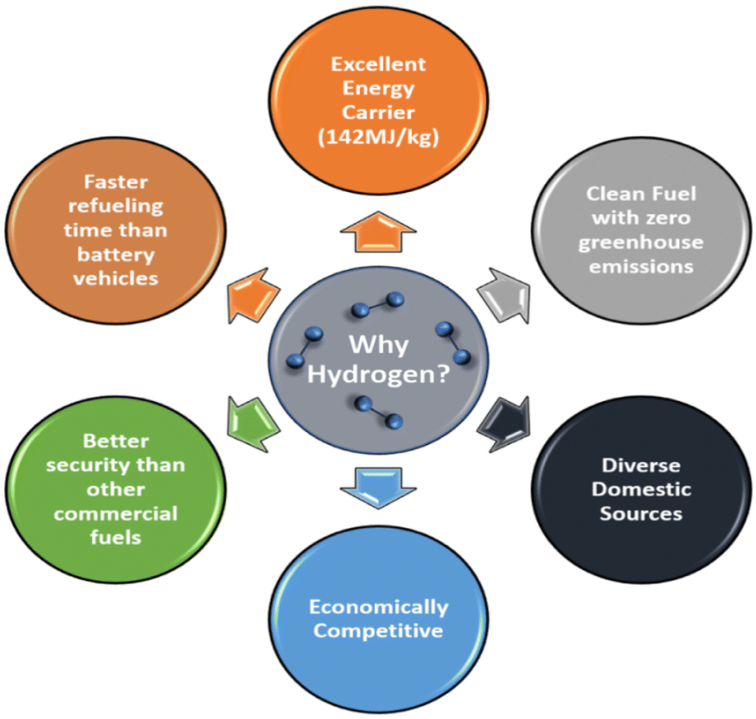
Hydrogen is currently produced from oil, natural gas, and coal.The production rate is estimated at approximately 50% from oil, 30% from natural gas, 15% from coal, and 5% from other sources.Hydrogen can be produced from the electrolysis of water, as water is electrolyzed into the element's oxygen and hydrogen, and in this way a gas of very high purity is produced.Water

available in seas and oceans is the main source of hydrogen gas production.Solar energy can be used to produce hydrogen by converting solar radiation into electrical energy using solar cells and then using the resulting electricity to decompose water.

Presence of hydrogen

Hydrogen gas has all the ingredients that make it a successful fuel, as it is the lightest and cleanest, in addition to the possibility of converting it into other forms of energy with complete efficiency. Hydrogen is a gas that has no taste or smell and is non-toxic. It consists of the diatomic molecule H2, which is one of the most abundant elements in the universe. Of the planets and stars, they consist only of it or contain a high percentage of it. For example, it constitutes 75% of the components of the sun, and its energy is produced as a result of the fusion of hydrogen nuclei to form the element helium. Hydrogen has the smallest and lightest atom and is flammable and liquefied by pressure and cooling. It is included in the composition of many chemicals, which The most important of these are water and the organic compounds that make up living bodies, including plants and animals.

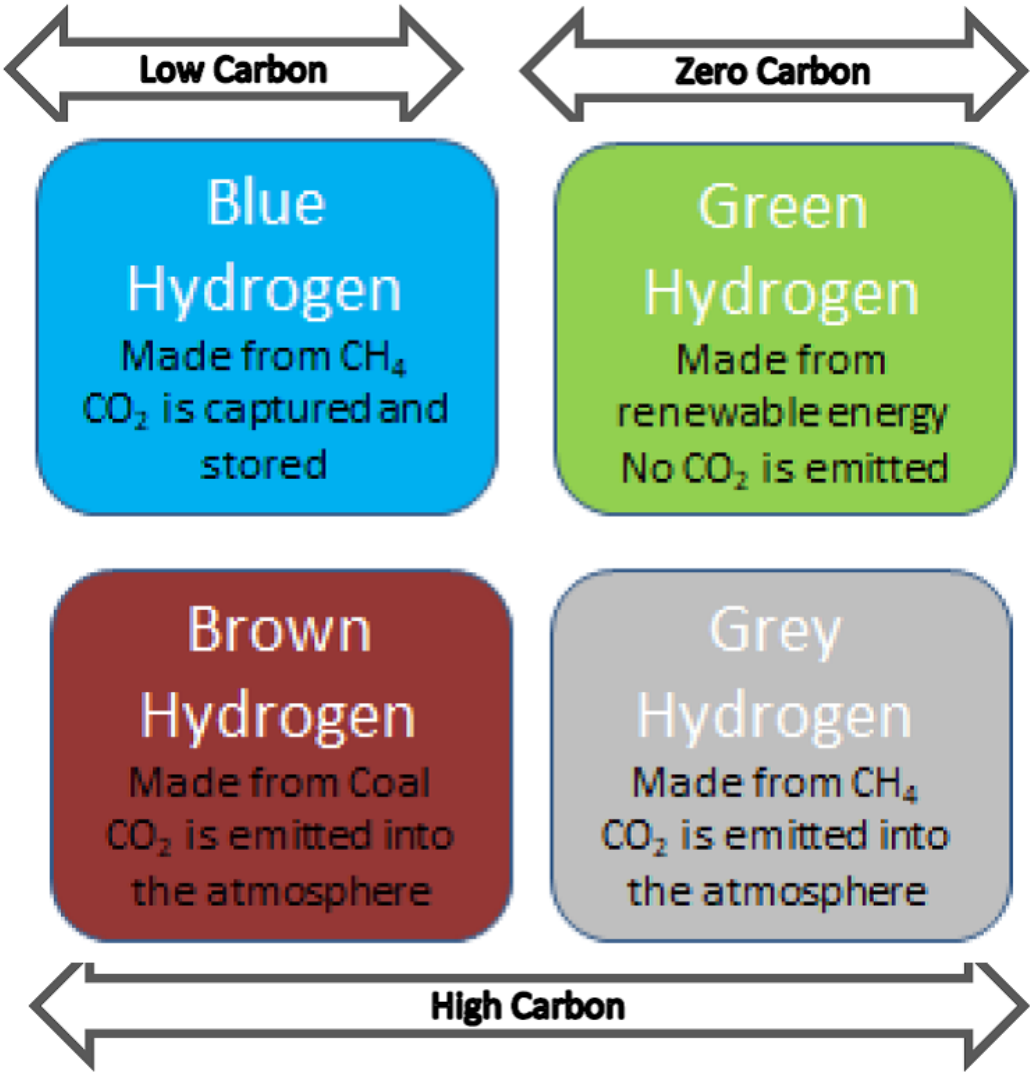
Hydrogen Oil



Source: data collected by researcher.

Despite its large presence in planets and stars, on the surface of the Earth it does not exist as an independent element. It is found in natural gas in small proportions and is found in great abundance combined with oxygen in the form of water in the seas, oceans and rivers. Therefore, the latter is the main source of fuel for the future. It is also present in Combined with carbon in the form of organic compounds necessary in food production,

From this we say that hydrogen plays an important role in the production of food, water and energy, which are among the basics of life today and in the future.



Source: data collected by researcher.

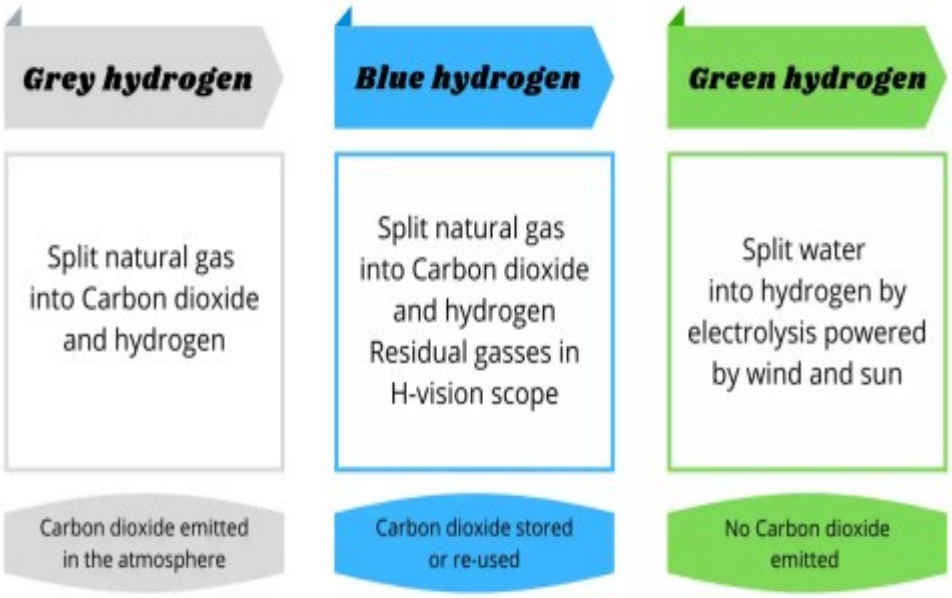
The idea of using hydrogen as an alternative source of energy began at the beginning of the twentieth century, but this process encountered difficulties, including: the high cost of its production. Separating hydrogen from oxygen by electrolysis or thermal analysis of water requires energy, and it also requires primary energy such as water to be produced, which hindered the development of Its production, which has witnessed increasing interest in recent decades due to its importance and qualifications that allow it to replace traditional energies.

This interest has been translated into developing methods for producing hydrogen and reducing, even if relatively, the cost of production. Scientists at the Center for Renewable Energy in the United States of America have also succeeded in producing it using solar energy. They have invented a device that separates hydrogen from water and converts it into electrical energy at the same time using more than 12.5% of the solar radiation, and as previously mentioned, the most important obstacle facing them remains the cost obstacle, as the device is still not economical in cost.

Hydrogen has many advantages that qualify it to be the fuel of the future, some of which were previously mentioned, and we add to it the ability to store, which is superior to other renewable

energies that suffer from the lack of permanent availability of the same capacity, such as solar energy and wind energy... However, it is not considered a primary source of energy. Rather, it is an intermediate source for its production. What are the most important methods used to produce it?

Green Hydrogen Advantages and Disadvantages



Source: data collected by researcher

Types of hydrogen and methods of producing it

Hydrogen is produced from a raw material that contains it in its chemical composition, such as water, biomass, fossil fuels, or bio- and plastic waste, but is extracted into its final form using another source of energy.

Second: Methods of producing hydrogen

There are several methods through which hydrogen can be produced, the most important of which are: electrolysis of water, thermal analysis, in addition to its production through the influence of direct solar radiation.

1. Water electrolysis

This method is considered the simplest and most widespread method known to obtain hydrogen from water. This method depends on passing an electric current through the water to decompose it into its main components, hydrogen and oxygen. To do this, we need a device called an electrolysis cell and energy. The efficiency of this method reaches 80%, but it is It decreases to about 30%, if we take into account the efficiency of converting primary energy into electricity and then into hydrogen.

The most important obstacle to this method is the cost barrier, as it costs more to produce hydrogen by electrolysis of water than to produce it from fossil fuels.

2. Thermal analysis of water

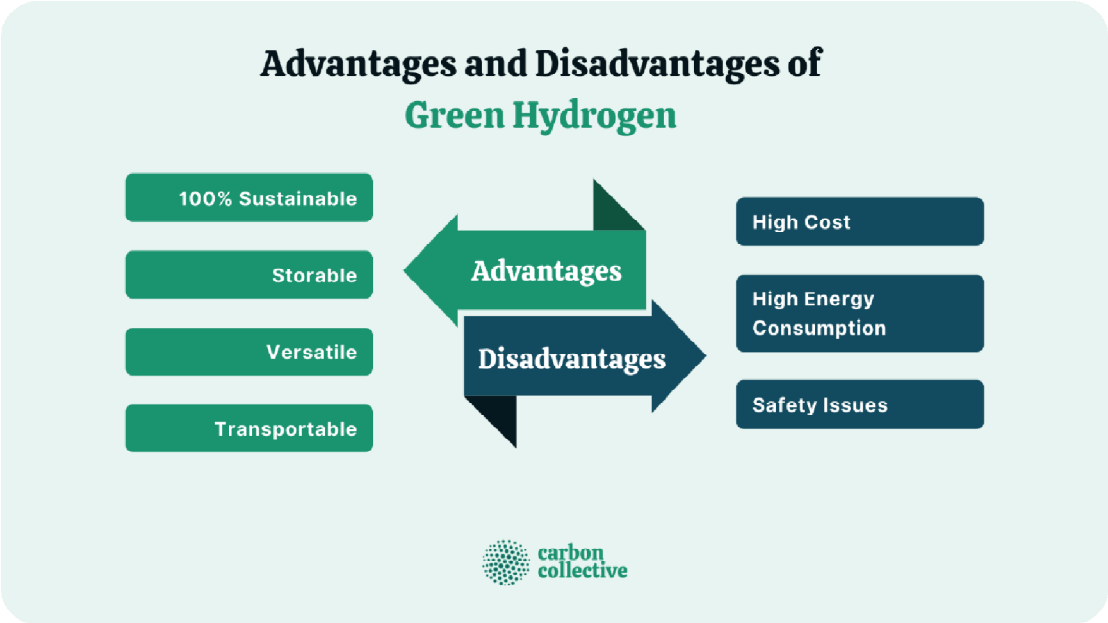
In order to decompose water into its elements by direct heating, it is necessary to heat it to about 3000 degrees Celsius or more, but reaching this temperature is not easy, and it is also difficult to find containers or materials that can withstand this high temperature, so scientists try to avoid these difficulties by performing electrolysis in several ways. Stages, provided that one or more chemical catalysts are used, such as iron oxide, sulfur dioxide, or calcium bromide and mercury, in order to carry out the reaction at lower temperatures, so that the highest temperature we need in the presence of the catalyst is 730 degrees Celsius.

3. Preparing hydrogen by direct solar radiation.

Green plants derive the energy needed for photosynthesis from solar rays, while the hydrogen needed for the recovery process is obtained by plants from the decomposition of water into its elements oxygen and hydrogen, and this process only takes place in the presence of an intermediary, which is chlorophyll.

In the presence of sunlight and chlorophyll, scientists have tried to decompose water, and they have been able to find chemical compounds to replace this natural mediator. They have found that some dissolved salts in water can perform this role, so that when dissolved in water, the salts ionize into positive and negative ions, and under the influence of Solar radiation takes these ions or gives one or more electrons to and from the water molecule, leading to the decomposition of water into oxygen and hydrogen.

Green hydrogen



Source: data collected by researcher.

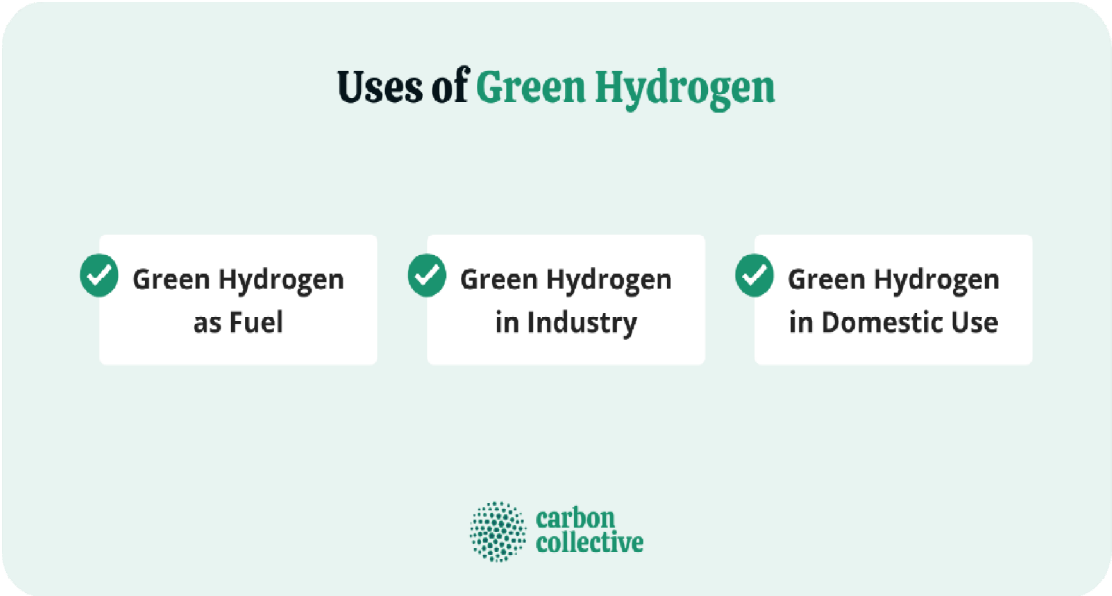
As a result of using one of these methods, the water decomposes, then the hydrogen is transported, stored, and distributed to consumers, as it can be used in most applications in which fossil fuels are used. The latter can produce hydrogen, such as coal gasification. However, we did not discuss this method because it is linked to a depleted source that pollutes the environment, and we are searching for Alternative sources of depleted energy.

Hydrogen uses

Using hydrogen, we can operate planes, cars, trains, ships, factories, and heat homes, offices, hospitals, schools, etc. Hydrogen, in its gaseous state, can transmit energy like electricity over long distances and through transmission pipelines with high efficiency and at the lowest possible cost. Hydrogen can rely on energy fuel technology or other energy-generating machines. To provide the consumer public with electricity, pure drinking water, and hydrogen, as a chemical element, which has various uses and applications other than electrical energy. We can classify the uses of hydrogen fuel mainly into the following four main fields:

1. Fuel for transportation vehicles (cars, airplanes) that use hydrogen fuel cell technology and its broader applications for future use in power generation plants.
2. Using it as a battery with capacities that range from the small ones used in portable personal computers, all the way to hydrogen transport ships that transport it from renewable energy stations to remote electricity generation locations to solve the problems and costs of long networks and the energy losses across them.
3. Fuel that generates thermal energy through direct combustion in boilers in power stations, in addition to its use as propellant fuel in missiles.
4. It is a working fuel in nuclear reactors, especially the ITER reactor technology, which works on the principle of generating energy on the surface of the sun.

Uses of Hydrogen

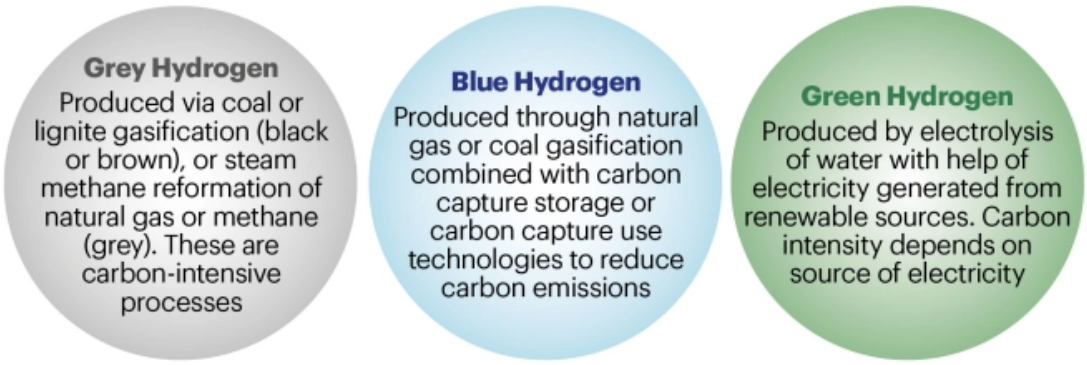


Source: data collected by researcher.

Hydrogen technology

One of the most famous uses of hydrogen technology is fuel cells. Fuel cells use free hydrogen or hydrogen found in other types of fuel, such as methanol, ethanol, natural gas, and diesel oil. The extracted hydrogen is used to produce electricity. Hydrogen for fuel cells can also be obtained through biomass, wind, solar and renewable energy sources.

Hydrogen types



Source: data collected by researcher

Third: Disadvantages of hydrogen

Obtaining hydrogen is not easy and is also expensive. The main source of hydrogen is natural gas (i.e. fossil fuels). Natural gas will cause emissions when used to produce hydrogen, and the gas is expensive and it is not economical to convert it to hydrogen at this stage. It may be better to use coal for this purpose, but it will require many years of development and investment.

Despite the many advantages that hydrogen has, it is not without disadvantages, including:

- The heavy reliance on natural gas to produce hydrogen, and this does not solve the problem of depletion of fossil energies as well as the emission of waste gases.
- The low energy per unit volume of hydrogen means the need for large tanks to hold it until needed.
- Hydrogen energy infrastructure differs from that of current energy sources, which means the need to make changes that may be costly.
- High costs of producing hydrogen. In order to produce a cubic meter of it in most of the devices currently deployed, we need from 4.5 to 4.8 kilowatts per hour. In order to reduce costs, research is focusing on improving the efficiency of these cells.

Hydrogen energy in the Arab Republic of Egypt

It is possible to extract hydrogen energy from renewable energies such as hydropower, solar energy, and wind energy in Egypt due to the availability of infrastructure for previous energies, as there are many hydro stations, wind energy stations, and solar energy through which hydrogen can be generated. Hydrogen can also be generated through traditional energies such as natural gas, as it is available in large quantities in Egypt.

Hydrogen can be generated from solar energy in Egypt, at the ideal location on the world map for generating hydrogen with solar energy, Lake Nasser in southern Egypt, due to its distinguished location and being the first candidate in the world to generate hydrogen with solar energy to exploit it as fuel at the local level and export the surplus to the outside world.

Hydropower is of great importance in Egypt, and hydrogen energy can be generated from hydropower stations to separate hydrogen in addition to generating electrical energy. Therefore, Egypt has a promising economic potential to produce hydrogen from renewable energies.

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