Beyond Energy Action Strategies

BEAST

D.3.1.c – Business Plan of Wind diesel system for Fuerteventura

Title of the project: Wind diesel system for Fuerteventura
Location: Fuerteventura, Canary Islands, Spain

Submission date: 10.12.2015

Co-funded by the Intelligent Energy Europe
Programme of the European Union

Contents

1 Summary of the Project/Project at a Glance

The project that has been proposed by the Island Authority of Fuerteventura (Canary Islands) basically aims at kick-start the wind-diesel system of Punta Jandía again. The wind-diesel system was in operation for some years, but unfortunately due to several non-technical reasons (financial, bureaucracy, lack of political will, etc.); the system was stopped some seven years ago. Since then the local municipality has been supplying diesel to run a genset that supplies electricity "free" to the residents (and people who dispose of second homes for weekends and holidays), including the electricity to run a reverse osmosis desalination plant to satisfy the water needs of the community (for free too).

The proposed project aims to carry out the necessary overhaul of the existing system components of the wind-diesel system at Punta Jandía, to guarantee the supply of electricity and desalinated water through a high RES penetration microgrid, to this small remote and isolated fishing village. This will substitute an important part of the diesel fuel currently being supplied free by the local Municipality of Pájara. The project's promoters are Cabildo de Fuerteventura and Ayuntamiento de Pájara., and has been analysed over a life span of 20 years. In the yearly balance the system will reduce diesel consumption by 75 %. Excess electricity produced when wind production exceeds electricity demand, will be used to power a reversible osmosis plant, that will supply desalinated water to the village residents.

2 Details of the Proposed Project

Given the high cost associated to the grid extension, the isolated community of el Puerto de la Cruz in Punta Jandía, will remain disconnected from the Fuerteventura electrical grid in the foreseeable future. The proposed project aims to carry out the necessary overhaul of the existing system components of the wind-diesel system at Punta Jandía, to guarantee the supply of electricity and desalinated water through a high RES penetration microgrid, to this small remote and isolated fishing village. This will substitute an important part of the diesel fuel currently being supplied free by the local Municipality.

Excess electricity produced when wind production exceeds electricity demand, will be used to power a reversible osmosis plant, that will supply desalinated water to the village residents.

The system is expected to contribute to the energy self sufficiency of an isolated community. The autonomous and clean wind electricity is expected to substitute a high share of polluting and imported diesel currently being consumed locally for electricity generation. In the yearly balance the system will reduce diesel consumption by 75 %.

The financial resources currently committed by the municipality o Pájara for buying diesel, could be used to finance the investment as well as the O&M cost of operating the wind-diesel system, and to cover other social needs of the community. The excess electricity (at moments of high wind velocity and low electricity demand), will be used to power the RO desalinated plant, and is expected to supply around 100,000 m^3 of fresh water to the community.

The system will reinforce the tourist image of the village, attracting tourist and improving the economy perspective of the community residents.

The proposed generation system will include a wind turbine and diesel genets. The distribution grid will deliver electricity to all the houses of the village and to the few existing business which are three bar-restaurants. The other important loads are the cooling cameras for storing the fish, and the water desalination RO plant. No energy storage components will be included, besides a flywheel for regulating the stability of the grid. This flywheel will be connected to a synchronous generator.

3 Internal aspects

Weaknesses

- A high RES penetration small microgrid. Such high levels of variable and intermittent wind energy, induces grid stability problems, which is an important restriction to the percentage of RES that can be integrated into the small electrical system.
- The random nature of wind, solar and other RES sources makes it necessary to have conventional power systems in stand-by for when the wind does not blow or the sun do not shine.
- Renewable energy investments generally require higher amounts of financing for the same capacity. Initial capital costs for renewable energy technologies are often higher on a cost-per-unit basis (i.e., $/kW).
- The initial high investment cost associated to renewable energy systems, makes it necessary to dispose of an stable price framework to guarantee that the investment can be recover in a reasonable time period
- Conventional generating technologies have a lower tax burden and subsidies. Fuel expenditures can be deducted from taxable income, but few renewables benefit from this deduction, since they do not use market-supplied fuels. Income and property taxes are higher for renewables, which require large capital investments but have low fuel and operating expenses.
- Externalities are not internalised in energy/fuel prices. Without internalising environmental and other costs, renewable generation is more expensive than conventional technologies. Many of the benefits of renewables are "public goods" which not always motivate everyone who benefits to pay for them. The environmental impacts of fossil fuels often result in real costs to society, although environmental impacts and associated dollar costs are often included in economic comparisons between renewable and conventional energy, investors rarely include such environmental costs in the bottom line used to make decisions. Renewables will be unable to compete on a level playing field with conventional generation until new policies are adopted to internalize the public costs of these fossil fuel sources. As well as the economic benefit, there are social and environmental benefits associated with renewable energy such as reduced noise, clean air, no risk of spillage of fuel, attraction of eco-tourists, and reduction of greenhouse gas emissions.
- Grid connection and access is not fairly provided. Utilities may not allow favourable transmission access to renewable energy producers, or may charge high prices for transmission access.
- Proven, cost-effective technologies may still be perceived as risky if there is little experience with them in a new application or region.

Strengths

- Outstanding levels of wind resources would allow the wind turbine to work 4,000 hours a year (high capacity factor of 45 %). This means that 1 kW of wind turbine could produce 4,000 kWh/yr. With current investment cost of around 1.200 €/kWp, we are past "grid parity" since wind energy could be produced at a cost of below 0.06 €/kWh, while conventional fossil generation has a cost of 0.22 €/kWh.

4 External environment

Threats

- In the absence of a legal framework, independent power producers may not be able to invest in renewable energy facilities and sell power to the utility or to third parties under so-called “power purchase agreements.”
- Long lead time to obtain necessary permits. Exact time to obtain a license is legislative set but always much more time is needed. Especially spatial planning related to permits can take many years. Permits for new renewable energy plants are difficult to obtain due to not optimized administrative processes. They often include unnecessary requirements and lack transparency of information

Opportunities

Punta Jandía unique and outstanding conditions for demonstrating the technical and economic feasibility of the new paradigm of distributed generation based on autonomous high RES penetration microgrids.

5 Market Potential

The experience of the wind diesel system of Fuerteventura could be extrapolated to many isolated communities, especially of less developed countries. There are many remote rural areas of poor countries in Africa, Latin-American and Southeast Asia, with plenty of wind resources that currently are supplying entirely their energy needs by burning fossil fuels. The hybridization of diesel with wind power can sensibly reduce the diesel consumption and CO2 emissions of these communities. Today´s technologies are able to guarantee a high quality electricity supply in the hybridization solutions.

As fuel prices rise, and electricity demand increases in less developed countries, the wind-diesel system will be gaining markets. Alone in the 15 countries of the ECOWAS community, in West Africa, has around 300 million people. These are less developed countries lacking proper energy infrastructure, with many rural communities without accesses to modern energy services. The wind-diesel system could be a cost-effective way of electrifying these communities, especially on the coastal areas where wind resources are higher.

6 Risk analysis

(Emphasis on those elements that are threats to the project with an important impact)

The wind-diesel system of Punta Jandía, in the south of Fuerteventura was in operation until 2001. The small fishing village of Puerto de la Cruz is located in the southern tip of the island of Fuerteventura, in a place called Punta Jandía. It has a permanent resident population of 36 people (7 families), but faces high increase of population during the weekends, given that it is a popular tourist destination for island residents. Average population rises to 183 people during the weekends. It also experiences high seasonal variations. In the summer months from June to September, the population increase to an average of 465 people. The changes in population translate into high energy demand difference during the week days, and from the winter to the summer months.

In 1995 a wind-diesel standalone off grid system was installed in Punta Jandía, to supply electricity to the remote village of Puerto de la Cruz. The system was complemented with a reverse osmosis plant to supply desalinated water to its inhabitants and with cooling cameras for storing fish, since fishing is the main economic activity. The system was fully operational until 2001. Given the lack of a suitable administrative organization structure to support the wind-diesel system, as well as public commitment to financially subsidize the O&M costs, the system stopped functioning due to proper maintenance. Since then the village has been supplied by electricity produced by two diesel engines, the fuel supplied free by the local municipality of Pájara.

The mayor risk associated with the project is that under the current legal framework, the Municipality of Pajara, which is giving total free energy and water services to the inhabitants of Punta Jandía, might not be able to charge for the operation of the new system. This scenario any way could be better than the current situation, since now the municipality is paying for the 144.000 litres of diesel consumed every year in power generation. If the wind turbine were to substitute part of the diesel consumed, the system operation would be less costly and more environmental friendly.

The system should include enough diesel backup to guarantee supply during the months when the wind speed is lower (ate the end of the year the Trade winds don't blow with the same intensity as in the summer months).

A risk of the wind-diesel system, as in any other RES project, is the initial capital requirements, which are usually higher than for the same capacity in conventional power generation. Initial capital costs for renewable energy technologies are often higher on a cost-per-unit basis (i.e., $/kW). The initial high investment cost associated to renewable energy systems, makes it necessary to dispose of an stable price framework to guarantee that the investment can be recover in a reasonable time period.

Long lead time to obtain necessary permits. Exact time to obtain a license is legislative set but always much more time is needed. Especially spatial planning related to permits can take many years. Permits for new renewable energy plants are difficult to obtain due to not optimized administrative processes. They often include unnecessary requirements and lack transparency of information

Another risk is the unfavourable tax framework. Conventional generating technologies have a lower tax burden and subsidies. Fuel expenditures can be deducted from taxable income, but few renewables benefit from this deduction, since they do not use market-supplied fuels. Income and property taxes are higher for renewables, which require large capital investments but have low fuel and operating expenses.

7 Financial Analysis

The project objective is to generate locally the electric power demanded in the small fishing village of Puertito de La Cruz, located in Punta Jandía, in the south of Fuerteventura, by a hybrid wind-diesel system that minimizes the consumption of fossil fuel. The electricity of Punta Jandía is currently totally being supplied through a diesel genset; the installed electric demand 520,000 kWh. The system should also cover heat and water (RO desalination) needs of the small village.

7.1 Cost

<u>The investment cost</u>

The unit cost of each of the energy generation components of the microgrid have been estimated. When multiplying by the estimated power of each component, a total investment cost is calculated to be 758,100 €:

SYSTEM COMPONENT	UNIT COST INVESTMENT	UNITS	TOTAL COST	ECONOMIC USEFUL LIFE
Genset	400 €/kW	500 kW	200.000 €	20 yr
Wind	1.100 €/kW	225 kW	247.500 €	20 yr
Solar Thermal	600 €/m²	26 m²	15.600 €	20 yr
Batteries	100 €/batt	100 batt	10,000 €	5 yr*
Flywheel	100,000 €/un	1 un	100,000 €	20 yr
RO desalination	50,000 €/un	1 un	50,000 €	20 yr
Energy efficiency			135,000 €	
TOTAL INVESTMENT			**758,100 €**	

* Batteries' economic life has been estimated to be 5 years. Therefore in a 20 year time horizon of the project, they will have to be substituted 3 times (years 5, 10 and 15)

Total yearly depreciation has been estimated at 37.905 €/yr

Other fixed cost includes:

- Personnel cost = 60,000 €/yr
- Insurance (1% of investment) = 7,581 €/yr
- Other O&M cost (9 % on income) = 17.010 €/yr

The variable cost of the system (marginal cost), is associated to the fossil fuel consumption. Although the propose solution aims at supplying maximum electricity demand, by the high RES microgrid, in the yearly balance there will always exist the need to support with diesel generation (cloudy days with little wind, when the PV and small power wind-turbines will not be able to supply totally de demand of the loads). Preliminary calculations point-out that in the yearly balance the system will be able to substitute 81.25 % on fossil fuels. Savings of 171 Ton/yr of fossil fuels are expected. Nevertheless still 39 Ton/yr of fossil fuels will be needed. Assuming the cost of the fuel to be 1 €/kg, the yearly variable cost would be

Variable Cost = 39,000 kg fuel/yr * 1 €/kg fuel = 39,000 €/yr

The interest rate has been estimated at 4 %. This rate should be used to discount cash flows in the financial feasibility analysis.

7.2 Income

There is a problem with existing regulation, and the possibilities of putting a selling price to the electricity and water supplied to the inhabitants of Punta Jandía. Both services have been historically provided free, by the local municipality that is not allowed to charge for the service.

Kick-starting the wind diesel system again into operation, will allow the reduction of 171 Ton/yr of fossil fuel being provided totally free by the municipality, to generate electricity (part of the electricity to produce water through a RO desalination plant coupled to the wind-diesel system). From that savings will come the benefit for the Municipality. Anyway, for the sake of the analysis, a selling price for the electricity, heat and water will be assumed, thinking that in the future, a private investor will be able to run the system, and be paid for the service.

Electricity and water Income will come from sales of electricity produced by the hybrid wind-diesel system. The hybrid system will also provide electricity to the RO water desalination system, which will also generate an income from each cubic meter of water sold. Electricity is currently being totally supplied by a diesel genset. Solar thermal heat collectors will also be deployed, and have been considered as part of the investment cost of the proposed system Punta Jandía. Although the thermal energy that will be produced will not be sold, it will help reduced current electricity consumption. We will consider this savings as an income.

	ENERGY UNITS	*UNIR PRICE*	*INCOME*
Income from sales of electricity	520,000 kWhe/yr	0.15 €/kWhe	78,000 €/yr
Income from sales of water	60,000 m^3/yr	1.80 €/m^3	108,000 €/yr
Income from heat (savings on electricity thanks to solar collectors)	50,000 kWht/yr	0.06 €/kWht	3,000 €/yr
Expected subsidies			35.600 €/yr
TOTAL INCOME			**224.600 €/yr**

7.3 Feasibility assessment

The life span of the project has been considered to be 20 years. The feasibility analysis has considered that prices of energy and water will suffer a yearly increase of 5 %, throughout the 20 years of the project lifespan. Variable cost will be affected by a 10 % yearly increment.

When carrying-out the cash flow analysis, considering the values for the different cost and incomes stated previously, and using a discount rate of 4 %, the Net Present Value estimated is:

NPV = 1,078,103 € €

The return on investment, expressed in terms of the Internal Rate of Return, is:

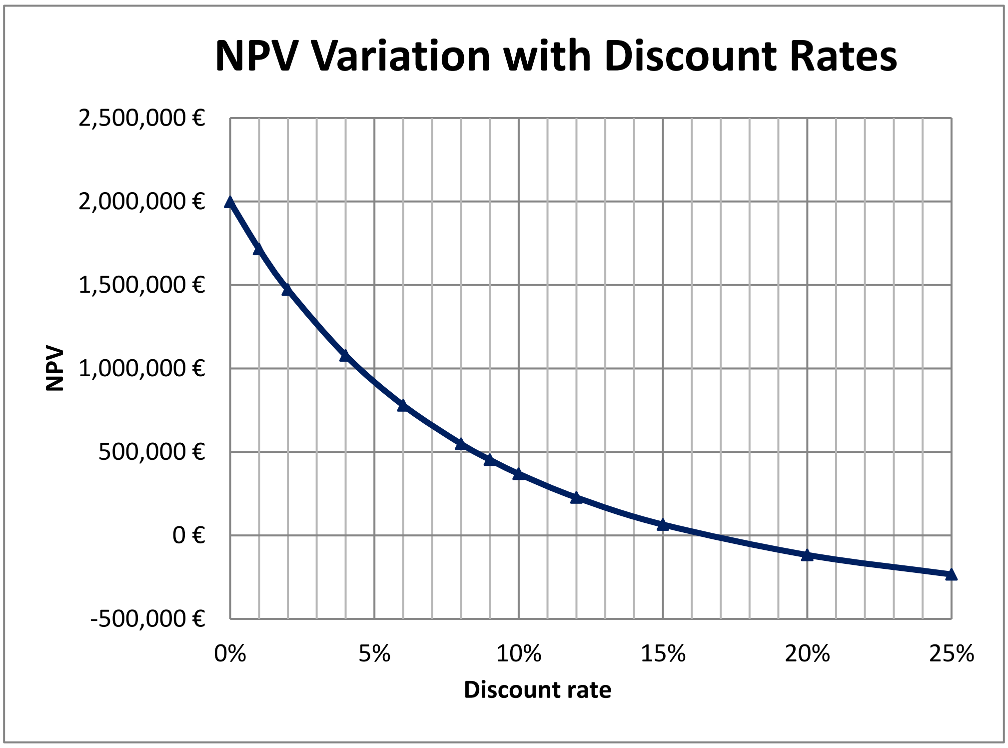
IRR = 16.5% %

The estimated period to recover the investment is 14 years, for a project that has a life of 20 years.

PAYBACK = 7 years

7.4 Sensitivity analysis

The sensitivity of the Net Present Value to the interest rate used for discounting the cash flows has been analysed. The graph shows the impact of variations of the discount rate:



7.5 Social benefits and Public support

The project gives a reasonable return of investment to the private investor, thanks to the yearly public subsidies, and a capital grant of 10 % of the total investment cost, a yearly public subsidy of 20,000 €/yr, and a feed-in tariff of 0.03 €/kWh. Otherwise the NPV would be negative. The justification for the public subsidies are the social benefits that the project. These benefits are considered positive externalities, and it is important that they are monetized, and introduced in a broader economic analysis to estimate the Social IRR of the project.

In the case of the hybrid wind-diesel system, the social benefits include reduction of emissions, local employment, improvements of the sustainable image of Punta Jandía as a tourist destination, energy independence, etc.

CO2 reductions = 650 Ton/yr

Jobs during construction = 1 job during a year

Jobs during 20 years = 1 job/year

8 Implementation roadmap

	SEMESTER						
	1st	2nd	3rd	4th	5th	6th	Year 1-20
Meetings with stakeholders							
Design of system							
Modelling							
Final system design							
Feasibility analysis							
Business model							
Contracts on exploitation							
Commissioning							
Installation							
Testing							
Operation and maintenance							

9 Conclusion

The hybrid wind-diesel system project for Punta Jandía, will allow for substitution of electricity being currently supplied totally by a diesel genset. The clean RES generation of the hybrid system will supply also an important load which is the RO water desalination system.

The project has the potential to reduce emissions of GHG and the current energy dependence of Punta Jandía, by creating the needed infrastructure to make maximum use of local available clean RES. The benefits for the Punta Jandía, besides the reduction of the energy bill, comes from all positive externalities associated to the use of RES, and reductions of fossil fuel consumption.

It is an interesting investment opportunity for investors interested in earning a reasonable payback, in a project with small technical risk. This return on investment is possible thanks to the public subsidies, which is justified for all social benefits, in terms of job creation, GHG emission reductions, and better image of a sustainable tourist destination.