Small-Scale Wind Turbines for Water Pumping and Electricity Generation, Egypt

Themes

★ Renewable energy
✲ Innovative technology applications
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Design and Manufacture of Small-Scale Wind Turbines for Water Pumping and Electrification; Design and Manufacturing of Wind Turbines for Electricity Generation
Implementing Organization: Egyptian Solar Energy Society (NGO)
Location: rural Egypt
SGP contribution: $28,000 (irrigation); $22,000 (electricity)
Start Date: September 1995 (irrigation); December 2000 (electricity generation)

ENERGY OVERVIEW

Energy Resource: wind, wind/solar hybrid
Technology: wind turbine that pumps water; wind/solar hybrid that generates electricity
Application: water pumping for irrigation and/or drinking; electricity for lighting, refrigeration and TV
Sector: agricultural,domestic
Cost per system: $2,500 per wind turbine to pump water; $4,000 per wind turbine to generate electricity
Power provided: turbines pump from between 700 and 9800 liters of water per hour at local average wind speed; 300-560 kWh/month, depending upon average wind speed
Number Served: 6 wind pumps installed in 6 villages, serving an unknown number of households;2 turbines generating electricity for 10 households (70 people)

BACKGROUND

Water access is a critical need in rural Egypt today.The Egyptian economy depends highly upon agricultural production, which accounts for over 15% of its GDP. Water is essential for agriculture, but these villages involved in this project do not receive sufficient water from the Nile. Diesel fuel was being used to pump water out of the ground.Because these communities are remote and transporting diesel fuel is costly, wind power can be an economical option.

Overall, Egypt has fairly good electricity access rates – an estimated 94% of the population has access to electricity – but this still leaves an estimated 4 million Egyptians, mostly living in remote areas, without access.Wind energy could be an effective way to provide electricity in areas that may not receive grid connection any time soon.

Wind energy for water pumping and electricity generation (Egypt).

PROJECT DESCRIPTION

Overview

These two projects,implemented by the Egyptian Solar Energy Society (ESES), involve the use of wind energy to meet water access and electricity needs.The goal is to build several turbines for small-scale use to demonstrate and refine the technology, and eventually to lower the cost of technology for larger-scale use. According to one report, the first project, which focused on designing, manufacturing and installing wind turbines to pump water, was successful in achieving lower costs of construction, and for this reason the second grant was made for designing and installing turbines for electricity generation.

Implementation

Wind energy for water pumping:The first project, carried out from September 1995 to September 1997,was resulted in the design and manufacture of four small-scale wind turbines for water pumping.The Egyptian Solar Energy Society, worked with the Arab Manufacturing Authority, the largest manufacturing company in Egypt, to design and build the turbines.The four small-scale versions were built and installed in four village areas between September 1996 and June 1998, pumping from 700-2400 liters of water per hour for agricultural use. After the SGP-funded project ended, several more turbines were manu-

factured at a lower per unit cost. These operate at greater capacities; one pumps 3000 liters of water per hour which is used for drinking, and another pumps 9800 liters per hour for agricultural use.

Wind energy for electricity generation:Given the success of the first project, SGP funded a second ESES project, this time to design and build wind turbines to generate electricity. ESES again worked with the Arab Manufacturing Company to produce the engines. Although the project originally planned to build only one turbine, the technology still is quite expensive, and therefore the decision was made to produce two turbines instead so that per-unit costs would be less.The first turbine, which will be connected to solar panels to create the first hybrid wind/solar system in Egypt, will be installed in August 2003.The second turbine is 60% complete, and ESES expects to install it in December 2003. ESES will provide a guarantee for the good operation of the turbines for the first two years, and then will sign a maintenance contract with the community. ESES plans to train local community members to operate and maintain the systems.

Technology

Wind pump: ESES has designed a 3kW wind pump that pumps water at a rate of 1-12 cubic meters per hour, depending upon well depth and average wind speed at the site.The pump, called the ESES2002, uses the mechanical energy produced by the wind to operate a pump. Each system is estimated to last a minimum of 10 years, and an average of 15 years. Very little maintenance is required;only an occasional check that the bolts are tight is necessary.Very detailed technical information,including sketches of the designs,are available on the NGO's website, http://www.soficom.com.eg/eses.

Wind-powered electricity generator: The first wind turbine to be installed will be connected to two 240-watt photovoltaic panels to create the first wind/solar hybrid system in Egypt. Once completed, this system will provide 300kWh/month at 4 m/s wind speed, 420kWh/month at 5 m/s, and 560 kWh/month at 6 m/s.

Environmental Benefits

In the six villages involved in the project,water pumping is now achieved through the use of wind power rather than diesel-powered pumps.In addition,electricity is being supplied to two Bedouin tribes, powering 10 lamps in 10 households, a collective refrigerator and a TV. These projects can reduce greenhouse gas emissions and pave the way for future emissions reductions by designing and testing wind energy technology.

Livelihood Benefits

Health: In at least one village using the new wind-powered pumps, water is used for drinking, which is likely to have produced some health benefits to the local population. With regard to electricity generation, the avoidance of kerosene or traditional lighting sources results in better indoor air quality, which leads to improved respiratory health. In addition, improved access to refrigeration will allow food to be kept fresh and possibly medication to be kept cold.

Income generation: Because of the low water supply, local farmers can normally only generate approximately $82 per month per feddan (a measure of land area).With a consistent water supply, income can be as much as four times greater.Therefore, a farmer who has approximately 5 feddans will earn approximately $1,640 per year instead of just $410.

Beneficiaries

Water pumps: The people in six villages benefit from improved access to water for agriculture and/or drinking.

Electricity generation: Two Bedouin tribes in Neweibaa,Aquaba Gulf benefit from the wind turbines used to generate electricity. The total number of beneficiaries in this community is 10 households or approximately 70 people.

Partners

Both projects have been carried out via a close partnership between the Egyptian Solar Energy Society, the Arab Manufacturing Company, SGP, and the beneficiaries. In general, ESES has been responsible for overall project implementation, the design of the turbines, supervising the manufacturing, installing the turbines and ensuring that the system is maintained.The Arab Manufacturing Company was responsible for manufacturing the turbines, and the pumps or engines. This partnership seems to have been beneficial, although after the first project a few problems were identified. Apparently, the Arab Manufacturing Company was not properly acknowledging ESES or SGP as being associated with the project. SGP therefore organized a meeting involving ESES, the manufacturing company, and representatives of the Bedouin tribes who were to benefit from the new electricity generation project, to discuss roles and responsibilities.

Capacity Building

It is very likely that this project has resulted in improved capacity at the Arab Manufacturing Company to manufacture wind turbines. Indeed,there is evidence of improved capacity in that SGP's support has been requested for a medium-sized GEF project to be implemented by the Arab Manufacturing Company and ESES.

LESSONS LEARNED

Environmental Management

This project has demonstrated the potential for the use of wind energy to meet development needs in Egypt, both to improve agricultural production via water pumping, and to improve access to electricity in remote areas not connected to the grid. However, given that the rate of water extraction increases with the installation of the wind turbines, it may be important to monitor the water extraction rate so that it is sustainable over the long term.

Barrier Removal

Technical: The Egyptian Solar Energy Project has developed and

implemented designs for two different uses of wind energy, and has made its design concepts and technical information available on its website. It has also worked closely with a major Egyptian manufacturing company in the production process, which means this company is now better prepared to produce similar wind energy equipment in the future.

Financial: SGP progress reports indicate that the first water pump project had resulted in lower per-unit costs for wind turbines connected to water pumps.This was part of the reason that the next project on wind energy for electricity generation was funded.However, it also seems that the per-unit cost of this equipment still may be too high to enable widespread marketing.

Institutional: This project provides a good example of how an NGO can help introduce new technology that is designed to meet development needs.ESES came up with a design concept then partnered with a major manufacturing company in order to construct it. ESES also made sure that the technology was properly installed and used. Such partnerships can help ensure that renewable energy technology is designed and implemented in order to meet development needs.In a sense, the NGO has been a bridge between communities and the manufacturing company:without ESES brokering the deal,this type of wind energy application might not have emerged.

Scaling Up

Currently, the ESES is the only designer of wind-powered pumps in Egypt.In late 2000, ESES and the Arab Manufacturing Company began to develop a proposal for a medium-size GEF grant. However, the concept paper they submitted was not accepted.ESES plans to continue its efforts to spread this technology in remote areas in Egypt.

SOURCES CONSULTED

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