

WORLD'S TOP MOST RENEWABLE POWER PROJECTS**K Ramesh**Department of Electrical & Electronics Engineering, Bapatla Engineering College Bapatla, India
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geethabec.nandur@gmail.com**Abstract**

Around the world renewable energy use is on the rise and these alternative energy sources could hold the key to combating climate change. Renewable energy is generated from sources that naturally replenish themselves and never run out. The most common sources are solar, wind, hydro, geothermal and biomass. Over 80 percent of the total energy consumed by humans is derived from fossil fuels however renewables are the fastest growing source of energy in the world. Renewable energy has many benefits. Huge amounts are being invested into green alternatives and new technologies that haven't yet been tested at scale all over the world. Fifteen passive renewable energy mega projects are presented in this paper.

Keywords: Renewable energy, solar, wind, hydroelectric, fossil fuel

1. Introduction

First it can combat climate change because it creates no direct greenhouse gas emissions, the only emissions that they produce are indirect meaning those that result from manufacturing parts installation operation and maintenance but even those are minimal [1]. Secondly renewable energy can decrease pollution and therefore reduce threats to our health. Wind, solar and hydroelectric systems create no air pollution emissions and geothermal and biomass energy systems emissions are much lower than non-renewable energy sources. Thirdly renewable energy is a reliable source of power because renewable energy sources are never run out once built. Renewable facilities cost very little to operate, and the fuel is often free as a result renewable energy prices tend to be stable over time. While renewable energy has many advantages it is not without downsides. It is difficult for renewable energy sources to generate power on the same large scale as fossil fuels [2]. Building wind farms and dams can disrupt wildlife and migration patterns and lead to ecological destruction. Both solar and wind energy are intermittent they only generate power while the sun is shining or while the wind is blowing batteries can store excess energy for later use however, they are often costly [3].

2. a) Pabla solar project

Pabla Solar Project, India. It is Located in Bhadla in the state of Rajasthan in India, the Pabla Solar Project Park is currently home to the largest solar farm in the world. The facility, which covers an area of around 17 square miles, is so arid and dry that is seen as being virtually on and habitable with temperature is usually ranging between 115- and 118-degrees Fahrenheit. So, we have almost

constant sunshine. It was a perfect place to produce solar energy built in 4 stages. The park officially reached the capacity in March in 2020 where it began producing over 2200 megawatts, which in comparison is around 25% more than the Hoover Dam is capable of generating despite costing an estimated. 1.3 billion dollars to build the fact that the fuel for the farm doesn't cost anything and there is a vast leaf blower maintenance requirement that had other power facilities. Because robots being responsible for keeping the panels clear [4]. This means that the energy produced there is also part cheaper than other options. It proves that in the right location solar energy is more than cost effective [5].

2. b) Geysers geothermal plant

The Geysers geothermal Power Plant, California. More than 12,000 years Native American tribes are going to have the magical qualities of the steam and hot waters that bubble from the ground and the Mayacamas Mountains in California and in the 19th century. The early 20th century saw a new opportunity develop, however [6]. The owners of one of the resorts built in geothermal plant in 1921 to power their lights and the region is now make up the largest geothermal field in the world. Taking advantage of the huge source of heat that comes from a large magnet cheaper, that's around 4 miles between the surface. There are no more than 350 different wells and a 30 square mile area. Combined they provide around 60% of the power to man for the coastal region between the Golden Gate Bridge and the Oregon State line and with an annual output of over 6500 gigawatt hours. 20% of the total renewable energy that is produced in all of California [7]. Again, this is the type of renewable energy project that is only possible in rare situations and shows how much future energy

fulfilment will vary from place to place depending on the geography of the area. There is also concern about how far the wells that the Geysers are pushing their capacity. Because in order to generate energy, water is injected into the underground cavities, the speed shown to be responsible for regular minor earthquakes that are recorded in the mountains [8].

2. c) See Sihwa lake Tidal Power Station

This involves the installation of 1025 megawatts of merged bulk turbines, which are driven by the incoming tide and an estimated cost of 560 million dollars. Its official installed capacity is 254 megawatts. Yearly output is 552 gigawatt hours. This makes it by far the largest tidal power station on Earth and it's an added bonus that the construction is improving the environment at the same time. Of course, in the grand scheme of things this isn't a huge amount of power in comparison to other energy sources, but it's not that the more tidal stations like this that are built, the more technology will improve to one day make it far more viable [9].

2. d) Australia Asia Power link

All the various renewable energy mega projects of Australia Asia Power link are currently in the design phase. Most ambitious is the Australia Asia power plant, planned to be completed by 2027. The idea is to use a large land on an uninhabited and sunny region of Australia to produce electricity that will be transported for use in Singapore. Each stage of the project represents a huge undertaking from the 30,000 acres of Photo voltaic modules that will be installed in Australia, Northern Territory to a huge battery array that will be built to provide load balancing because of the varying levels of electricity produced as levels of sunlight change [10]. And not to mention the world's longest undersea power line to take it to Singapore which at 300 miles is around 5 times longer than any other. In 2015, 95% of Singapore's energy came from natural gas. This is just the beginning of mega projects that will be needed in the region to fully move away from fossil fuels, but it shows how ingenious solutions can overcome virtually any hurdles [11].

3. a) The Alta Wind Energy Center

The Wind Farm is currently ranked as the 3rd largest onshore wind power project on the planet. Located within the Tehachapi Pass of the Tehachapi Mountains in California, the development covers an area of just over 50 square miles, and it's made up of 600 Vestas wind turbines. Commissioned in 2010 with an estimated cost of 2.9 billion dollars, it's now more than double the original plant size

because of how successful it improved to be and it has a capacity of about 1550 megawatts with an average annual production of 3100 gigawatt hours [12]. Windspeeds and their construction didn't affect any other activities too much, which made it the ideal location for a farm like this. Currently it is by far the largest such project in the whole of the United States, and its being seen as a blueprint for how initiatives like this can be run effectively, with several plans to reproduce it elsewhere in the country [13].

3. b) Quaid-e-Azam Solar Park

With an average and mostly sunny climate of the Punjab, province of Pakistan is an ideal place that leveraged solar power and that's why it was chosen as the site of the country's newest energy facility that went complete is expected to have a production capacity of 1000 megawatt hours named the Career Azam Solar Park in honour of the man who founded Pakistan. The 6500 acre plot of land was set aside for the venture, with the plant being that the government would invest the initial 130 million dollars needed to complete their first phase in order to attract private investment for the subsequent ones. This pilot stage was completed in 2015 and with the capacity of 100 megawatt hours it has the installation of almost 400,000 solar modules. Over 100 acres seen as an undoubted success, this has already been expanded to a capacity of 400 megawatts. It is to be fully completed within the next decade [14]. If it is, it will easily be one of the largest solar energy production facilities on Earth and will have the same output as one of the nuclear reactors at the Virginian Sea summer power station in North Carolina. Three Gorges Dam, China is one of the widest points of the Yangtze river near to the town of Sandouping and the Hubei Province of China, the Three Gorges Dam is currently the largest power station on the planet. Surprisingly, it was built there not just because of how effective would be a generating power. Because the river used to be prone to extreme flooding, and the result has been a much more productive agricultural industry downstream, as well as the creation of a more stable shipping route along the entirety of the river. The first idea of a dam crossing the river and that location was suggested back in 1919 [15]. That survey of this took place in the late 30s and 40's. Due to lack of funds, attention was focused elsewhere for several decades, but construction finally began in 1994 that was fully completed by 2015. The dam itself is made from concrete steel. And almost 3700 feet

wide and enables water to constantly flow over the 34 main generators that have a total combined production capacity of 22,000 megawatts. To put this into perspective, the largest power station in the US is the Grand Coulee gravity. Washington and its maximum capacity is less than a 3rd of what the Three Gorges Dam can produce.

3.c) The International Thermonuclear Experimental Reactor

One of the problems with producing huge amounts of electricity from renewable means huge amount of space that's needed to replace a power generator with solar panels or wind farms. The most efficient means of energy production that we know of is the process that takes place in the center of the sun, which is known as nuclear fusion. And an international coalition is trying to make this reality on Earth too. It is one of the most ambitious and complicated engineering projects of all time and by far the most expensive science experiment ever conceived and an estimated cost of around 55 billion dollars. The rewards could be life changing if the entire shows nuclear fusion to be possible in a contained. Solve the problem of our ever increasing need for clean energy. Work began in 2010 and its currently 75% completed and expected to be switched on in 2025 and full fusion power with everything goes to plan taking place by 2035 [16]. The reactor itself will use deuterium and tritium as its fuel. The plasma that's created will be controlled by magnets. The vacuum vessel designed to contain all of this will weigh almost 5500 tonnes more, being 64 feet diameter.

4. a) The Topaz Flower Farm, California

To keep up with California's initiative to leave the way with the introduction of renewable energy, it's perhaps no surprise that this state is also home to one of the world's largest solar farms, first conceived in 2009. Construction began in 2011. Incredibly, the project uses a combined total of 9,000,000 cadmium Telluride photovoltaic panels, with 1,000,000 being installed every 5 months. Designed to generate power during the middle of the day at a time when it is most needed add most valuable, the farm began providing energy. And was fully operational by 2014. Now it has the production capacity of 550 megawatts and by the time it was finished it was estimated that the entire project cost 2 billion dollars [17]. There are however longer term concerns about the viability of the Topaz Solar farm. Because of the way that the power market works and mean that works share

half the way, Energy, which is the company that operates in, essentially receives all of its revenue from just one customer, the Pacific Gas and Electric Company.

4. b) Dogger Bank, Northeast England

The UK is committed to delivering the vast majority of energy from where Photo means by the end of the decade, but with so little reliable sunlight that made resources and take advantage of Here is the wind. The country now has completed wind farms on land and in coastal regions. But there is one project that is currently underway that's not a whole different level. As Dogger Bank costing around 15 billion dollars, it will become the world's largest offshore wind farm that some of the states are almost unbelievable. It's been built between 78 and 100 miles off the north eastern coast, where the water is unusually shallow, which allows for fixed foundation turbines to be installed split into force separate forms. When it's finally complete, there will be around 313 megawatt turbines and total, which will give the entire development at the identical maximum output of 3.6 Gigawatts due to their location there at the same concerns of their visual impact as there on land [18]. This means these turbines are supersized and blades that are 721 feet long. Amazingly, one spin of these would be enough to power an average home for 2 days, but the whole project is expected to generate power for as many as 6,000,000 for 5% of the countries total requirement.

4. c) Moss Landing energy storage facility

One of the biggest challenges that energy providers will face as we rely more on renewable energy which maintain a regular supply of electricity. Solar panels will obviously only be useful during the day, while wind turbines rely on weather systems, so this is going to need to be in excess capacity built into this system. The way to store that extra energy that is produced in the productive times that could be released when demand exceeds supply. California is again leading the way in the United States for the installation of storage battery technology like this and the most. This mega project is making use of existing turbine buildings and interconnecting units that integrate with the grid, split into a number of different phases [19]. The first phase began operating in 2020 to give a capacity of 300 megawatts. The plan is to expand the racks of lithium ion power cells to be able to store up to 1500 megawatts, something that is

already better proved but will likely take many years to fully realise.

5. a) Mohammed bin Rashid Al Maktoum Solar Park

Despite driving so much wealth from the sale of oil to buy, is investing hugely into the development of alternative fuels and technologies, and a large part of this initiative has been the construction of the Mohammed bin Rashid Al Maktoum Solar Park. 31 miles to the South of Dubai covers an area of around 30 square miles, is one of the biggest renewable mega projects to have ever been undertaken and is expected when finished to have a maximum capacity of 3000 megawatts. Rather than relying on one type of way to harness solar energy, the solar park is instead using two types. The first is the more traditional photovoltaic panels, with at least 2.5 million of them being installed across board different stages [20]. And the other approach is the technique called concentrating solar power, whereby mirrors and lenses are used to concentrate the sun's rays onto East Central receiver and converted to heat that is used to drive a turbine. The final stages of the park are still under construction. But it's also proved out, cheap energy and produces actually it is claimed to be 20% lower than any other unsubsidised power purchase agreement ever signed.

5.b) Grand Inga Hydroelectric Project, Democratic Republic of the Congo

The Congo River, which is the second largest river in the world when measured by discharge volume, has an enormous basin which represents around 13% of the total land mass of Africa and runs from the mountains of the East African to the Atlantic Coast. It's the only river in the world that crosses the equator twice, and it's also rare in the way that its huge flow is almost constant, there is always a rainy season feeding into it from either side of the equator. This makes it the ideal river to build a series of hydroelectric power stations, and the Grand Inga hydroelectric project will see a series of dams. Being built along with 7 generating stations, which is around 140 miles upstream. In petrol cost an estimated 80 billion dollars to complete. This means that each generating station could well be owned and operated by different companies or nations, but it would undoubtedly become a complete game changer in the region. If the feasibility studies proved to be correct, the final output of this project could be 70 gigawatts,

making it easily the largest power station on the planet by a considerable distance [21].

5.c) Gansu wind farm, China: Despite being known for continuing to build fossil fuel based power plants, China is also investing heavily into renewable sources too, and the largest mega project currently under construction is the Gansu wind. Desert is one of the most consistently windy places on land anywhere in the world. The Plant with 18 Wind farms, which will be operated from Central Control Center when complete, will be able to generate as much as 20 gigawatts, which will not only with the largest wind farm on Earth, but also one of the biggest power plants of any type. The full project has been split up into several stages. Work began in 2009. There are already at least 6000 turbines installed which have a current combined capacity of around 8 gigawatts and the government hopes that it will be fully finished by the end of the decade. There is a lack of infrastructure to transport the energy from where it is being created to where it can be used, so a lot of it is going to waste. It's a similar problem to what's happening in the United States and elsewhere, where the national grids are designed to carry huge amounts of power from the most effective renewable sites to where it is needed. This will take huge investments in the coming years.

6. Noor Ouarzazate Solar Complex, Morocco

It is located approximately 6.5 miles from the town of Mozart in Morocco. The Solar Complex began construction in 2013 and at this 3 of the 4 plant stages have been completed. With a generating capacity of 510 megawatts, it's already the world's largest concentrated solar power plant. It is covering an area of over 6000 acres. It's able to continue producing electricity for up to 8 hours without any actual sunlight [22]. The current production from the site is enough to power the city, which makes the 2.5 million dollars. As facilities like this become cheaper to build than technology is proven to be effective, this is likely going to become a regular site across the sun of the regions of the planet in the decades to come.

7. Conclusion

Renewable energy presents some challenges. It offers an environmentally friendly alternative to the greenhouse gas emissions and pollution of fossil fuels and as advances in technology make renewable energy more accessible affordable and efficient and end to climate change could be within our reach.

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