

# A wind diesel system

Business



**Abstract** This is description of the technical and economic design employed to choose a hybrid wind-diesel power system as a self-sufficient energy supply for isolated communities. The project is to be executed with the intention of wholly meeting the energy needs of a small and isolated village, at the same time as decreasing fuel consumption and carbon emissions.

The focus is on the decisions made and lessons learned during the execution of the hybrid system project. The project presents a practical model for the supply of renewable energy to a remote community with no external electricity supply. The paper proves that low-carbon emissions mean addition cost in the poor supply system. The project also aims to solve other relevant energy related problems like availability of clean water, storage for products and drainage system of the isolated community. The aim of this project is to demonstrate how planning, design and development of a small, isolated community can be incorporated into the provision of sustainable energy.

Local authorities, investors, developers, and leaders in the public and private domains could copy the project. It promotes prospects for sustainable energy and takes into consideration the role of the planning system and communities. **Introduction** Energy is the major driving forces that inspire the development and advancement of a community. Isolated communities are faced with a double energy problem in the 21st century (Mostert, 2008)). The first is satisfying the requirements of its population who are lacking in access to basic, modern energy services while the second is at the same time taking part in a worldwide shift to clean, low-carbon emitting energy systems.

Both facets of this challenge require urgent solution. The first challenge is urgent since access to dependable, inexpensive, and socially suitable energy services is a precondition to alleviating severe poverty and achieving development goals. The second problem also poses a challenge; it needs an urgent solution carbon emissions from the less developed nations is on the rise. This is causing an increasing environmental harm, like climatic changes and air pollution that gravely risk the health and prosperity of people, particularly those in poor countries (Barnes, 2007). In this context, it is imperative to reduce the dependence on external energy supplies.

Consequently, this will cut down the environmental problems that result from the production and consumption of energy. At the same time, communities aim to realize higher economic development and creation of jobs. To achieve this we decided to employ the use of renewable energy, with the objective that such supplies will provide a significant percentage of the community with sufficient and sustainable energy. Energy is imperative in every economy; additionally, it plays an important part in the development of geographically isolated or remote regions and the sparsely populated countryside. Such areas often have to deal with the technical or economic challenge of linking with the usual energy supply lines.

These challenges, in addition to the effects of using fossil fuels such as acid rain, greenhouse effect, and ozone weakening among other effects, necessitate the choice of renewable energy source. This is an explanation of the method used in the configuration of a self-reliant wind-diesel. The system is set up for an isolated community in a model small island society. The objective is that the system be an example of a descriptive illustration of <https://assignbuster.com/a-wind-diesel-system/>

how a system powered by wind and diesel can wholly supply the energy demands of an isolated community. Aims and objectives The model island is 1, 731 square kilometers in size with an extended contour (approx.

100 km long by 20 km wide) and has a southwestern extension. The members of this community are a small population, whose main activity is fishing. They are without energy resources or clean drinking water. It is linked to a suburban and a tourist resort area by a 20 km long, meandering dirt road. The community is home to about 80 residents even though the municipal allows the area to house 450 of inhabitants in the summer and 500 day guests. The community catches fish near the coast.

They use typically small wooden boats that are less than 10 meters long. These boats are used on almost all family type economies and they are adopted in a wide-ranging area in the fishing communities. Considering the socioeconomic state of affairs in the area and the fact that steady and strong winds are occasioned, this system is viable. The project aim is two-tiered. On a broad level, the aim is to show that a renewable, clean and self-regulating source of energy could meet the need for a community to be independent, an appropriate quality of life, and a clean and unpolluted environment. On a local level, the objective is to maintain the area as protected natural scenery, by limiting the energy supply (by providing energy only to the small number of residents).

Work to be carried out The following wide-ranging operations will be carried out: The village is to be overhauled to recondition the homes, lanes, and pavements. It is to be provided with the entire requisite infrastructure i. e.

household and public lighting, clean water supply, and drainage system fitting. All work will be done with the utmost regard to the original setting of the area i.

e. sandy and unpaved lanes and hidden supply mains. The actual installations will be set up close to the village architecturally respecting the natural landscape and satisfying energy needs of the society. Various equipments will be installed, they include: a wind-driven generator to change wind energy to electrical power, back-up diesel generators for use in the absence of wind, a plant to desalinate sea-water, a reservoir for the storage and circulation of clean water, a refrigerating compartment for fish, and ice-making plant for the moving of the fish to points of sale, a crank for beaching vessels, and sewage works. Methodology Used In Measuring the System In order to determine the suitable wind-diesel system requisite to take care of the energy burden of the community, three basic criteria were taken into consideration: Due to the nature of the project, the intention is to reduce the use of the diesel generator. This would lessen the consumption of fuel, lower carbon emissions, and ensure use of renewable energy most times.

A major challenge facing the community is inadequate fresh water supply. The paucity of water, which is required to cover the need of the local people and their guests, has meant that the islands' population had to put massive effort into extracting water from the underground, storing it, transporting it and recycle it. This, in addition to the consequential high-energy use, has made the islanders extremely sensitive to the question of water. Because of this consciousness, one of the main concerns of the project is to produce all the clean water necessary for the population by using electric power from <https://assignbuster.com/a-wind-diesel-system/>

the wind energy. The project requires customization; this will ensure that it remains within the budget proposal. Five business wind-driven generators with an ostensible power of between 150 and 250 kW will be examined technically with the aim of meeting the above objectives.

The generators are Danwind 26/250 (D), Bonus 150/30 (B), WindMaster 200 (W), Vestas 225 (V), and Micon 250 (M). The energy production potential of each will be computed. The energy 'E' generated by each Wind Energy Conversion System (WECS) average will be determined. The numbers were added up from the hourly-wind power that was calculated from the speed of wind data P (V) curve that is characteristic of every WECS. Secondly, seasonal patterns of the wind in the locality will be considered, and the demand patterns for filtered water.

Several hypotheses will be examined to determine the system required to address the estimated water needs. This is based on the assumption that the WECS and the supplementary diesel generator would be able to generate the electrical energy to power the desalination plant in the circumstances projected. Thirdly, inverse osmosis was selected from the various desalination systems feasible as it adapted pretty well to the need of low production, low consumption, and quality of available water. Additionally, it reduced working time and boosted a broad use of the existing technology on the island among others significant resources. The capability of the desalination plant will be dependent on the working hypothesis being considered.

There is a range of technical conclusions from the probable combinations among the five WECS and several hypotheses for desalination. The selected wind-driven generator should adequately cover the average monthly power demand. Additionally, it is anticipated that the generators will adequately satisfy the energy demand during the energy peak seasons in July and August. The average everyday variation in produced power should be higher than the daily normal demand. Once the system has been chosen, the osmosis plant should be set to commence working in July each year, when the level of clean water stocked up in the tank has reached its lowest reserve level, considered as the equal of 15 days consumption volume.

It would run until August, by which time adequate water would have collected in the storage cistern to cover demand until the start of July the next year. The basic criterion to be used in selecting the diesel generators is guaranteeing a hundred percent quality of life in terms of energy and water. For that reason, the diesel generators ought to be able to guarantee supply in periods of peak energy demand. From projected demand, a minimum of 27.7 kW will be required during various months, a peak of 48.

4kW in Easter week, with the highest demand in summer (99.7 kW). Thus, the solution is to have two parallel generators on hand running; one generator should have a capacity of producing 40 kW and the other a capacity of 60 kW. The 40-kW generator will cover the demand for all days apart from Easter week and the summer. The 60-kW generator, alone, will take care of the Easter demand, while the unfeasibility of the wind-driven generator use in the summer (July and August) would be covered with both generators operating at once.

Economic study Majority of studies of the worth of wind power or solar-electric power have employed a life-cycle model to get the breakeven cost (March, 1982); others have computed the averaged cost (Lindley, 1977; Asmussen et al., 1975; Lindquist et al., 1976). In order to undertake an economic assessment of the electrical energy generating system as well as clean water production system, a method that utilizes the principles that are applied in the life cycle costing, will be used. First, costs will be assessed in reference to the year of setting up (year 0), the electricity generating systems (wind-diesel), will be expressed in dollars per kWh generated and that of water production and storage, expressed in dollars per meter squared of water filtered and stored.

The energy costs for year one will be dependent a great deal on the cost of maintenance. Thus, the rigidity of the soaring cost of investment and maintenance of this design of the project must be kept in mind. In order to calculate the profitability of the design project, in relation to energy and water prices, a calculation of the Internal Rate of Return (IRR), Accumulated Present Value (APV) and the Pay-back Period (PBP) inclusive of states' tax rates on profits is done.

Description of the Hybrid System and Equipment  
Installed Location of the " Power Complex" The site earmarked for the wind-diesel set up, christened the " power Complex," is situated on a side of the village adjacent to the boats' harboring ramp. This site was settled upon due to its appropriateness as a site free of barriers that could obstruct the winds. It is also placed adequately, far away from the residential areas to avoid the diesel generators and the wind-powered generator noise disturbances.



The site is envisaged as enclosed and spherical in shape, inside, which will be, housed the wind-driven generator, the diesel generator room, the control room, the water plant, the cold storage compartment and the ice plant. The site has a passageway in the middle from which all installation can be accessed, hence making feasible educational tours to the complex. The single installation, not inside the power complex and at the Converseside of the beach village, is the sewage treatment plant. This is a precaution in case there is damage to the plant then the wind will blow the foul smells away from the residential area.

**An Explanation of the Installations Wind-Driven Generator** The wind-driven generator projected to be appropriate is a Vestas-27, manufactured in Holland, but with a local authorized supplier. It is to be set up at the northern end to ensure it is free of obstacles to the winds from the North and Northeast. The Vestas-27 boasts two induction type generators with 6 and 8 poles. The power is regulated by the use of three blades with changeable pitch positioned at 30 meters high. **Diesel Generators** Although it was shown to be convenient to install two diesel generators of 40 kW and 60 kW, purchase of two matching diesel generators of 60kW at 1, 500 rpm would be more cost effective. This alteration would signify a 28.

7% rise in fuel use when compared to the approximation originally made for the 40 kW and 60 kW generators. It would also increase the cost of water and energy. Both generators have a 75 kVA synchronous device that is attached to a flywheel. The flywheel is in turn linked by a clutch to the diesel motor. Every flywheel, at 1, 200 kg/m<sup>2</sup>, delivers half the peak power demand, i. e.

<https://assignbuster.com/a-wind-diesel-system/>

100 kW, for roughly half a minute, with no falling of the frequency to the allowed levels of 48 Hz. Desalination Plant To achieve a sum flow of 56m<sup>3</sup> a day with atypical power utilization of a 7 kWh/m<sup>3</sup> single phase plant is to be set up. The plant consists of a pressure hose with six 8-inch volute rolled smented polyamide membranes in succession. A submersible perpendicular centrifugal pump is installed at various stages. The pump, pumps water at a flow rate of 111 liters per minute; the water is pumped at 0.

3 MPa of pressure. A semi-buried cistern was designed and created next to the beaching ramp to stock up water filtered in periods of peak wind frequency and intensity. Freezer and Ice-producing Plant For the provision of refrigeration of fish, a 1, 200 kg per day cold storeroom chamber and a 490 kg per day ice-producing machine were installed. These two are housed in a 36m<sup>2</sup> building positioned in the southern part of the complex. There is a spacious path to permit vehicles to move in for loading and unloading.

Dump load When the power generated by the WECS outstrips the demand, and hence the diesel motors are not in operation, the WECS control mechanism normalizes the power produced by activating the blades turning system. Still, a dump load and the inertia flywheels are jointly necessary to sustain the dynamic stability i. e. to waste the momentary power overload. The energy installed in dump loads i.

e. resistance blocks, so as to sustain the allowed limits (48-51 Hz) is 100 kW separated into dump loads that vary from 390 W to 50 kW. A small building with a forced draught is constructed on the western area of the complex to house these dump loads. Main Control System The illustrated wind-diesel

system would never function in an optimal environment without a central control mechanism to measure, order, and control the whole power complex. This central mechanism is made up of an industrial type PC, the monitor of which allows, via a specifically designed software, real time surveillance of the system in operation. Together with the central control system, in hand are localized control mechanisms in the wind driven generator, desalination and in the diesel generators.

These mechanisms collect and escalate the signals to the central control mechanism (Linguist and Malver, 1976). Likely problems The first probable problem that could be faced is that the population growth projections might turn out to be incorrect. This may cause under consumption of the water and energy if the population remains the same or if it goes down, hence underutilization. It may conversely cause over consumption if the estimates for population growth are surpassed. The political and administrative problems, such as changes in administration, may force the project to provide water and electricity free of charge to a few members of the community.

This would be discriminatory to the rest of the islanders. Conclusions The wind-diesel system as illustrated here would significantly better the life of the community. It would be crucial to the community by supplying the services needed by the community. Even though a diesel-only alternative would be more cost-effective than the hybrid system (a hybrid system requires more investment and high working costs), it would not be sustainable due to the endeavors of reducing carbon emissions. A drop in carbon emissions results into extra costs.

<https://assignbuster.com/a-wind-diesel-system/>

In the near future, numerous clean and sustainable energy sources are expected to remain more costly than their traditional counterparts. Even when they are cost-effective (as is already the situation for most efficient sources), spectacular market failures, and obstacles regularly hinder them. Changing the motivations and surmounting those obstacles is today more a problem of political spirit and management than it is of ample resources, at least globally. Comparatively soaring investments are necessary in the hybrid mechanism to warrant that both the traditional and the wind power mechanisms are capable of covering peak energy demands i. e. utmost dependability.

Additionally, costly maintenance will result from a range of factors that include geographical remoteness of the area, the features of the system, and the shortage of companies in the island that can carry out the maintenance. It is of the essence that, in these types of projects, a thorough study be undertaken in advance for all factors like consumer profiles, investment and maintenance costs and wind data, as miscalculations in such statistics are capable of having extensive procedural and fiscal consequences. For a successful and effective energy supply in isolated communities, the set up must incorporate extensive training of local personnel in maintenance of the energy equipments. This will be an effective way of reducing maintenance cost of the equipments. The long-term sustainability of remote area power supply or off-grid electrification is dependent on more than new technology. It entails efficient setting of priorities and preparation to facilitate economical selection of technology, suitable infrastructure to make sure that services

are offered over the long run, and sustainable funding to make these capital-intensive technologies inexpensive.