Energy production at Mutriku remains constant even if the wave force increases

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The EOLO research group of the UPV/EHU-University of the Basque Country has confirmed the increase in the power flow of the waves in the Bay of Biscay from 1900 onwards. It has identified ten types of sea state and has used a statistical model to link them to the output of the Mutriku wave farm. Thus, it has been possible to calculate the amount of electrical power that could have been produced during the 1979-2019 period if these facilities had been operational.

The Mutriku wave power plant was built on the Mutriku breakwater, a site with great wave energy potential, and has been in operation since 2011. With 14 oscillating water columns to transform wave energy, it is the only wave farm in the world that supplies electricity to the grid on a continuous basis. In general, technologies that harness the power of the waves to produce electricity are in their infancy, and this is precisely what is being explored by the UPV/EHU's Research Group EOLO, which focusses on Meteorology, Climate and Environment, among many other aspects.

Gabriel Ibarra, researcher in the group and lecturer in the UPV/EHU's Department of Energy Engineering, explained that "one thing is the energy the waves produce, the hydraulic energy they have, and another thing is the amount of electrical power obtained from them." This is what they have been working on over the last few years. "After identifying some of the key aspects of the operation of the Mutriku facilities a few years ago, we have now developed a methodology that allows us to find out the impact of climate change on the output at Mutriku. We have used it to reconstruct the daily electrical power that would have been generated if the Mutriku wave farm had been operational during the entire 1979-2019 period, and this will help us to predict what might happen in the future," explained Ibarra.

The researcher affirmed that "we have found that there has been a growing trend in the strength of the waves in the Bay of Biscay as a result of climate change, from 1900 to the present day. The aim was therefore to analyze how the Mutriku facilities responded to this trend. In this respect, while taking into account the evolution of the waves over the last four decades, we developed a methodology that allows us to determine how this increase may affect generation at Mutriku."

Gabriel Ibarra and an image of the dock that houses the Mutriku facilities for transforming wave energy into electrical power. Credit: Mitxi. UPV/EHU

Wave energy increases, but not electricity output

The research group found that "in the Mutriku area this upward trend in wave energy is not as high as in other areas of the Bay of Biscay, and that this trend would be dampened and electricity output would remain constant at the Mutriku facilities as a result of the way they function, their regulation system." It follows that the energy flow levels off above a certain threshold and is therefore more stable than the wave energy flow; consequently, they determined that moderate long-term changes in wave energy cannot directly affect wave power installations consisting of oscillating water columns. In Ibarra's opinion, much stronger waves

would be needed to increase electricity production.

In the study, they identified ten main types of sea state with which a distinctive pattern of electrical power generation has been associated on a daily scale. This has allowed them to reconstruct the daily electrical power that would have been generated if the Mutriku wave farm had been operational during the entire 1979-2019 period and, consequently, to assess the impact that the observed changes in the wave climate and the associated energy flow would have had on electrical power output.

So, "the next step is to consider the future that climate change will bring and make a forecast; we believe that this upward trend will continue and we want to see, firstly, whether this trend will be on a large or small scale, and secondly, what impact this will have in the future, over the coming decades, on output at Mutriku. All the research carried out at the Mutriku facilities is hugely useful in advancing this type of technology, as it is the only facility in the world that supplies energy continuously to the grid," said Ibarra. The research has therefore shown that highly reliable feasibility and economic studies of wave power facilities can be carried out, as the future uncertainties of the resource itself will not have a significant impact on the electrical power performance of the installations throughout their life cycles.

More information: Gabriel Ibarra-Berastegi et al, The power flow and the wave energy flux at an operational wave farm: Findings from Mutriku, Bay of Biscay, *Ocean Engineering* (2021). DOI: 10.1016/j.oceaneng.2021.108654

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