

Customization of wind-solar hybrid power generation system in Cuba

How can solar and wind power improve energy security in Cuba?

Every time solar and wind capacity is progressively increased, Cuban authorities will save on fuel costs and achieve environmental improvements and energy security. The money saved could be gradually reinvested in new solar and wind power installations.

What types of energy systems are covered in Cuba?

Coverage includes generation and storage systems, renewable energy installations (hydropower, solar PV, wind, biomass, ocean, and solar thermal), electrical grid history and characteristics, and an analysis of Cuba's electrical energy resiliency.

What is a hybrid solar-wind energy system?

By combining solar and wind energy, the system aims to optimize power generation and distribution, ensuring a stable and sustainable energy supply for the community. The proposed system integrates a hybrid solar-wind configuration to power the entire setup efficiently.

Will solar and wind improve Cuba's climate?

These scenarios were compared with the official projection of the Cuban government for 2030 showing that the introduction of solar and wind improve the situation of the island by reducing CO₂ emissions, improving air quality, and generating economic benefits.

Is energy transition possible in Cuba 2030?

The shift demand from fuels to electricity in transport and industry is necessary to enhance energy security. This study evaluated the possibilities of energy transition in Cuba 2030. Cuba is currently in a vulnerable energy situation since it strongly depends on the importation of fossil energy.

How much solar energy does Cuba have?

Due to its geographical location in the tropical latitude, the country is extremely well endowed with solar energy. Studies on climate conditions provide confirmatory evidence of around 2 800 sunshine hours (32% of utilization factor) annually. The daily average solar energy that reaches Cuban land throughout the year is 5 kWh/m².

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Rahman et al. [7] gave the feasibility study of Photovoltaic (PV)-Fuel cell hybrid energy system considering difficulty in the use of PV and provide new avenues for the fuel cell technology. A photovoltaic system uses

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photovoltaic cells to directly convert sunlight into electricity and the fuel cell converts the chemical energy into electricity through a chemical ...

Solar and wind are the most promising renewable energy ventures in Cuba, but biomass, hydropower, and ocean energy are also being considered. Bagasse (sugar extraction dry pulp residue) is an important source of biomass for renewable energy generation in Cuba but has declined with the sugar industry. Cuba intends to allocate \$3.5 billion for developing ...

Renewable resources like the sun, wind, biomass, hydropower, geothermal energy, and ocean resources can all be technologically used to produce clean energy. Despite producing significantly less energy than fossil fuels, solar and wind power have grown rapidly in recent years thanks to the use of PV cells and wind turbines. The solar-wind hybrid power system, which uses both ...

Since the late 1980s, the growth of wind energy has visibly reduced in the US, while it continues to grow in Europe due to sudden awareness and alertness on the need for urgent environmental response to various research indicating changes to global climate if the use of fossil fuels arises at that rate [7]. Today, wind-powered generators operate in every size, which ...

A hybrid renewable energy source (HRES) consists of two or more renewable energy sources, such as wind turbines and photovoltaic systems, utilized together to provide increased system efficiency and improved stability in energy supply ...

If you want to go completely off the grid, the cost of using a stand-alone wind turbine system will be much higher than a hybrid wind-solar system. A more economical approach is a 3:1 ratio. For example, a 3kw wind-solar hybrid ...

In December 2022, with the incorporation of two new mobile floating Turkish power plants in Havana Bay, [iii] along with a 17% reduction in average demand, the frequency and duration of power outages has been reduced. Natural Gas. The substitution of liquefied natural gas (LNG) for the highly polluting oil with a high sulfur content, as a fuel in base-load ...

implementation of a Solar-Wind Hybrid System Generation. The hybrid system harnesses the complementary strengths of solar and wind energy, aiming to achieve a more reliable and consistent power supply. The design phase involves the integration of photovoltaic panels and wind turbines into a cohesive and efficient system.

How Does The Hybrid Solar Wind System Work? Solar wind hybrid systems are needed to generate electricity during the summer and winter seasons. The variation in the intensity of sunlight and wind speed throughout the year does not organically affect the working of hybrid solar wind systems. It can produce power at any time of the year.

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The efficiency (η_{PV}) of a solar PV system, indicating the ratio of converted solar energy into electrical energy, can be calculated using equation [10]:
$$\eta_{PV} = \frac{P_{max}}{P_{inc}}$$
 where P_{max} is the maximum power output of the solar panel and P_{inc} is the incoming solar power. Efficiency can be influenced by factors like temperature, solar ...

Since the uncertainty of HRES can be reduced further by including an energy storage system, this paper presents several hybrid energy storage system coupling technologies, highlighting their major advantages and disadvantages. ...

Earlier only two sources are used of hybrid power generation (solar-wind). In this we are adding one more source of energy power generation (solar-wind-hydro). 2. HYBRID ENERGY SYSTEM The combination two or more energy sources which generates the electricity is known as hybrid power generation system.

Energy storage solutions, such as batteries and pumped hydro storage, can help mitigate the impact of fluctuations in solar energy generation by storing excess power for use during periods of low sunlight [9, 10]. ... a hybrid solar-wind power system was designed and simulated to address power quality issues in a domestic grid application. The ...

Renewable energy integration has attracted widespread attention due to its zero fuel cost, cleanliness, availability, and ease of installation. Among various renewable energy sources, photovoltaic (PV) and wind turbines (WT) have become very attractive due to the abundant local availability in nature, technological progress, and economic benefits. The hybrid combination ...

2020). One strategy to increase wind and solar photovoltaic (PV) deployment is through the co-location of wind and solar PV plants to form a single hybrid power plant. By building wind and solar PV in the same location, hybrid plants have the potential to reduce transmission infrastructure costs

The total energy efficiency η_{bat} of the battery is the ratio of the energy obtained during discharging process to that required to restore it to its original condition, and can be expressed by Jossen et al. [10]:
$$\eta_{bat} = \frac{W_{out}}{W_{in}} \times 100 \%$$
 Calculated from the one-year field data of the hybrid solar-wind power generation project ...

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