

Case study for a small scale grid disconnected installation

Background

We describe a scenario in which the installation of one 50kW wave machine is done in front of a small village or a resort in a grid disconnected situation. The typical pre-wave cost of electricity in such a scenario is above 20 c\$, and due to skyrocket if the price of oil stays consistently above 100 USD/barrel. The power produced can be used to lower significantly the average price of electricity, to shelter from fluctuations in the price and availability of diesel, and also to start new economic activities which require the extra energy.

In this respect, there are many activities which cope well with a fluctuating power source, mainly related to agriculture. A fluctuating power source can be used effectively to produce desalinated water (water can be stored for the periods when waves are absent) or refrigeration (modern refrigerators can maintain a stable temperature for days without a power source).

Coupling fresh water and refrigeration can be a powerful engine for economic development, especially in tropical areas. In a resort, both water and refrigeration are significant power sinks, and a wave energy device can take them completely out of the equation.

In the case study below we imagine a small village in a developing country, which is part of a larger set of villages in the same area. This allows for second level maintenance to be carried out centrally, with only first level (on site) maintenance carried out by local personnel. This arrangement allows for a drastic reduction of the O&M costs. In a resort the O&M costs (and hence the LCOE) would be higher, especially if the resort is located in a remote area.

Case study: 50kW installation near shore

As said, we describe a scenario in which the installation of one wave machine is done in front of a small village or a resort in a grid disconnected situation.

Ordinary maintenance can be carried out by local personnel, with a small support boat (no barges or special purpose boats are needed). This allows for a very significant reduction of maintenance costs. The machine is monitored remotely by 40South Energy 24/7. The area occupied is a square of sizes approximately 100m x 100m, with only the signaling buoys on the outer perimeter.

Installation requires three main steps:

- cable installation
- mooring points installation
- machines installation

The most onerous part is the cable installation, which is however significantly easier than the cable necessary for offshore wind parks. This installation procedure is generally carried out in a few days (for the 0.5NM length and 50kW of power assumed in this scenario). In specific situations it may be possible to trench the cable only gravitationally (letting the weight of the cable sink it into the mud).

A Wave energy device installation will incur the following main costs:

- Cost of project development: USD 20,000 (6% of CAPEX)
- Capital cost (CAPEX): USD 350,000 (7 \$/Watt)
- Cost of cable (including installation): USD 70,000 (20% of CAPEX)
- O&M costs: USD 16,000 per year (4.5% of CAPEX)

All the above costs depend on the specific site of installation, and are therefore difficult to quantify in general. We will very generally assume the above, which are reasonable assumptions for a location where 35 meters of depth are achievable within 0.5NM from shore, and where the trenching of the electrical cable does not have any special requirements (especially on the shore side). We are considering an installation of one F2-50 machine, for a total power of the installation of 50kW and a total investment of 440,000 USD. The final Levelized Cost of Energy (LCOE) is estimated to be 173 \$/MWh, with a capacity factor of 50%. This capacity factor is estimated to be achievable in

many coastal sites, even at low latitudes, but will need to be validated case by case.

The resulting LCOE is comparable with the price paid for electricity in developed countries, and is therefore extremely competitive. One should bear in mind however that even with a very high 50% capacity factor, half of the energy will still need to be produced with fossil fuels (typically, in this scenario, diesel generators).

The detailed assumptions used as inputs in the economic model (produced by Bloomberg BNEF) to come up with the 173 USD/MWh LCOE are the following:

LCOE	173 USD/MWh
Operating life	25y
Development time/cost	1y/ \$20,000
Construction time/cost+capital cost	1y/ \$420,000
% Debt/Debt spread over LIBOR	50% / 700bps
Loan	10y
Operating and Maintenance	\$16,000 per year

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