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GREEN ENERGY TO PROTECTING THE ENVIRONMENT

ENERGIA VERDE PARA PROTEGER O MEIO AMBIENTE

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Abstract

After 1950, began to appear nuclear fission plants. The fission energy was a necessary evil. In this mode it stretched the oil life, avoiding an energy crisis. Even so, the energy obtained from oil represents about 60% of all energy used. At this rate of use of oil, it will be consumed in about 60 years. Today, the production of energy obtained by nuclear fusion is not yet perfect prepared. But time passes quickly. We must rush to implement of the additional sources of energy already known, but and find new energy sources. Green energy in 2010-2015 managed a spectacular growth worldwide of about 5%. *The most difficult obstacle met in worldwide was the inconstant green energy produced.*

Key-words: environmental protection, green energy, wind power, hydropower, pumped-storage.

Resumo

Depois de 1950, começaram a aparecer plantas de cisão nuclear. A energia de fissão era um mal necessário. Neste modo ele esticou a vida do óleo, evitando uma crise de energia. Mesmo assim, a energia obtida do petróleo representa cerca de 60% de toda a energia utilizada. A esta taxa de uso de petróleo, ele será consumido em cerca de 60 anos. Hoje, a produção de energia obtida por fusão nuclear ainda não está perfeita. Mas o tempo passa rapidamente. Devemos apressar para implementar as fontes de energia adicionais já conhecidas, mas e encontrar novas fontes de energia. A energia verde em 2010-2015 geriu um crescimento espectacular em todo o mundo de cerca de 5%. *O obstáculo mais difícil encontrado no mundo foi a energia verde inconstante produzida.*

Palavras-chave: a protecção do ambiente, energia verde, energia eólica, energia hidroeléctrica, Armazenamento bombeado.

1. Introduction

Energy development is the effort to provide sufficient primary energy sources and secondary energy forms for supply, cost, impact on air pollution and water pollution, mitigation of climate change with renewable energy.

Technologically advanced societies have become increasingly dependent on external energy sources for transportation, the production of many manufactured goods, and the delivery of energy services.

This energy allows people who can afford the cost to live under otherwise unfavorable climatic conditions through the use of heating, ventilation, and/or air conditioning. Level of use of external energy sources differs across societies, as do the climate, convenience, levels of traffic congestion, pollution and availability of domestic energy sources.

All terrestrial energy sources except nuclear, geothermal and tidal are from current solar insolation or from fossil remains of plant and animal life that relied directly and indirectly upon sunlight, respectively.

Ultimately, solar energy itself is the result of the Sun's nuclear fusion.

Geothermal power from hot, hardened rock above the magma of the Earth's core is the result of the decay of radioactive materials present beneath the Earth's crust, and nuclear fission relies on man-made fission of heavy radioactive elements in the Earth's crust; in both cases these elements were produced in supernova explosions before the formation of the solar system.

Renewable energy is energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished).

In 2008, about 19% of global final energy consumption came from renewable, with 13% coming from traditional biomass, which is mainly used for heating, and 3.2% from hydroelectricity.

New renewable (small hydro, modern biomass, wind, solar, geothermal, and biofuel) accounted for another 2.7% and are growing very rapidly.

The share of renewable in electricity generation is around 18%, with 15% of global electricity coming from hydroelectricity and 3% from new renewable. Wind power is growing at the rate of 30% annually, with a worldwide installed capacity of 158 (GW) in 2009, and is widely used in Europe, Asia, and the United States.

At the end of 2009, cumulative global photovoltaic (PV) installations surpassed 21 GW and PV power stations are popular in Germany and Spain.

Solar thermal power stations operate in the USA and Spain, and the largest of these is the 354 megawatt (MW) SEGS power plant in the Mojave Desert.

The world's largest geothermal power installation is The Geysers in California, with a rated capacity of 750 MW. Brazil has one of the largest renewable energy programs in the world, involving production of ethanol fuel from sugar cane, and ethanol now provides 18% of the country's automotive fuel.

Ethanol fuel is also widely available in the USA, the world's largest producer in absolute terms, although not as a percentage of its total motor fuel use.

While many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas, where energy is often crucial in human development.

Globally, an estimated 3 million households get power from small solar PV systems. Micro-hydro systems configured into village-scale or county-scale mini-grids serve many areas.

More than 30 million rural households get lighting and cooking from biogas made in household-scale digesters. Biomass cook stoves are used by 160 million households.

Climate change concerns, coupled with high oil prices, peak oil, and increasing government support, are driving increasing renewable energy legislation, incentives and commercialization.

New government spending, regulation and policies helped the industry weather the 2009 economic crisis better than many other sectors.

Green energy in 2010-2015 managed a spectacular growth worldwide of about 5%.

2. Wind power

Airflows can be used to run wind turbines. Modern wind turbines range from around 600 kW to 5 MW of rated power, although turbines with rated output of 1.5–3 MW have become the most common for commercial use; the power output of a turbine is a function of the cube of the wind speed, so as wind speed increases, power output increases dramatically. Typical capacity factors are 20-40%, with values at the upper end of the range in particularly favorable sites. Wind energy is the cleanest and sufficient, the safest, cheapest and most sustainable. Where land space is not enough, wind farms can be built and in the water. It must put the wind to work.

Wind energy or wind power is extracted from air flow using wind turbines or sails to produce mechanical or electrical energy. Windmills are used for their mechanical power, windpumps for water pumping, and sails to propel ships. A wind farm or wind park is a group of wind turbines in the same location used to produce electricity. A large wind farm may consist of several hundred individual wind turbines and cover an extended area of hundreds of square miles, but the land between the turbines may be used for agricultural or other purposes. A wind farm can also be located offshore. Many of the largest operational onshore wind farms are located in Germany, China and the United States. In just five years, China leapfrogged the rest of the world in wind energy production, going from 2,599 MW of capacity in 2006 to 62,733 MW at the end of 2011. However, the rapid growth outpaced China's infrastructure and new construction slowed significantly in 2012.

A windfarm or wind park is a group of wind turbines in the same location used to produce electricity. A large wind farm may consist of several hundred individual wind turbines and cover an extended area of hundreds of square miles, but the land between the turbines may be used for agricultural or other purposes. A wind farm can also be located offshore.

Many of the largest operational onshore wind farms are located in Germany, China and the United States. For example, the largest wind farm in the world, Gansu Wind Farm in China has a capacity of over 6,000 MW of power in 2012 with a goal of 20,000 MW by 2020. The Alta Wind Energy Center in California, United States is the largest onshore wind farm outside of China, with a capacity of 1,020 MW. As of April 2013, the 630 MW London Array in the UK is the largest offshore wind farm in the world, followed by the 504 MW Greater Gabbard wind farm in the UK.

There are many large wind farms under construction and these include Sinus Holding Wind Farm (700 MW), Lincs Wind Farm (270 MW), Lower Snake River Wind Project (343 MW), Macarthur Wind Farm (420 MW).

In just five years, China leapfrogged the rest of the world in wind energy production, going from 2,599 MW of capacity in 2006 to 62,733 MW at the end of 2011. However, the rapid growth outpaced China's infrastructure and new construction slowed significantly in 2012.

At the end of 2009, wind power in China accounted for 25.1 gigawatts (GW) of electricity generating capacity, and China has identified wind power as a key growth component of the country's economy. With its large land mass and long coastline, China has exceptional wind resources. Researchers from Harvard and Tsinghua University have found that China could meet all of their electricity demands from wind power by 2030.

By the end of 2008, at least 15 Chinese companies were commercially producing wind turbines and several dozen more were producing components. Turbine sizes of 1.5 MW to 3 MW became common. Leading wind power companies in China were Goldwind, Dongfang Electric, and Sinovel along with most major foreign wind turbine manufacturers. China also increased production of small-scale wind turbines to about 80,000 turbines (80 MW) in 2008. Through all these developments, the Chinese wind industry appeared unaffected by the global financial crisis, according to industry observers.

According to the Global Wind Energy Council, the development of wind energy in China, in terms of scale and rhythm, is absolutely unparalleled in the world. The National People's Congress permanent committee passed a law that requires the Chinese energy companies to purchase all the electricity produced by the renewable energy sector (Fig. 1-2).

Fig. 1 Wind farm in Xinjiang, China

Source: https://en.wikipedia.org/wiki/Wind_farm#/media/File:Wind_power_plants_in_Xinjiang,_China.jpg

Fig. 2 The Gansu Wind Farm in China is the largest wind farm in the world, with a target capacity of 20,000 MW by 2020.

Source: https://en.wikipedia.org/wiki/Wind_farm#/media/File:Gansu.Guazhou.windturbine_farm.sunset.jpg

U.S. wind power installed capacity in 2012 exceeded 51,630 MW and supplies 3% of the nation's electricity.

New installations place the U.S. on a trajectory to generate 20% of the nation's electricity by 2030 from wind energy. Growth in 2008 channeled some $17 billion into the economy, positioning wind power as one of the leading sources of new power generation in the country, along with natural gas. Wind projects completed in 2008 accounted for about 42% of the entire new power-producing capacity added in the U.S. during the year.

At the end of 2008, about 85,000 people were employed in the U.S. wind industry, and GE Energy was the largest domestic wind turbine manufacturer. Wind projects boosted local tax bases and revitalized the economy of rural communities by providing a steady income stream to farmers with wind turbines on their land. Wind power in the U.S. provides enough electricity to power the equivalent of nearly 9 million homes, avoiding the emissions of 57 million tons of carbon each year and reducing expected carbon emissions from the electricity sector by 2.5%.

Texas, with 10,929 MW of capacity, has the most installed wind power capacity of any U.S. state, followed by California with 4,570 MW and Iowa with 4,536 MW. The Alta Wind Energy Center (1,020 MW) in California is the nation's largest wind farm in terms of capacity. Altamont Pass Wind Farm is the largest wind farm in the U.S. in terms of the number of individual turbines (Fig. 3-4).

Fig. 3 The Shepherds Flat Wind Farm is an 845 MW wind farm in the U.S. state of Oregon.

Source: https://en.wikipedia.org/wiki/Wind_farm#/media/File:Shepherds_Flat_Wind_Farm_2011.jpg

Fig. 4 Brazos Wind Farm in the plains of West Texas.

Source: https://en.wikipedia.org/wiki/Wind_farm#/media/File:GreenMountainWindFarm_Fluvanna_2004.jpg

3. Wind power design

As a general rule, economic wind generators require windspeed of 16 km/h or greater. An ideal location would have a near constant flow of non-turbulent wind throughout the year, with a minimum likelihood of sudden powerful bursts of wind. An important factor of turbine siting is also access to local demand or transmission capacity.

Usually sites are screened on the basis of a wind atlas, and validated with wind measurements. Meteorological wind data alone is usually not sufficient for accurate siting of a large wind power project. Collection of site specific data for wind speed and direction is crucial to determining site potential in order to finance the project. Local winds are often monitored for a year or more, and detailed wind maps constructed before wind generators are installed.

The wind blows faster at higher altitudes because of the reduced influence of drag. The increase in velocity with altitude is most dramatic near the surface and is affected by topography, surface roughness, and upwind obstacles such as trees or buildings. Typically, the increase of wind speeds with increasing height follows a wind profile power law, which predicts that wind speed rises proportionally to the seventh root of altitude. Doubling the altitude of a turbine, then, increases the expected wind speeds by 10%, and the expected power by 34%.

Individual turbines are interconnected with a medium voltage (usually 34.5 kV) power collection system and communications network. At a substation, this medium-voltage electric current is increased in voltage with a transformer for connection to the high voltage transmission system. Construction of a land-based wind farm requires installation of the collector system and substation, and possibly access roads to each turbine site (Fig. 5).

Fig. 5 First wind farm consisting of 7.5 megawatt (MW) Enercon E-126 turbines, Estinnes, Belgium, 20 July 2010, two months before completion.

Source:https://en.wikipedia.org/wiki/Wind_farm#/media/File:Windpark_Estinnes_20juli2010_kort_voor_voltooiing.jpg

4. Wind turbine

A wind turbine is a device that converts kinetic energy from the wind into electrical power. The term appears to have migrated from parallel hydroelectric technology (rotary propeller). The technical description for this type of machine is an aerofoil-powered generator.

The result of over a millennium of windmill development and modern engineering, today's wind turbines are manufactured in a wide range of vertical and horizontal axis types. The smallest turbines are used for applications such as battery charging for auxiliary power for boats or caravans or to power traffic warning signs. Slightly larger turbines can be used for making contributions to a domestic power supply while selling unused power back to the utility supplier via the electrical grid. Arrays of large turbines, known as wind farms, are becoming an increasingly important source of renewable energy and are used by many countries as part of a strategy to reduce their reliance on fossil fuels (Fig. 6).

Fig. 6 Offshore wind farm, using 5 MW turbines REpower 5M in the North Sea off the coast of Belgium.

Source:https://en.wikipedia.org/wiki/Wind_turbine#/media/File:Windmills_D14_%28Thornton_Bank%29.jpg

Wind Turbine Types

Modern wind turbines fall into two basic groups; the horizontal-axis variety, like the traditional farm windmills used for pumping water, and the vertical-axis design, like the eggbeater-style Darrieus model, named after its French inventor. Most large modern wind turbines are horizontal-axis turbines.

Turbine Components

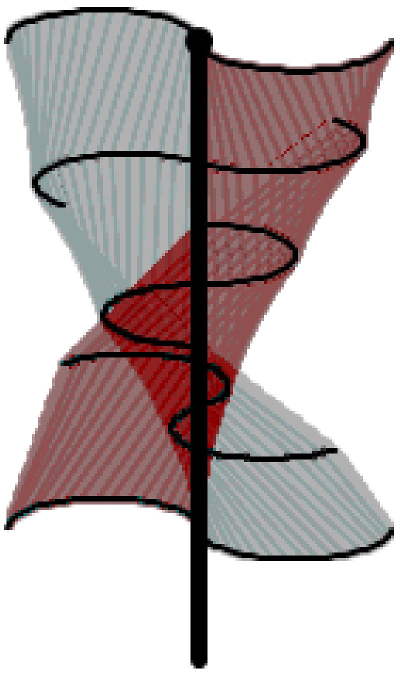
Horizontal turbine components include:

- blade or rotor, which converts the energy in the wind to rotational shaft energy;

- a drive train, usually including a gearbox and a generator;
- a tower that supports the rotor and drive train; and
- other equipment, including controls, electrical cables, ground support equipment, and interconnection equipment.

Vertical-axis wind turbines (or VAWTs; Fig. 7) have the main rotor shaft arranged vertically. One advantage of this arrangement is that the turbine does not need to be pointed into the wind to be effective, which is an advantage on a site where the wind direction is highly variable. It is also an advantage when the turbine is integrated into a building because it is inherently less steerable. Also, the generator and gearbox can be placed near the ground, using a direct drive from the rotor assembly to the ground-based gearbox, improving accessibility for maintenance.

Fig. 7 A vertical axis Twisted Savonius type turbine.



Source:https://en.wikipedia.org/wiki/Wind_turbine#/media/File:Twisted_Savonius_wind_turbine_in_operation@60rpm.gif

The key disadvantages include the relatively low rotational speed with the consequential higher torque and hence higher cost of the drive train, the inherently lower power coefficient, the 360 degree rotation of the aerofoil within the wind flow during each cycle and hence the highly dynamic loading on the blade, the pulsating torque generated by some rotor designs on the drive train, and the difficulty of modelling the wind flow accurately and hence the challenges of analysing and designing the rotor prior to fabricating a prototype.

When a turbine is mounted on a rooftop the building generally redirects wind over the roof and this can double the wind speed at the turbine. If the height of a rooftop mounted turbine tower is approximately 50% of the building height it is near the optimum for maximum wind energy and minimum wind turbulence. Wind speeds within the built environment are generally much lower than at exposed rural sites, noise may be a concern and an existing structure may not adequately resist the additional stress.

5. Hydropower and pumped-storage

Hydropower or water power (from the Greek: ύδρω, "water") is power derived from the energy of falling water or fast running water, which may be harnessed for useful purposes. Since ancient times, hydropower from many kinds of watermills has been used as a renewable energy source for irrigation and the operation of various mechanical devices, such as gristmills, sawmills, textile mills, trip hammers, dock cranes, domestic lifts, and ore mills. A trompe, which produces compressed air from falling water, is sometimes used to power other machinery at a distance.

In the late 19th century, hydropower became a source for generating electricity. Cragside in Northumberland was the first house powered by hydroelectricity in 1878 and the first commercial hydroelectric power plant was built at Niagara Falls in 1879. In 1881, street lamps in the city of Niagara Falls were powered by hydropower.

Since the early 20th century, the term has been used almost exclusively in conjunction with the modern development of hydroelectric power. International institutions such as the World Bank view hydropower as a means for economic development without adding substantial amounts of carbon to the atmosphere, but in some cases dams cause significant social or environmental issues.

In India, water wheels and watermills were built; in Imperial Rome, water powered mills produced flour from grain, and were also used for sawing timber and stone; in China, watermills were widely used since the Han dynasty In China and the rest of the Far East, hydraulically operated "pot wheel" pumps raised water into crop or irrigation canals (Fig. 8).

The power of a wave of water released from a tank was used for extraction of metal ores in a method known as hushing. The method was first used at the Dolaucothi Gold Mines in Wales from 75 AD onwards, but had been developed in Spain at such mines as Las Médulas. Hushing was also widely used in Britain in the Medieval and later periods to extract lead and tin ores. It later evolved into hydraulic mining when used during the California Gold Rush (Fig. 9).

Fig. 8 The Three Gorges Dam in China; the hydroelectric dam is the world's largest power station by installed capacity

Source: https://en.wikipedia.org/wiki/Hydropower#/media/File:The_Dam_%282890371280%29.jpg

Fig. 9 Saint Anthony Falls, United States

Source: https://en.wikipedia.org/wiki/Hydropower#/media/File:SaintAnthonyFalls.jpg

In the Middle Ages, Islamic mechanical engineer Al-Jazari invented designs for 100 hydraulic devices in his book, The Book of Knowledge of Ingenious Mechanical Devices, including water wheel designs that rival designs of even the 21st century. He took a particular interest in pumping water to other regions, and because of this he created several "scooping" designs that were designed to employ buckets, cranks, and cogs to lift water up from rivers.

In 1753, French engineer Bernard Forest de Bélidor published Architecture Hydraulique which described vertical- and horizontal-axis hydraulic machines. By the late 19th century, the electric generator was developed and could now be coupled with hydraulics. The growing demand for the Industrial Revolution would drive development as well.

At the beginning of the Industrial Revolution in Britain, water was the main source of power for new inventions such as Richard Arkwright's water frame. Although the use of water power gave way to steam power in many of the larger mills and factories, it was still used during the 18th and 19th centuries for many smaller operations, such as driving the bellows in small blast furnaces and gristmills, such as those built at Saint Anthony Falls, which uses the 50-foot (15 m) drop in the Mississippi River.

In the 1830s, at the early peak in U.S. canal-building, hydropower provided the energy to transport barge traffic up and down steep hills using inclined plane railroads. As railroads overtook canals for transportation, canal systems were modified and developed into hydropower systems; the history of Lowell, Massachusetts is a classic example of commercial development and industrialization, built upon the availability of water power.

Technological advances had moved the open water wheel into an enclosed turbine or water motor. In 1848 James B. Francis, while working as head engineer of Lowell's Locks and Canals company, improved on these designs to create a turbine with 90% efficiency. He applied scientific principles and testing methods to the problem of turbine design. His mathematical and graphical calculation methods allowed confident design of high efficiency turbines to exactly match a site's specific flow conditions. The Francis reaction turbine is still in wide use today. In the 1870s, deriving from uses in the California mining industry, Lester Allan Pelton developed the high efficiency Pelton wheel impulse turbine, which utilized hydropower from the high head streams characteristic of the mountainous California interior.

The Chief Joseph Dam is a concrete gravity dam on the Columbia River, 2.4 km (1.5 mi) upriver from Bridgeport, Washington. The dam is 877 km (545 mi) upriver from the mouth of the Columbia at Astoria, Oregon. It is operated by the USACE Chief Joseph Dam Project Office, and the electricity is marketed by the Bonneville Power Administration (Fig. 10). Among sources of renewable energy, hydroelectric plants have the advantages of being long-lived (many existing plants have operated for more than 100 years). Also, hydroelectric plants are clean and have few emissions (Fig. 11).

Fig. 10 Chief Joseph Dam near Bridgeport, Washington, U.S., is a major run-of-the-river station without a sizeable reservoir

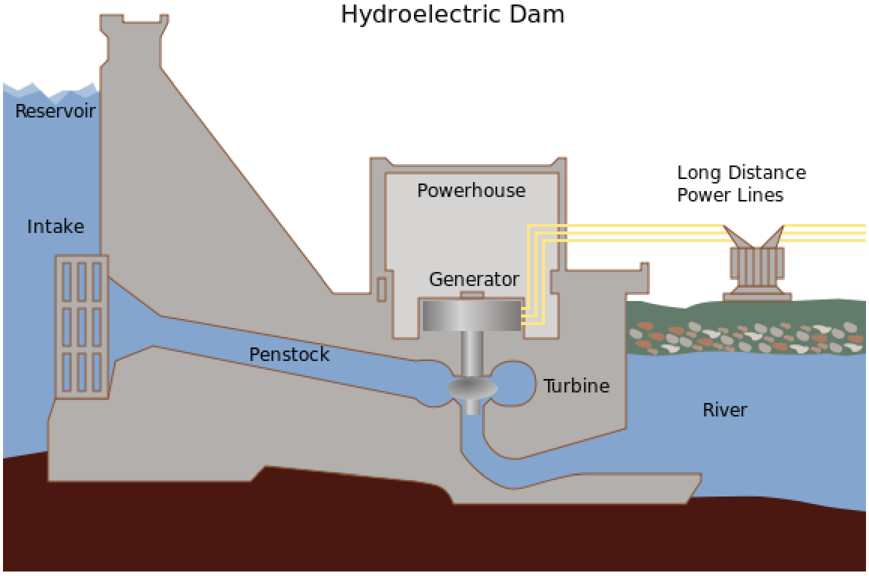
Source: https://en.wikipedia.org/wiki/Hydropower#/media/File:Chief_Joseph_Dam.jpg

Fig. 11 Hydroelectric plants

Source: Grand Coulee Dam.jpg

Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on the volume and on the difference in height between the source and the water's outflow. This height difference is called the head. A large pipe (the "penstock") delivers water from the reservoir to the turbine (Fig. 12-13).

Fig. 12 A conventional dammed-hydro facility (hydroelectric dam) is the most common type of hydroelectric power generation



Source: https://en.wikipedia.org/wiki/Hydropower#/media/File:Hydroelectric_dam.svg

Fig. 13 Turbine row at Los Nihuiles Power Station in Mendoza, Argentina

Source: https://en.wikipedia.org/wiki/Hydroelectricity#/media/File:Sala_de_turbinas.jpg

Run-of-the-river hydroelectric stations are those with small or no reservoir capacity, so that only the water coming from upstream is available for generation at that moment, and any oversupply must pass unused. A constant supply of water from a lake or existing reservoir upstream is a significant advantage in choosing sites for run-of-the-river. In the United States, run of the river hydropower could potentially provide 60,000 megawatts (80,000,000 hp) (about 13.7% of total use in 2011 if continuously available).

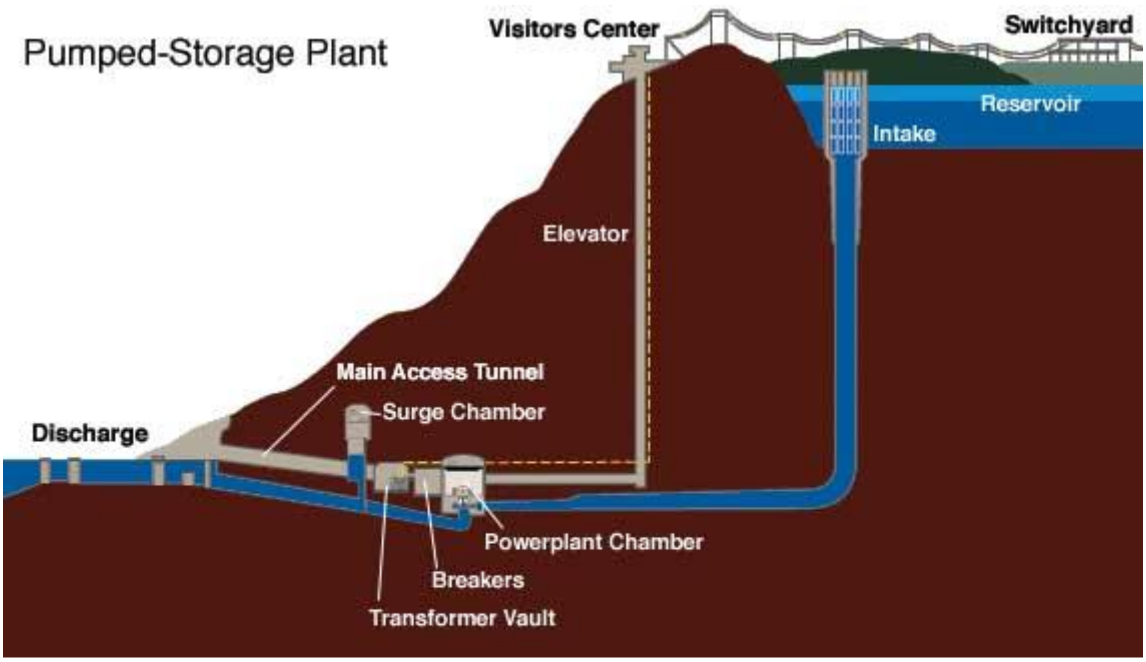
Pumped-storage

This method produces electricity to supply high peak demands by moving water between reservoirs at different elevations. At times of low electrical demand, the excess generation capacity is used to pump water into the higher reservoir.

When the demand becomes greater, water is released back into the lower reservoir through a turbine.

Pumped-storage schemes currently provide the most commercially important means of large-scale grid energy storage and improve the daily capacity factor of the generation system (Fig. 14).

Fig. 14 Diagram of the TVA pumped storage facility at Raccoon Mountain Pumped-Storage Plant



Source: https://en.wikipedia.org/wiki/Pumped-storage_hydroelectricity#/media/File:Pumpstor_racoon_mtn.jpg

Pumped storage is the largest-capacity form of grid energy storage available, and, as of March 2012, the Electric Power Research Institute (EPRI) reports that PSH accounts for more than

99% of bulk storage capacity worldwide, representing around 127,000 MW. Typically, the round-trip energy efficiency of PSH varies in practice between 70% and 80%, with some claiming up to 87%. The main disadvantage of PHS is the specialist nature of the site required, needing both geographical height and water availability. Suitable sites are therefore likely to be in hilly or mountainous regions, and potentially in areas of outstanding natural beauty, and therefore there are also social and ecological issues to overcome (Fig. 15).

Fig. 15 Pumped-storage hydroelectricity – the upper reservoir (Llyn Stwlan) and dam of the Ffestiniog Pumped Storage Scheme in north Wales. The lower power station has four water turbines which generate 360 MW of electricity within 60 seconds of the need arising

Source: https://en.wikipedia.org/wiki/Hydropower#/media/File:Stwlan.dam.jpg

At times of low electrical demand, excess generation capacity is used to pump water into the higher reservoir. When there is higher demand, water is released back into the lower reservoir through a turbine, generating electricity. Reversible turbine/generator assemblies act as pump and turbine (usually a Francis turbine design). Nearly all facilities use the height difference between two natural bodies of water or artificial reservoirs. Pure pumped-storage plants just shift the water between reservoirs, while the "pump-back" approach is a combination of pumped storage and conventional hydroelectric plants that use natural stream-flow. Plants that do not use pumped-storage are referred to as conventional hydroelectric plants; conventional hydroelectric plants that have significant storage capacity may be able to play a similar role in the electrical grid as pumped storage, by deferring output until needed.

Taking into account evaporation losses from the exposed water surface and conversion losses, energy recovery of 80% or more can be regained. The technique is currently the most cost-effective means of storing large amounts of electrical energy on an operating basis, but capital costs and the presence of appropriate geography are critical decision factors.

The relatively low energy density of pumped storage systems requires either a very large body of water or a large variation in height. For example, 1000 kilograms of water (1 cubic meter) at the top of a 100 meter tower has a potential energy of about 0.272 kW•h (capable of raising the temperature of the same amount of water by only 0.23 Celsius = 0.42 Fahrenheit). The only way to store a significant amount of energy is by having a large body of water located on a hill relatively near, but as high as possible above, a second body of water. In some places this occurs naturally, in others one or both bodies of water have been man-made. Projects in which both reservoirs are artificial and in which no natural waterways are involved are commonly referred to as "closed loop".

This system may be economical because it flattens out load variations on the power grid, permitting thermal power stations such as coal-fired plants and nuclear power plants that provide base-load electricity to continue operating at peak efficiency (Base load power plants), while reducing the need for "peaking" power plants that use the same fuels as many baseload thermal plants, gas and oil, but have been designed for flexibility rather than maximal thermal efficiency. However, capital costs for purpose-built hydrostorage are relatively high.

Along with energy management, pumped storage systems help control electrical network frequency and provide reserve generation. Thermal plants are much less able to respond to sudden changes in electrical demand, potentially causing frequency and voltage instability. Pumped storage plants, like other hydroelectric plants, can respond to load changes within seconds.

The upper reservoir (Llyn Stwlan) and dam of the Ffestiniog Pumped Storage Scheme in north Wales. The lower power station has four water turbines which generate 360 MW of electricity within 60 seconds of the need arising.

The first use of pumped storage was in the 1890s in Italy and Switzerland. In the 1930s reversible hydroelectric turbines became available. These turbines could operate as both turbine-generators and in reverse as electric motor driven pumps. The latest in large-scale engineering technology are variable speed machines for greater efficiency. These machines generate in synchronization with the network frequency, but operate asynchronously (independent of the network frequency) as motor-pumps.

The first use of pumped-storage in the United States was in 1930 by the Connecticut Electric and Power Company, using a large reservoir located near New Milford, Connecticut, pumping water from the Housatonic River to the storage reservoir 230 feet above.

The important use for pumped storage is to level the fluctuating output of intermittent energy sources. The pumped storage provides a load at times of high electricity output and low electricity demand, enabling additional system peak capacity. In certain jurisdictions, electricity prices may be close to zero or occasionally negative (Ontario in early September, 2006), on occasions that there is more electrical generation than load available to absorb it; although at present this is rarely due to wind alone, increased wind generation may increase the likelihood of such occurrences. It is particularly likely that pumped storage will become especially important as a balance for very large scale photovoltaic generation.

6. Using hydropower and pumped-storage together the wind power

Every day, the planet produces carbonic acid gas that's free to the earth's atmosphere and which is able to still be there in 100 years time. This augmented content of carbonic acid gas and increases the heat of our planet. One answer to heating is to exchange and retrofit current technologies with alternatives that have comparable or higher performance, however don't emit carbonic acid gas.

By 2050, minimum of one third of the global energy has to be came from stars (solar), wind, and different renewable resources. Who says that? Even "British Oil" and "Royal Dutch Shell" two of the world's largest oil corporations. Global climate changes, increment of planet population, and fuel depletion, mean that renewables ought to play an even bigger role within the future than they are doing it now (Pineda, 2016).

All new energies need to have no desagreable consequences such as for example the fossil fuels or nuclear energy. Real planetary alternative energy sources need to be renewable and are thought to be "free" energy sources. These need to have decreased carbon emissions, compared to conventional energy sources. It may be included: Biomass Energy, Wind Energy, Solar Energy, Geothermal Energy, Hydroelectric Energy, Tidal Energy, Wave Energy, (Petrescu and Petrescu, 2011, 2012; Petrescu et al., 2016 a-b).

Nuclear fission energy was virtually a necessary evil. With all its risks, he managed to stop the increasing of energy crisis of humanity until the advanced technology has allowed us the transition to alternative energy.

Nuclear fusion energy will be the most powerful energy source for mankind when it will be implemented (Petrescu and Petrescu, 2014). Although great advances have been made in this direction, the nuclear fusion power plants did not yet built. Because it is not known when they will be operative in large quantity, should be required to equip us in advance with green energy farms.

Most that are easy to be built and used now are the wind farms and the solar ones (Ramenah and Tanougast, 2016).

Their great technical problem is to have times when they produce less, or do not produce anything.

Hydropower was used since ancient times for many kinds of watermills or has been used as a renewable energy source to irrigation and to operate various mechanical devices (Sabău, 2015), (Sabău and Iovan, 2015).

A known method for produces energy (electric energy) for supply high energy demands is to moving and storing water between reservoirs at different elevations. This method is named pumped-storage.

At the times with low energy demand, the excess generation capacities are used to pump water into a reservoir upper positioned.

In the moments when the demand becomes greater, water is released back into a lower positioned reservoir by a turbine (see the Fig. 14; Petrescu et al., 2016a).

It can build such a hydropower plant in that area with the great advantage to be constantly supplied with water pumped even further by the surplus electricity generated by wind (that otherwise would be lost in vain).

For a better understanding of the ideas, we will present below, very briefly, special technical characteristics of a windmill (Dubău, 2015).

Electric power generated by wind is proportional to the cube of the wind speed.

A windmill is set to function optimally for a small or medium wind speed. If the speed of wind in the area increases 10 times for example, one single windmill will produce wind power such as a normal production given from the 1000 windmills (El-Naggar and Erlich, 2016).

Obviously, this surplus energy cannot be picked up by any electric network and is lost. There is thus a large amount of energy produced but not used. If this energy could be used to act the pumps which lift water to a storage energy system, it would solve two problems simultaneously. Once, it would use the extra energy produced, which is lost otherwise. Second would store energy, that is then used in periods of high consumption, or when the wind stops beating.

In other words, when wind energy is very high (when strong wind) energy production on coal and hydro are limited and even stopped temporarily. But the inverse problem (when not too windy and the demand is high from population and industry) is more difficult to solve.

Usually in such situations are utilized at maximum capacity all hydro and coal plants.

A more viable solution would be to introduce into a national power grid yet two nuclear fission reactors.

But another important solution would be the introduction of hydro energy storage systems, as it has already been described previously.

7. Conclusions

After 1950, began to appear nuclear fission plants. The fission energy was a necessary evil. In this mode it stretched the oil life, avoiding an energy crisis. Even so, the energy obtained from oil represents about 60% of all energy used. At this rate of use of oil, it will be consumed in about 60 years.

Today, the production of energy obtained by nuclear fusion is not yet perfect prepared. But time passes quickly. One must rush to implement of the additional sources of energy already known, but and find new energy sources. Green energy in 2010-2015 managed a spectacular growth worldwide of about 5%.

The most difficult obstacle met in worldwide was the inconstant green energy produced (especially the wind power).

A more viable solution would be to introduce into a national power grid yet two nuclear fission reactors.

But another important solution would be the introduction of hydro energy storage systems, as it has already been described previously.

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