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COMMON FUTURES

Summary: integration of renewable resources offshore

Market developments in wave power and offshore solar combined with offshore wind

Foreword

Invest-NL believes there is untapped potential in diversifying the energy landscape and the opportunity to deliver enhanced social goods from this diversification. Discussions related to offshore energy revolve mostly around wind. In fact, offshore wind is the powerhouse of the energy transition in the Netherlands and presents a substantial opportunity to deliver competitively priced green energy – now and in the future – due to our easy access to the North Sea.

However, there arises a compelling question whether even greater value could be untapped from the infrastructure and space currently allocated to the development of offshore wind only. Assuming that this is the case, the potential challenges and barriers to be overcome in order to realise this value need to be identified (and overcome). This forms the basis of our research study.

We would like to express our deep appreciation to all those who took part in the study. Entrepreneurs in start-ups, energy companies, grid operator TenneT, various government departments, banks and financiers all contributed. The contributions from the Dutch Ministry of Economic Affairs and Climate Policy and TenneT in particular added great value to the end result. We would also like to express our gratitude and appreciation to the team at Common Futures who collated a huge amount of data, and translated this information into a readable and understandable report.

The research shows that there is potential value in diversifying the energy landscape and, for this reason, we believe there are good grounds to follow up on the results of this study. There is an opportunity here for innovative Dutch companies to (continue to) test, prove and scale up the technology and, in this way, help to accelerate the energy transition worldwide. Dutch industry has a strong marine engineering background and expertise and therefore could make a real impact in the development offshore solar and wave.

The study shows there are opportunities for investors to add new *asset classes* to their portfolio. This is not without risks. The new technologies are expected to follow a similar development trajectory to offshore wind. Costs need to be brought down, for which the companies and their financiers will have to bring forward projects both within and outside the Netherlands. Large-scale projects with higher-priced electricity can contribute to the learning curve. There is also an upside for policymakers. The Netherlands has invested in the infrastructure to bring electricity generated from wind farms at sea to shore. Once it becomes possible to use existing and future infrastructure for multi-use concepts, it will add further value to investments. There are further opportunities in spatial planning terms, including the question of how multiple (energy) activities can be deployed in the same area as offshore wind in the North Sea.

Finally, we eagerly anticipate the availability of better data in the future. It became apparent during the project that there is currently a lack of data to properly assess the potential of wave power. At the same time, technology is continuing to evolve. Innovative ventures are working on alternative ways to convert energy from waves into electricity and a great deal of research is being done in this area, including at TU Delft. For offshore solar, the real life experience and data that we can expect to see emerging in the near future will be of huge value. Invest-NL is monitoring these developments closely, and we hope this study inspires you to do the same.

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Summary

We are in the midst of a **race as innovative developers seek ways to harness the power of the sun and waves at sea**, potentially within offshore wind farms. An emerging market for both offshore solar and wave power technologies is taking shape, with Dutch technology developers among those at the forefront of these developments. For such technology developers to become major players on the global market, the right playing field will need to be created to facilitate further pilots, innovation and scale-up. This would also enable the Netherlands to expand and strengthen its knowledge base and expertise in the development, integration, installation and maintenance of offshore energy generation facilities.

In addition to developing a framework to enable the shared use of electricity transmission capacity to shore, **creating the right playing field** will involve making changes to the regulatory framework, providing grid-connected offshore test facilities, and the inclusion of these technologies in future tenders for offshore wind farms.

Wave power and offshore solar are not currently competitive compared to mature renewable power generation technologies, such as offshore wind, onshore wind and onshore solar. Any significant moves in the Netherlands to scale up wave power or offshore solar generation by 2030 will be driven primarily by energy, spatial planning, environmental and technology export considerations, in addition to economic factors.

The integration of wave power or offshore solar facilities into a wind farm, is considered along with the assumption that the additional electricity generated would be brought to shore through the same grid connection used by the wind farm. The power generated would then be brought to shore at times when the wind farm is not running at full capacity.
One of the notable benefits of hybrid offshore energy generation is the potential to **increase the utilisation of existing infrastructure**. In the future, much of the power brought to shore could be used by industrial clusters based along the coast, potentially resulting in less congestion in land-based infrastructure during hours when sufficient electricity is generated offshore to meet demand.

The generation costs for offshore solar and wave power are currently much higher than for offshore wind. Developers expect the **generation costs** (LCOE) **for offshore solar to achieve parity with offshore wind within 5 – 10 years**, and wave power within 10+ years. However, when integrated into an offshore wind farm, a proportion of the energy generated would still be *curtailed*, resulting in higher ultimate costs per kWh brought to shore compared to the cost of generation. Therefore, it is important to consider the potential power generation and the value of the electricity supplied to the energy system.

Electricity generation from wave power peaks a few hours after wind, meaning that power generation peaks are generally prolonged. However, there is still a paucity of research and a lack of wave data to allow for a proper assessment of the energy potential of ocean power plants combining wave and wind. Energy from offshore solar is for the most part generated during low-wind hours. Both sources of power generation increase the cable utilisation of an offshore grid connection by around the same number of hours when added in the same capacity. However, in this case, a much higher proportion of wave-generated energy would have to be *curtailed* than for offshore solar. Given this, it would seem to make more sense to **co-locate offshore solar with a wind farm, rather than wave power generation**.

The value of the extra electricity generated to the grid will depend on further developments in the energy system. Energy brought to shore from offshore solar will mainly compete with energy from onshore solar, and wave power with energy from batteries. As a result, it is likely that wave power would yield more per kWh that can be supplied to the electricity market.