Economic and financial evaluation of a floating wind project in the Northwest of the Iberian Peninsula

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Extended Abstract

1. Introduction

The acceleration of energy consumption has been subject of special attention from both the political class and the scientific community. There is a need to take measures aiming to reduce the use, or even non-use, of fossil fuels. On the one hand, to combat climate change, and on the other, to ensure countries' energy independence. In this context, targets have been set for the incorporation of renewable energies into final consumption, especially with the use of floating offshore wind energy, due to the maturity of the technology. In addition, floating wind energy will contribute to achieving the Sustainable Development Goals (SDGs) set out in the United Nations 2030 Agenda. Portugal is no exception. In fact, its geographical location gives it a significant advantage when it comes to utilising this renewable resource. Mainland Portugal's maritime space, under national sovereignty or jurisdiction, extends over 591,502 km^2. If, on one hand, the ocean's tri-dimensionality poses challenges in terms of governance and maritime spatial planning, on the other hand, it allows for various human activities and use.

2. Case Study

This work presents a case study of a hypothetical company, 'Vento no Mar', which intends to invest in two floating offshore wind farms in two areas in the Northwest of the Iberian Peninsula (Viana do Castelo). The study was divided into two phases. The first relates to maritime spatial planning to select the location in order to ensure a balance between the private use of maritime space, on the one, and the common use and freedom of movement on the oceans, on the other. For this purpose, exclusion criteria were imposed: after being analysed, the areas were geo-referenced in the MT and EEZ. Figure 1 shows the geometry of the selected areas, orientated according to the dominant wind direction. These areas cover a total of 607 km^2: 313 km^2 in the northern area and 294 km^2 in the southern area.

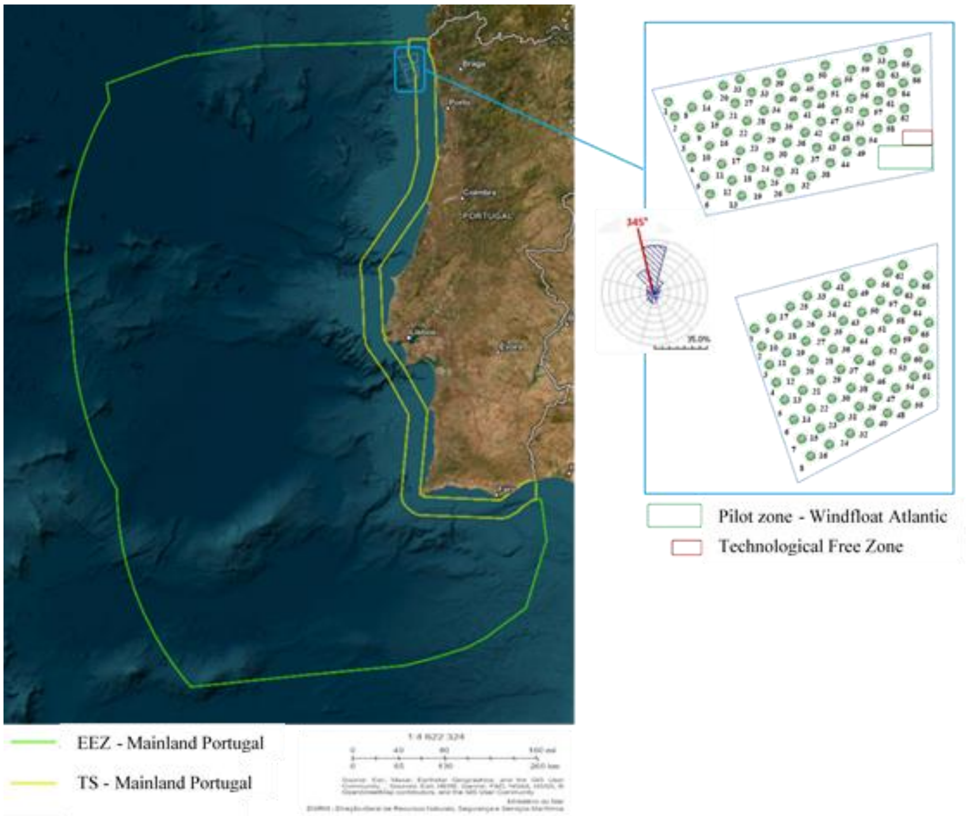

Figure 1 - Geospatialisation of the areas north and south of Viana do Castelo with wind turbines.

With regard to Climate Taxonomy, the company will have to ensure that the economic activity - 'Production of electricity from wind energy' will not significantly jeopardise compliance with the environmental objectives of descriptors 1 (biodiversity), 6 (seabed integrity) and 11 (noise/energy) laid down in the MSFD, as provided for in paragraphs 4.3 of Annexes I and II of Delegated Regulation (EU) 2021/2139. In the second phase, the economic and financial viability of the project was estimated, with a view to making a decision on it.

To this end, different scenarios were constructed and the respective Internal Rate of Return (IRR), Net Present Value (NPV), Payback Period and Levelised Cost of Energy (LCOE) were estimated. Three alternative discount rates (5%, 7.5% and 10%) and two possible equity/debt financing combinations (25% and 70%) were also considered as hypotheses.

Figure 2 shows the curves representing the NPV profiles, which relate the surpluses generated to the respective discount rates (Soares et al., 2015) of 5%, 7.5% and 10% (Castro-Santos et al., 2013).

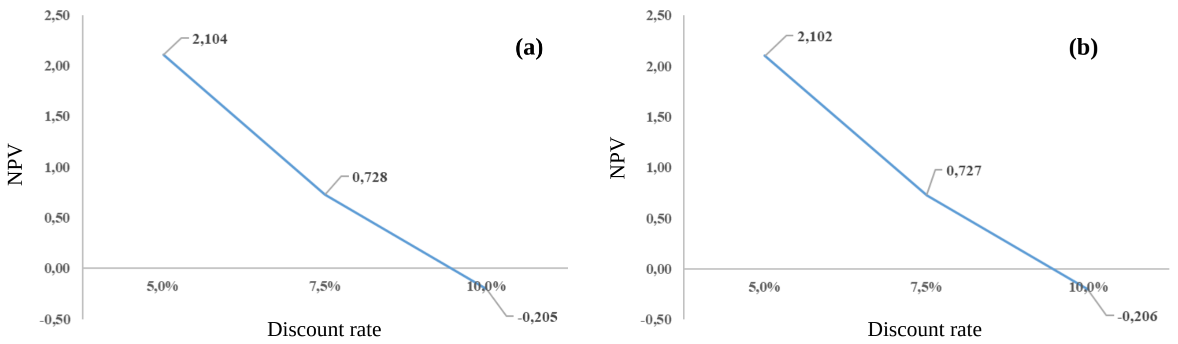

Figure 2 - NPV evolution as a function of the update rate (a) North area; (b) South area.

The graphs (Figure 2) show that the lower the slope of the curve, the lower the sensitivity of the NPV to the discount rate (Soares et al., 2015).

The IRR results indicate that for discount rates below 9.37% (North area) and 9.36% (South area) the decision will be to accept the investment. Above these rates, the decision will be to reject (Soares et al., 2015). In other words, the project is economically viable for discount rates of 5% and 7.5% (IRR > discount rate) (Castro-Santos et al., 2013).

Figure 3 shows the equivalence of NPV and IRR in investment selection for the two areas under study.

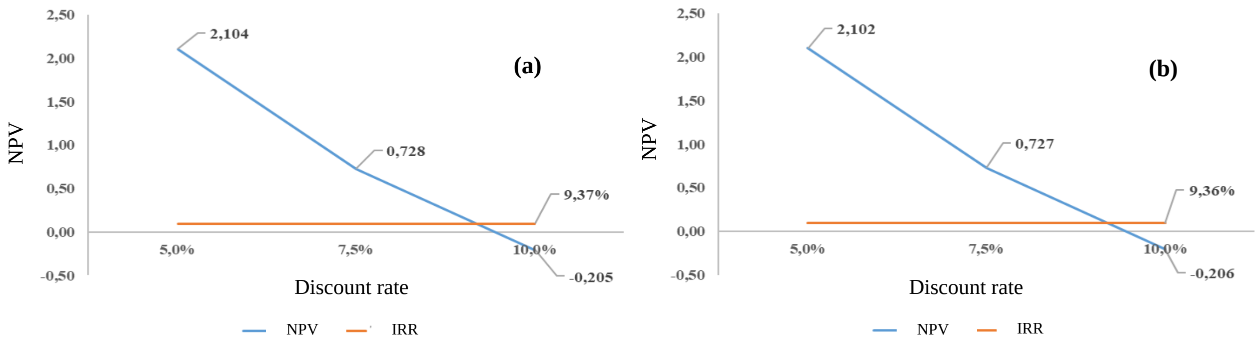

Figure 3 - NPV and IRR equivalence: (a) North area; (b) South area.

On the one hand, positive NPV values for discount rates (5% and 7.5%) means that they are lower than the IRR. On the other hand, if the NPV is negative, the IRR is lower than the discount rate.

With regard to the Payback Period for both areas, with the exception of when the 10% discount rate is applied, the results are always lower than the project's useful life, 30 years. This indicates that the investment is acceptable.

Figure 4 shows the curves representing the NPV profiles (bank credit of 25% and 70% of the total investment, respectively), which relate the surpluses generated to the respective discount rates (Soares et al., 2015) of 5%, 7.5% and 10% (Castro-Santos et al., 2013).

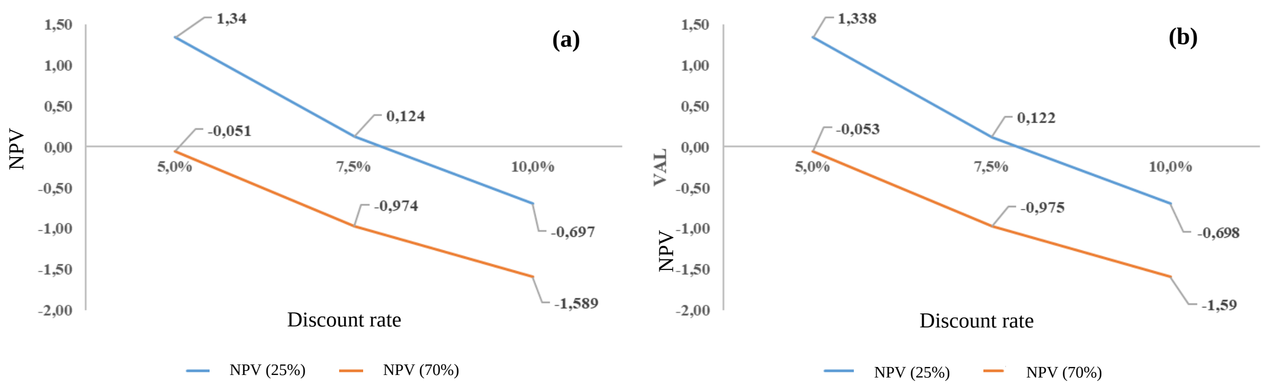

Figure 4 - NPV evolution as a function of the update rate (a) North area; (b) South area.

The graphs (Figure 4) show that the NPV is sensitive to the cost of capital. In the scenarios with a 25% source of equity and debt financing (bank credit), the Payback Period is less than the project's useful life (30 years). When the 10% discount rate is applied, the project is not economically viable.

If the share of external financing is 70% of the total investment, regardless of the discount rate applied, the project is not economically viable. The IRR is lower than the discount rate, the NPV < 0 and the Payback Period > 30 years.

The payback period is the time it takes for the project to pay off the cost of the investment and start making a profit. It can be inferred from this that the longer this period, the greater the risks. This period must always be shorter than the useful life of the project, otherwise the company should not make the decision to invest.

3. Conclusions

The sensitivity analysis showed that the project's critical variable is the discount rate, which has a decisive influence on the NPV. The conclusion is that the project is economically and financially viable for the scenarios with an equity financing source and discount rates of 5% and 7.5%. This result is considered positive for the realisation of the investment, taking into account the interest rates currently charged on the financial markets. With a source of funding from own and debt party capital, the project is only viable in the scenario with a 25% financed portion and discount rates of 5% and 7.5%. It can also be concluded that the NPV (≥2.5 M€), IRR (≥10%) and Payback Period (≤10 years) defined as profitability limits by the shareholders were exceeded by 22% by the NPV (3 M€), 31.8% by the IRR (13.18%) and 7.5% by the Payback Period (9.3 years) in the scenario with a 5% discount rate and equity financing source. It can therefore be concluded that these criteria support approval of the project. The values obtained for the LCOE are considered acceptable, as they are within the ranges of other studies presented by Martinez et al. (2022). The capacity factor obtained (36%) is above the average capacity factor for wind farms (20-40%). With regard to the 'Employment' indicator, it can be concluded that the project will make a positive contribution to the local and regional economy. The large number of homes that will benefit from the energy produced by the two wind farms will help mitigate climate change and achieve the decarbonisation targets set for 2050. With regard to environmental indicators, it can be concluded that the implementation of the two wind farms will significantly reduce CO^2 and SO^2 emissions. The operation of these wind farms will also contribute to the realisation of the SDGs, as shown in Table 1.

Table 11 - Contributions of the Investment Project to the United Nations SDGs

SDG	Contribution of offshore floating wind farms
	Minimising the effects of climate change on human health by reducing greenhouse gas emissions.
	Producing electricity from a renewable energy source, wind, which is considered more sustainable and less polluting than fossil fuels such as coal and oil. By providing clean electricity, they will contribute to reducing greenhouse gas emissions and combating climate change, which is a key goal of this objective.

SDG	Contribution of offshore floating wind farms
8 TRABALHO DIGNO E CRESCIMENTO ECONÓMICO	Creation of 33,066 jobs, with 100 per cent of the work carried out by companies based in Portugal.
9 INDÚSTRIA, INOVAÇÃO E INFRAESTRUTURAS	Promotion of the development of the floating offshore wind industry in Portugal.
13 AÇÃO CLIMÁTICA	Reduction of more than 1.4 million tonnes of CO_2 emissions per year, which will contribute significantly to climate action.
14 PROTEGER A VIDA MARINHA	Producing electricity from a renewable energy source, wind, which is considered more sustainable and less polluting than fossil fuels such as coal and oil, will reduce greenhouse gas emissions, which will promote the mitigation of the impacts of climate change on the oceans, which is a major threat to marine life.
15 PROTEGER A VIDA TERRESTRE	Mitigating the effects of climate change on terrestrial ecosystems and biodiversity by reducing greenhouse gas emissions. These ecosystems and species are in danger due to rising temperatures, extreme weather events and other effects of climate change. In addition, the development of offshore wind energy will help reduce the demand for fossil fuels and help reduce the negative impacts of the extraction and use of these fuels on terrestrial ecosystems.

4. References

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