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Research paper

Sensitivity study of the economics of a floating offshore wind farm. The case study of the SATH® concrete platform in the Atlantic waters of Europe

Almudena Filgueira-Vizoso [a], David Cordal-Iglesias [b], Félix Puime-Guillén [c], Isabel Lamas-Galdo [d], Araceli Martínez-Rubio [e], Irati Larrinaga-Calderón [e], Laura Castro-Santos [f,*]

[a] Universidade da Coruña, Campus Industrial de Ferrol, Departamento de Química, Escola Politécnica de Enxeñaría de Ferrol, Esteiro, 15471 Ferrol, Spain
[b] Universidade da Coruña, Campus Industrial de Ferrol, Escola Politécnica de Enxeñaría de Ferrol, Esteiro, 15471 Ferrol, Spain
[c] Universidade da Coruña, Campus Industrial de Ferrol, Departamento de Empresa, Facultade de Economía e Empresa, Elviña, 15071 A Coruña, Spain
[d] Universidade da Coruña, Campus Industrial de Ferrol, Departamento de Ciencias da Navegación e Enxeñaría Mariña, Escola Politécnica de Enxeñaría de Ferrol, Esteiro, 15471 Ferrol, Spain
[e] Saitec Engineering, Offshore Technologies, Parque Empresarial Ibarrabarri, Edif. A-2, 48940, Leioa, Bizkaia, Spain
[f] Universidade da Coruña, Campus Industrial de Ferrol, Departamento de Enxeñaría Naval e Industrial, Escola Politécnica de Enxeñaría de Ferrol, Esteiro, 15471 Ferrol, Spain

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ABSTRACT

The objective of the present work is to develop a sensitivity analysis to determine the most essential parameters that affects to the economic feasibility of a marine wind farm composed by platforms built in concrete material. The main purpose is to analyze how the input variables such as number of offshore wind turbines, the energy produced by one wind turbine, the interest rate, the capital cost, the electric tariff, etc. affect to the economic output variables: the Levelized Cost Of Energy (LCOE), the Internal Rate of Return (IRR), the Net Present Value (NPV) and the Discounted Pay-Back Period (DPBP) of the considered offshore wind farm. This paper studies the concrete floating offshore wind platform SATH®, developed by the SAITEC enterprise. Results indicate what are the most relevant variables in economic terms to take them into consideration for their installation in the future.

1. Introduction

The growth of the population and the increase in the energy consumption ratio are causing the levels of CO2 emitted into the atmosphere to increase, on the one hand because the demand for electrical energy causes the electricity generating plants to work at full capacity, emitting more CO2, and on the other hand, because the increase in population causes an increase in consumption (housing, vehicles, etc.), thus causing an increase in the CO2 generated.

Uncontrolled emissions of greenhouse gases (Tuckett, 2019) are causing climate change on the planet (Heesterman, 2017a). This climate change is one of the main environmental problems that the planet suffers with important economic and social repercussions (Fankhauser and Tol, 2005; Tol, 2009).

In the first third of the 20th century, awareness of the problems posed by greenhouse gases began to be realized and measures began to be taken to reverse this problem through the Kyoto Protocol (Nordhaus and Boyer, 1999). Through this protocol, founded on the principles of the United Nations Framework Convention on Climate Change (Bodanksy, 1993), industrialized countries committed to reducing their greenhouse gas emissions. From that beginning to the present, different conferences have been held, the last being the one held in Glasgow (United Kingdom) on November 1, 2021 (CP26) (Maslin, 2020). In addition, the UN Framework Convention on Climate Change took place in November 2023, considering the main principles for international climate change cooperation for reducing greehhouse gases (UN, 2022). One of the main objectives to be achieved is the so-called objective 55 (Anon, 2022b), which establishes the reduction of greenhouse gases by at least 55% by the year 2030 and to achieve

* Corresponding author.
E-mail addresses: almudena.filgueira.vizoso@udc.es (A. Filgueira-Vizoso), david.cordal@udc.es (D. Cordal-Iglesias), felix.puime@udc.es (F. Puime-Guillén), isabel.lamas.galdo@udc.es (I. Lamas-Galdo), aracelimartinez@saitec.es (A. Martínez-Rubio), iratilarrinaga@saitec.es (I. Larrinaga-Calderón), laura.castro.santos@udc.es (L. Castro-Santos).

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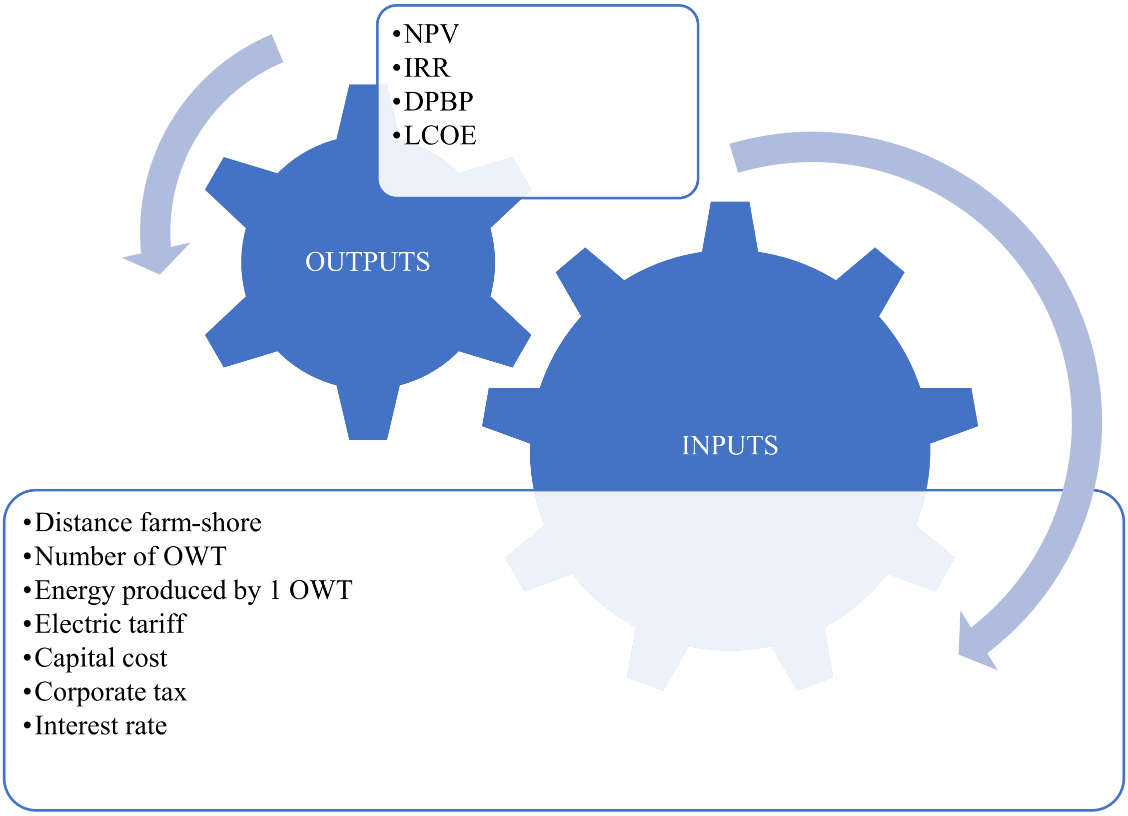

Fig. 1. Inputs and outputs of the sensitivity study developed.

climate neutrality by 2050. The package of measures of "Objective 55" includes a proposal to review the Directive on Renewable Energy Sources. It attempts to accelerate the energy transition towards renewable energies, going from 32% to 40% as an objective to be achieved in 2030. Wind and solar photovoltaic are the technologies that will lead the increase as they are the most developed and the most feasible both technically and economically speaking (Heesterman, 2017b; Kemfert, 2019). (Anon, 2022b).

Within renewable energies, wind power is achieving important achievements, both on land and at sea and taking into account that the sea occupies 70% of the planet, the use of this renewable energy in this environment is a resource with a very high potential yet to be exploited (Li et al., 2020; Emeksiz and Demirci, 2019).

To take advantage of wind energy in the sea there are different types of technologies, which differ mainly in the type of platforms to be used. We can classify them as fixed or floating, within the fixed we have: monopile (Heesterman, 2017b; Kemfert, 2019), tripilote (Anon, 2022a), tripod (Plodpradit et al., 2019; AREVA, 2022), gravity (Esteban et al., 2015; Wu et al., 2019) and jacket (Esteban et al., 2015; Wu et al., 2019) and within the floating we have the semi-submersible (Cermelli et al., 2009; PowerTechnology, 2020), the TLP (Oguz et al., 2018) and the spar (Rahman et al., 2016). They can also be classified according to the material with which the structure is made. At this point it should be said that most of the current platforms are made of steel, but there are already several prototypes of concrete structures that are giving good results (Molins i Borrell and Campos Hortigüela, 2016; Molins i Borrell et al., 2014; Baita-Saavedra et al., 2019; Campos et al., 2016; Serna and Javier Nieto, 2017). The case that concerns us in this investigation is for a floating concrete platform.

Fig. 2. SATH® floating offshore wind platform (SAITEC, 2020).

Fig. 3. Locations selected in ARCWIND project for the farms: Farm 1 (a) and Farm 2 (b). (Google, 2021).

Previous sensitivity analysis of offshore wind were focused on offshore wind platforms built in steel (Castro-Santos and Diaz-Casas, 2015), only in LCOE of offshore wind (Lerch et al., 2018; Castro-Santos et al., 2021), on offshore wind farm O&M strategies (Martin et al., 2016; Vis and Ursavas, 2016) or aspects of the design of the platform, such as fatigue loads (Velarde et al., 2019). The objective of the present paper is to develop a sensitivity analysis to determine the most important parameters that affects to the economic feasibility of an offshore wind farm. The main purpose is to analyze how the input variables such as number of offshore wind turbines, the energy generated by one wind generator, the interest rate, the capital cost, the electric tariff, etc. affect to the output variables: Internal Rate of Return (IRR), Net Present Value (NPV), Discounted Pay-Back Period (DPBP) and Levelized Cost Of Energy (LCOE) of the considered offshore wind farm. This paper studies the location of A15 Scotland (UK) for the case of the concrete platform SATH®. Results indicate what are the most relevant variables in economic terms to take them into consideration for future studies in the field of floating offshore wind energy.

2. Method

2.1. Economic considerations

The economic study is based on the analysis of all the costs contemplated in each farm considered in the project, and the calculation of each of the indicators: Net Present Value (NPV), Internal Rate of Return (IRR), Discounted Pay-Back Period (DPBP) and the Levelized Cost Of Energy (LCOE).

The total costs (LCC) have been previously calculated in Action 8.1 and they depend on the costs of each step of the life-cycle of the farm (cost of conception and definition (C1), design & development (C2), manufacturing (C3), installing (C4), exploiting (C5) and dismantling (C6)), as Eq. (1) shows (Baita-Saavedra et al., 2020):

$$LCC = C_1 + C_2 + C_3 + C_4 + C_5 + C_6 \tag{1}$$

It does not consider current inflation because it is assumed that the inflaction on incomes and expenses is the same. Therefore, the values obtained regarding the economic feasibility are not influenced by it (Boedo Vilabella, 2010). On the other hand, the economic feasibility indicators (NPV, IRR, DPBP and LCOE) have been previously calculated in Action 8.2. They were calculated considering the total costs of the life-cycle as equations from (2) to (5) are shown. NPV (in €) €, is the net value of the discounted cash flows of the project during all its life spam (Short et al., 1995; Castro-Santos et al., 2016, 2020). IRR (in %) is defined as the value (in %) that cancels the NPV. DPBP (in years) represents the time (in years, in this case) that is needed for recovering the total investment. Finally, the LCOE (in €/MWh) is the levelized cost of energy at present.

$$NPV = -G_0 + \sum_{t=1}^{N_{farm}} \frac{CF_t}{(1+r)^t} \tag{2}$$

$$-G_0 + \sum_{t=1}^{N_{farm}} \frac{CF_t}{(1+IRR)^t} = 0 \tag{3}$$

$$\sum_{t=1}^{N_{farm}} \frac{CF_t}{(1+r)^t} \geq G_0 \tag{4}$$

$$LCOE = \frac{\sum_{t=0}^{t=N_{farm}} \frac{LCC_t}{(1+r)^t}}{\sum_{t=0}^{t=N_{farm}} \frac{E_t}{(1+r)^t}} \tag{5}$$

Being:

- G_0: the initial investment (in €).
- N_{farm}: life of the farm (years).
- r: capital cost (in %).
- CF_t: Cash Flow in period t (in €).
- E_t: Energy generated (in MWh)

2.2. Sensitivity analysis

A sensitivity analysis indicates the variation of the outputs when the inputs are altering. In this paper, Oracle Crystal Ball™ and Microsoft Excel™ software have been considered to develop the study, transforming the spreadsheet in a lab under diverse scenarios.

This tool has a wide variety of uses (Cooke, 1993): buildings (Hongxiang and Wei, 2013), energy (Yue et al., 2012; Kitzing, 2014; Castro-Santos et al., 2012; Nesamalar et al., 2021), wind

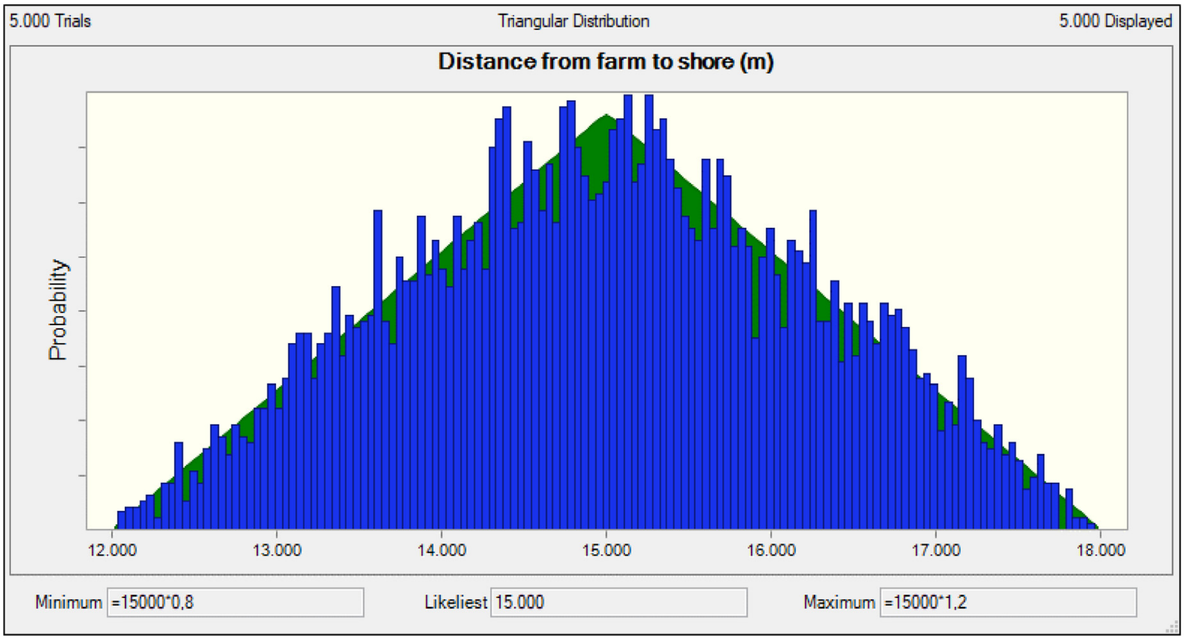

Fig. 4. Distribution considered for distance from farm to shore.
Source: Own elaboration.

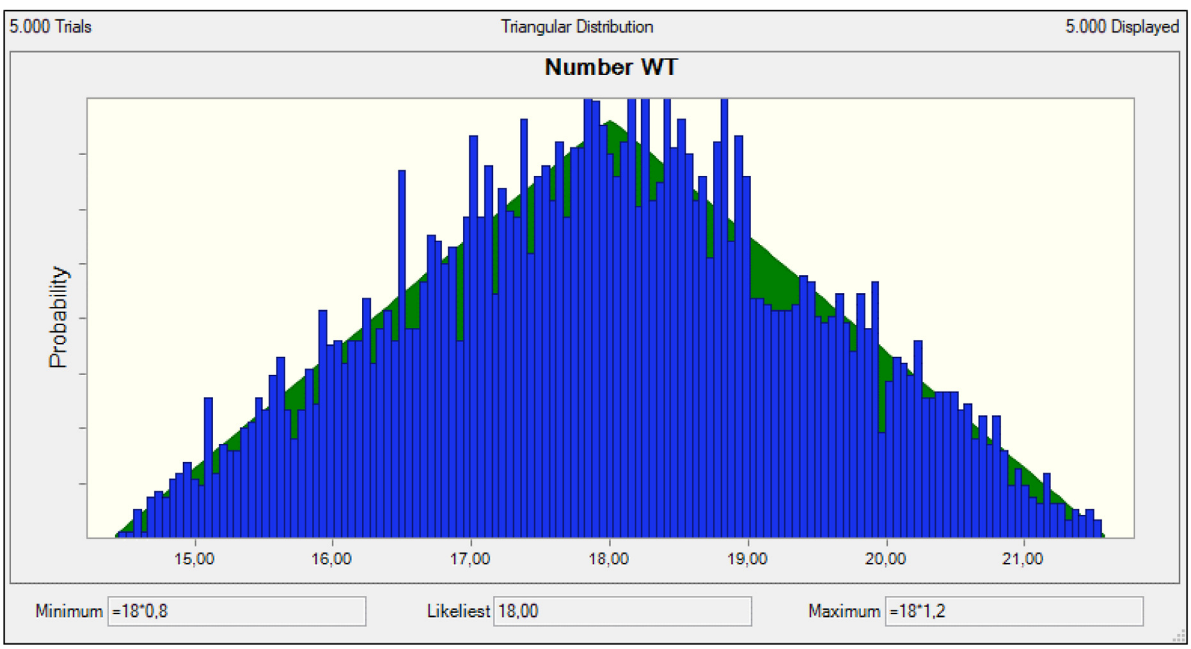

Fig. 5. Distribution considered for the number of offshore wind turbines.
Source: Own elaboration.

resource (Tsvetkova and Ouarda, 2021), etc. Moreover, a overall approach of a sensitivity study of an offshore wind farm was developed by Koukal and Breitner (2013) and Castro-Santos and Diaz-Casas (2015), but these studies considered steel platforms, not concrete ones.

Crystal Ball™ systematizes the procedure about a estimation model already built considering a Montecarlo simulation, which permits to study the probability of occurrence of each of the values, defining the behavior of the variables. Therefore, the this technique produces probability distribution for the inputs, which generates thousands of outputs. It assists to the decision-making processes (Google, 2021).

Montecarlo simulation spreads uncertainties in the inputs into uncertainties in the outputs, generating probability distributions. Then, the software computes the effects on the output variables bearing in mind the possible variations in the input variables. Consequently, the data achieved can be analyzed to reduce risks in the future of floating offshore wind farms composed by concrete platforms.

The present study will analyze the influence that the principal parameters in the offshore wind energy farm have regarding the principal economic feasibility indicators: NPV, IRR, DPBP and LCOE (Henderson et al., 2004). Therefore, the inputs and outputs should be defined.

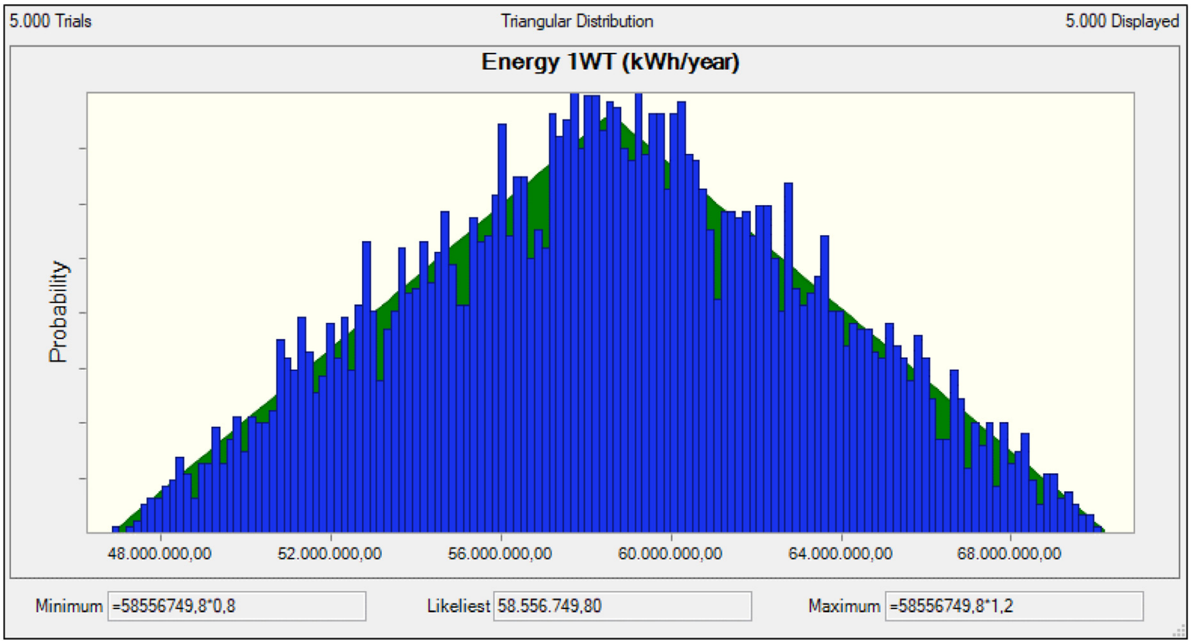

Fig. 6. Distribution considered for the energy produced by one wind turbine.
Source: Own elaboration.

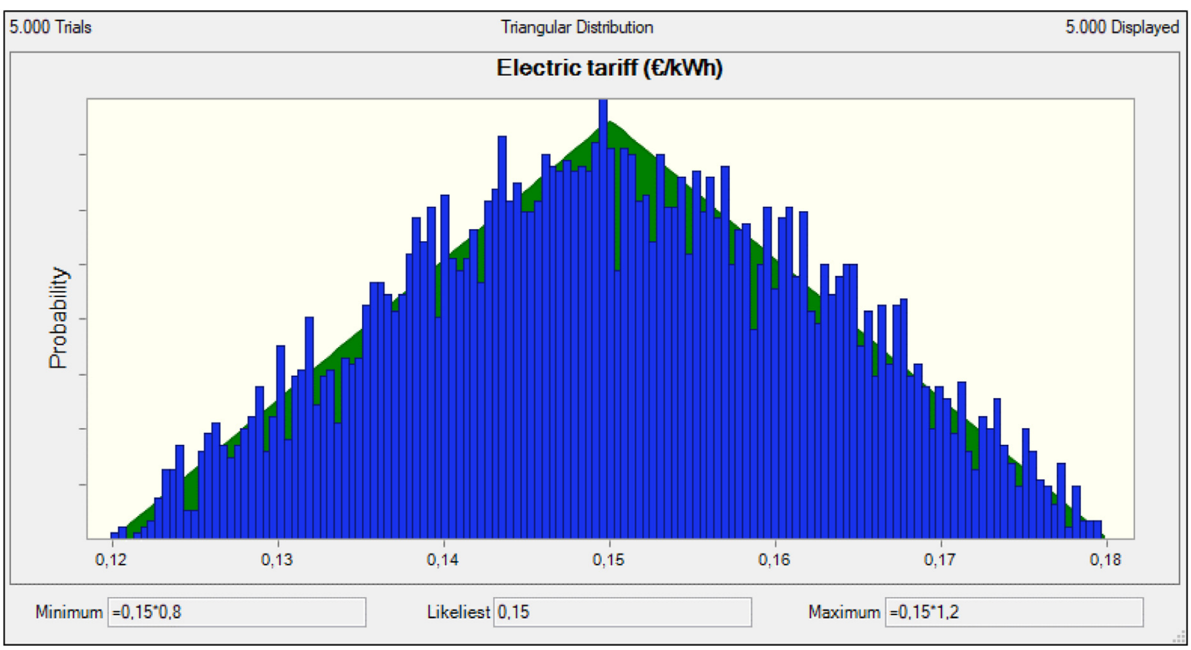

Fig. 7. Distribution considered for the electric tariff.
Source: Source: own elaboration.

Input variables are statistical distributions adjusted to the deviations in time. They have been selected taking into account the work of Castro-Santos and Diaz-Casas (2015). They are listed in Table 1: distance offshore farm-shore, number of offshore wind generators, energy produced by one wind turbine, electric tariff, capital cost, corporate tax and interest rate. For all the inputs a triangular distribution varying a 20% around the most feasible value will be considered, considering that these values can suffer variations in future. Although a different value of % can be used in the model, this work will consider the same variation for all the inputs in order to simplify the study.

The present sensitivity study has taken into consideration the **outputs** indicated in Table 2: Internal Rate of Return (IRR), Discounted Pay-Back Period (DPBP), Net Present Value (NPV) and Levelized Cost Of Energy (LCOE).

Fig. 1 is shown all the input and outputs considered in the present paper.

3. Case of study

In the case of study analyzed, the Montecarlo simulation has been developed for 5000 iterations.

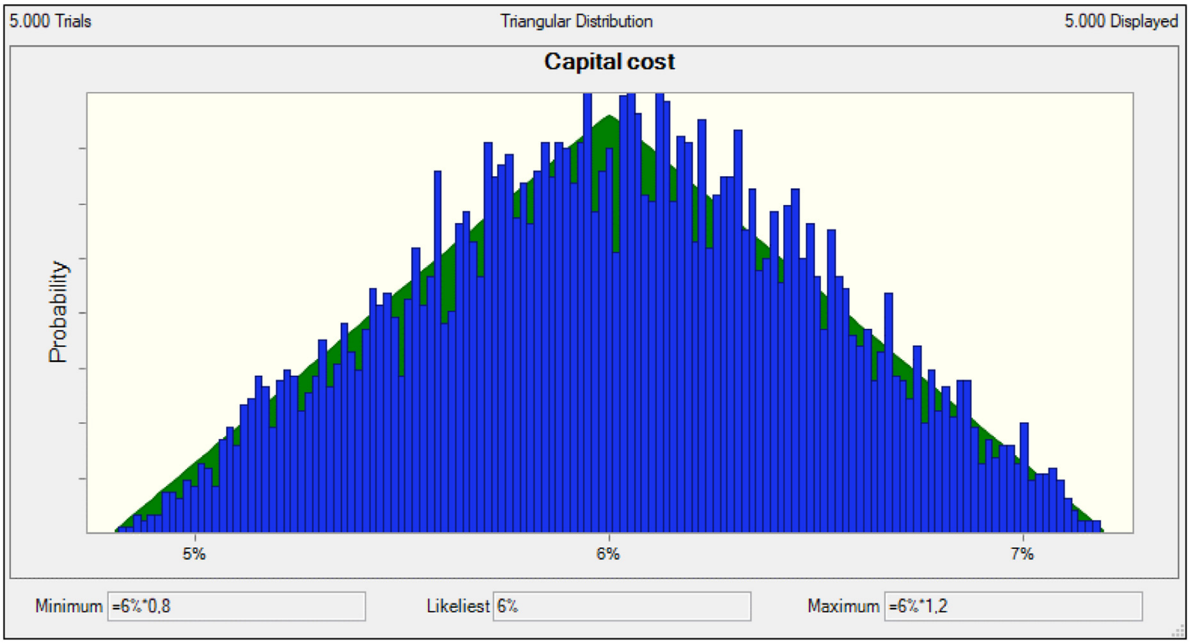

Fig. 8. Distribution considered for the capital cost.
Source: Own elaboration.

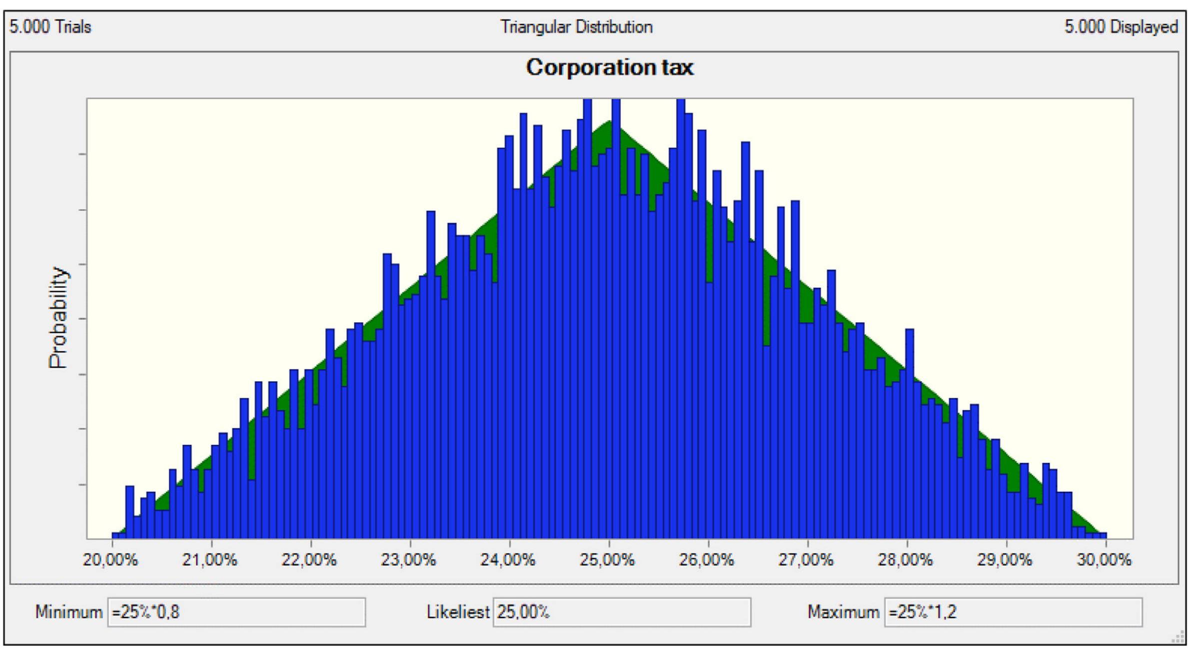

Fig. 9. Distribution considered for the corporation tax.
Source: Own elaboration.

The platform selected in this paper is the SATH® concept designed by the SAITEC enterprise (see Fig. 2). Considering the turbine that this floating structure must support, the ARCWIND project has selected the DTU 10 MW Reference Wind Turbine (Bak et al., 2013).

In addition, the work developed on the ARCWIND research project, which has also financed the present work, has considered two offshore wind farms, as Table 3 is shown. They were selected in previous papers by other partner of the project (Díaz and Guedes Soares, 2020).

The locations of the farms shown in Fig. 3: (a) Figueira da Foz (Portugal) and (b) A15 Scotland (UK).

However, for the sensitivity analysis, only the location that gave the best results in economic terms has been analyzed, because the dependence of the variables of each case of study will be the same, independently on the location selected, because the model is the same. In this context, the location where the sensitivity analysis has been analyzed has been selected considering the best LCOE in this area. It is important to notice that the values considered are for a particular electric tariff of 150 €/MWh (Filgueira-Vizoso et al., 2022) and a capital cost of 6%. In this sense, Table 4 shows in blue the best values of each case of study: A15 Scotland (UK). Therefore, it will be the location studied in the sensitivity analysis.

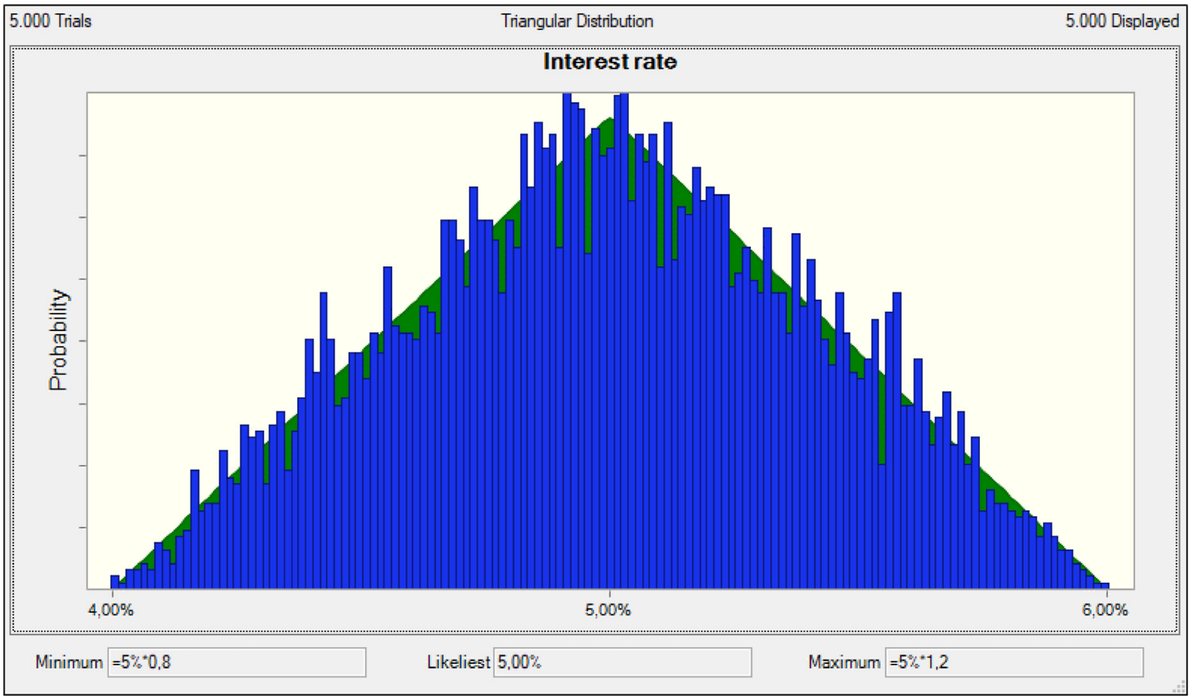

Fig. 10. Distribution considered for the interest rate.
Source: Own elaboration.

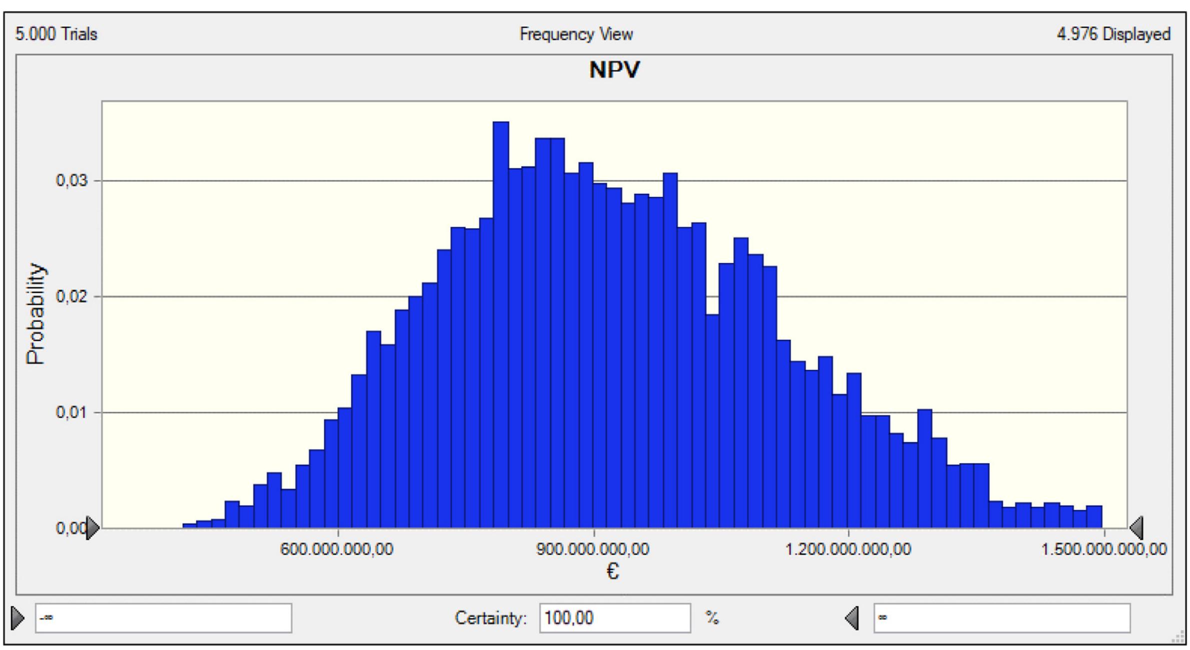

Fig. 11. NPV distribution.
Source: Own elaboration.

On the other hand, the most probable values for the input variables taken into account in this sensitivity study are shown in Table 5. There are values that are the same for all the platforms, such as the electric tariff, the capital cost, the corporate tax and the interest rate; and there are values whose value depends on the case of study considered such as the distance from farm to shore, the number of OWT and the energy produced.

4. Results

The distributions of all the inputs are shown from Figs. 4 to 10.

The statistics of all the inputs are shown in Table 6. It is shown that the mean for all the inputs is similar to the base case considered.

The percentiles of all the inputs (corporation tax, number of offshore wind turbines, energy produced by one offshore wind turbine, distance from farm to shore, electric tariff, interest rate and capital cost) are shown in Table 7.

The distributions of all the outputs are shown from Figs. 11 to 14.

The statistics of all the outputs are shown in Table 8. It shows a minimum and maximum value of 5 and 13 years for DPBP, of 327 M€ and 1819 M€ for NPV, of 44.69 €/MWh and 74.36 €/MWh

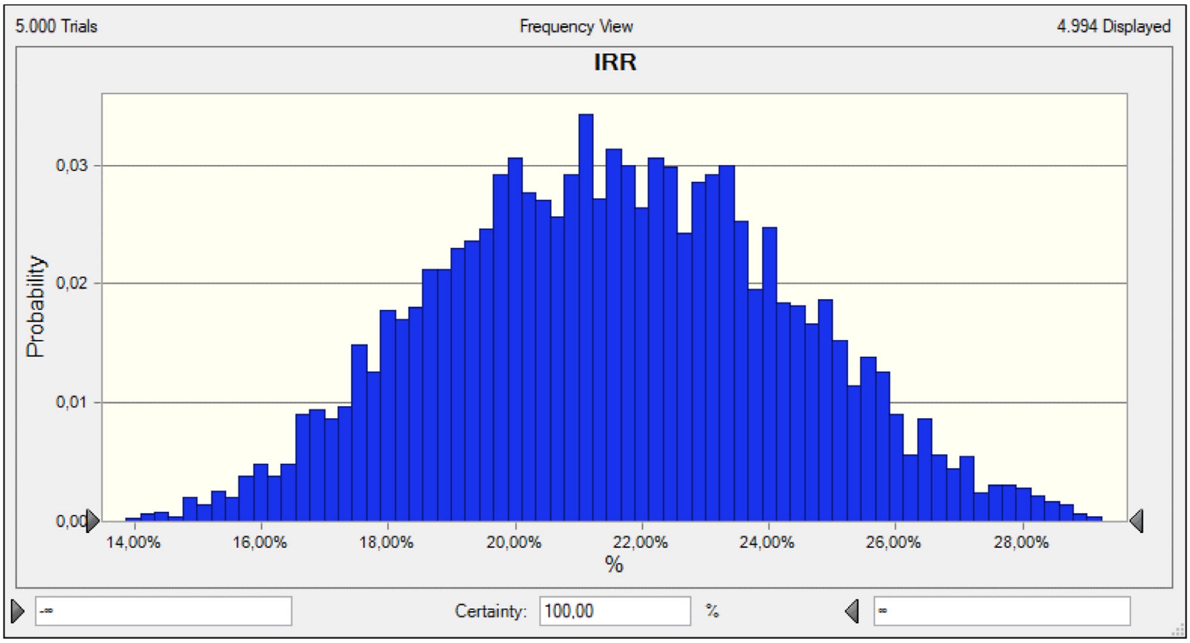

Fig. 12. IRR distribution.
Source: Own elaboration.

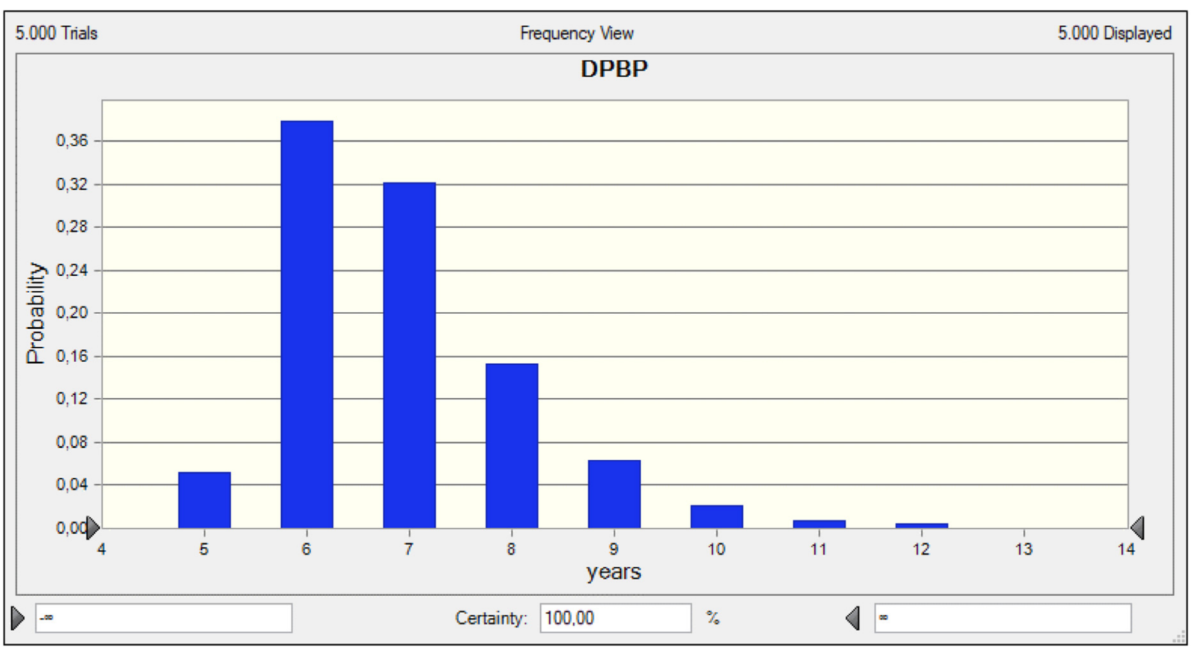

Fig. 13. DPBP distribution.
Source: Own elaboration.

for LCOE and 13.40% and 30.96% for IRR. In addition, it shows that the mean of all the outputs is very similar to the base case proposed.

The percentiles of all the outputs (DPBP, NPV, LCOE and IRR) are shown in Table 9.

The sensitivity charts of all the outputs are shown from Figs. 15 to 18.

Regarding NPV, it shows that the most important inputs in the calculation of the NPV are the electric tariff, the energy produced by one offshore wind turbine and the number of offshore wind turbines, representing them 39.3%, 37.6% and 16.3% respectively, having a positive influence (increases of these variables make increases of NPV). In addition, other variables such as the capital cost, the interest rate and the corporation tax have an effect of −3.8%, −1.7% and −1.2% respectively, having an opposite influence (increases of these variables make decreases of NPV).

Regarding IRR, it shows that the most important inputs in the calculation of the IRR are the electric tariff, the energy produced by one offshore wind turbine and the number of offshore wind turbines, representing them 48.5%, 46.1% and 2.8% respectively, having a positive influence (increases of these variables make

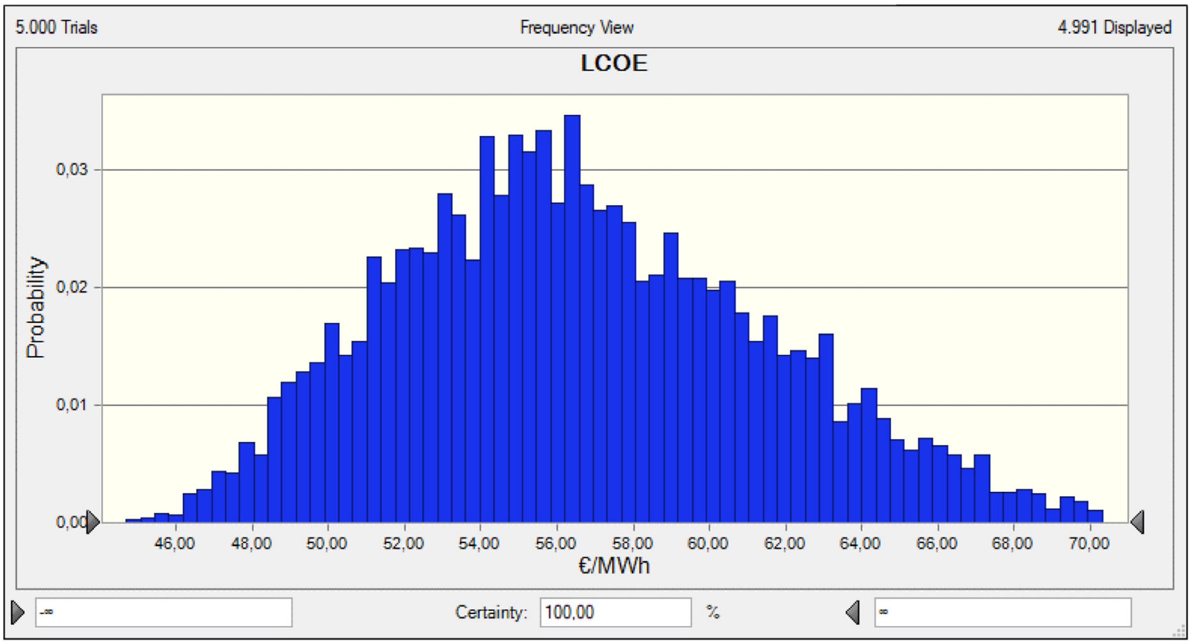

Fig. 14. LCOE distribution.
Source: Own elaboration.

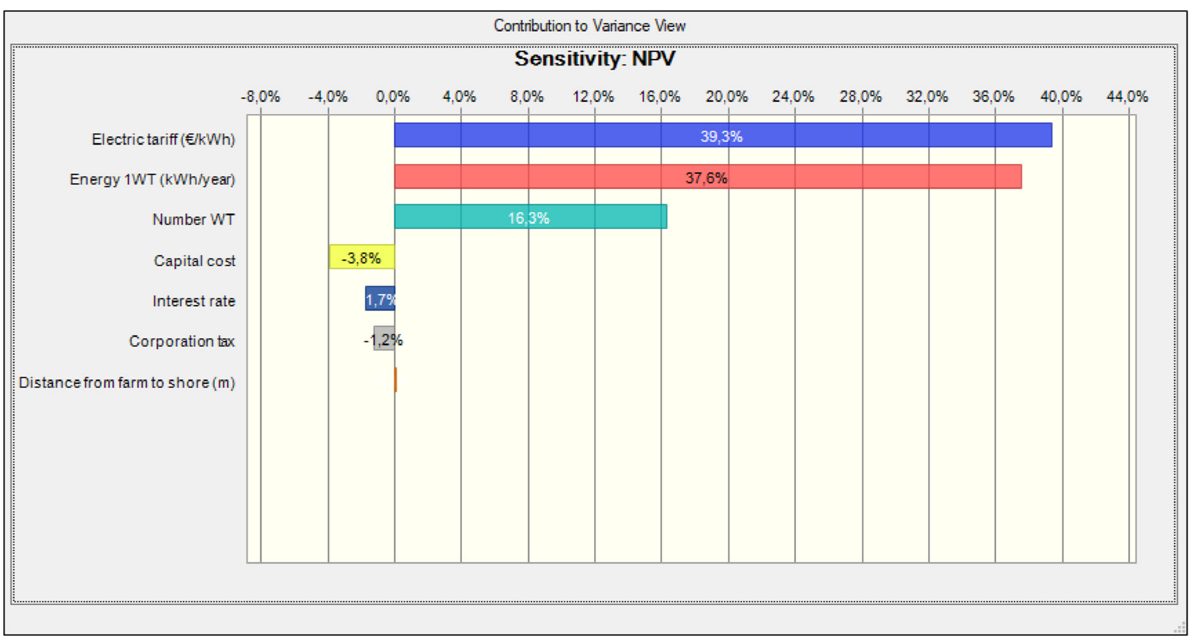

Fig. 15. NPV sensitivity chart.
Source: Own elaboration.

Table 1
Input variables.

Input	Units
Distance farm-shore	m
Number of Offshore Wind Turbines (OWT)	Wind turbines
Energy produced by 1 WT	kWh/year
Electric tariff	€/kWh
Capital cost	%
Corporate tax	%
Interest rate	%

Table 2
Output variables.

Input	Units
NPV	€
IRR	%
DPBP	Years
LCOE	€/MWh

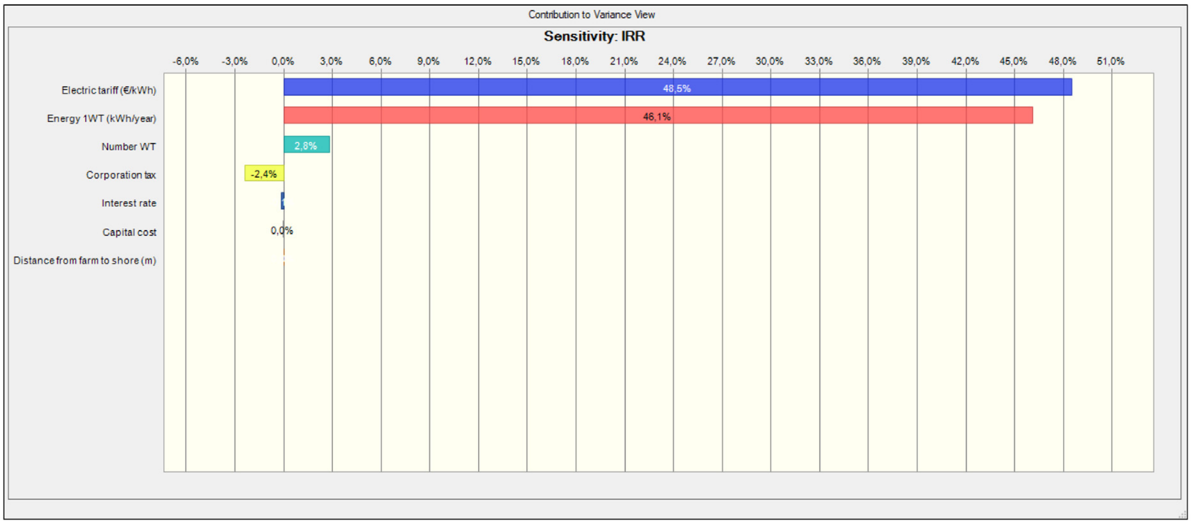

Fig. 16. IRR sensitivity chart.
Source: Own elaboration.

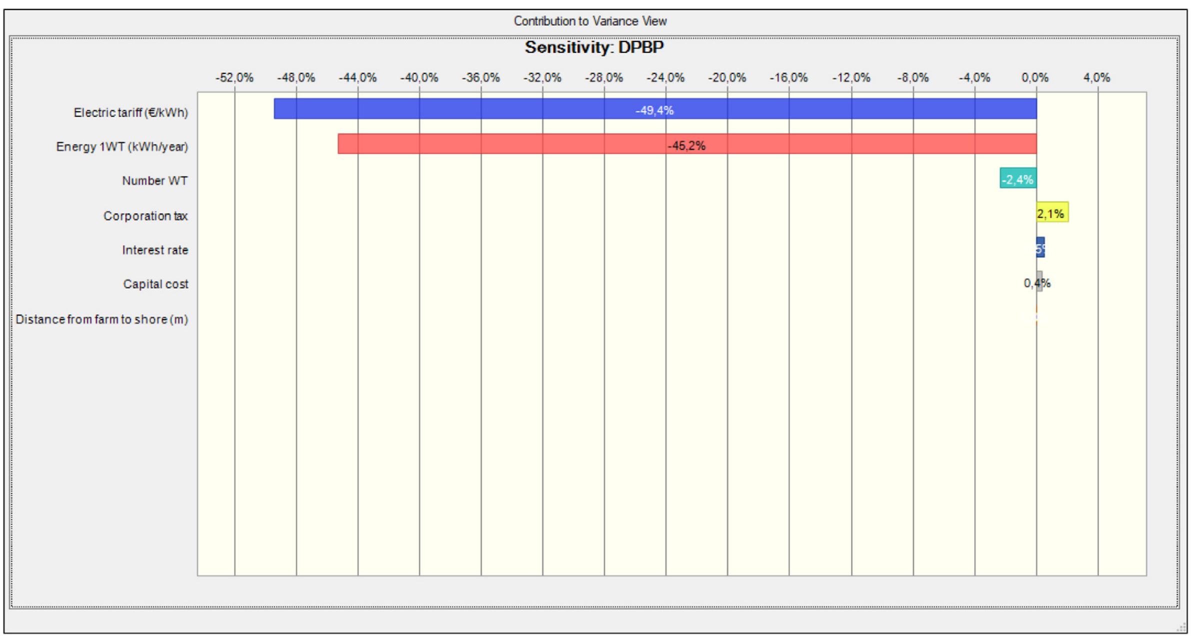

Fig. 17. DPBP sensitivity chart.
Source: Own elaboration.

Table 3
Characteristics of the offshore wind farms considered.

Number of farm	Farm 1	Farm 2
Location	Figueira da Foz (Portugal)	A15 Scotland (UK)
Coordinates	40.21N 09.56 W	58.00N 06.25 W
Depth (m)	150	150
Distance farm-shore (km)	51	15
Number of offshore wind turbines	70	18
Total power of the farm (MW)	700	180
Type of platform	SATH platform SAITEC	SATH platform SAITEC

Table 4
Farms selected to carry out the sensitivity study.

Platform	Location	LCOE (€/MWh)
SATH	Figueira da Foz (Portugal)	65.11
SATH	A15 Scotland (UK)	56.07

increases of IRR). In addition, other variables such as the corporation tax have an effect of −2.4%, having an opposite influence (increases of this variable make decreases of IRR). It is important to notice that capital cost does not have influence on the IRR calculations.

Regarding DPBP, it shows that the most important inputs in the calculation of the DPBP are the electric tariff, the energy produced by one offshore wind turbine and the number of offshore wind turbines, representing them −49.4%, −45.2% and −2.4% respectively, having an opposite influence (increases of these variables make decreases of DPBP). In addition, other variables such as the corporation tax have an effect of 2.1%, having a direct influence (increases of this variable make increases of DPBP).

Regarding LCOE, it shows that the most important input in the calculation of the LCOE are the energy produced by one offshore

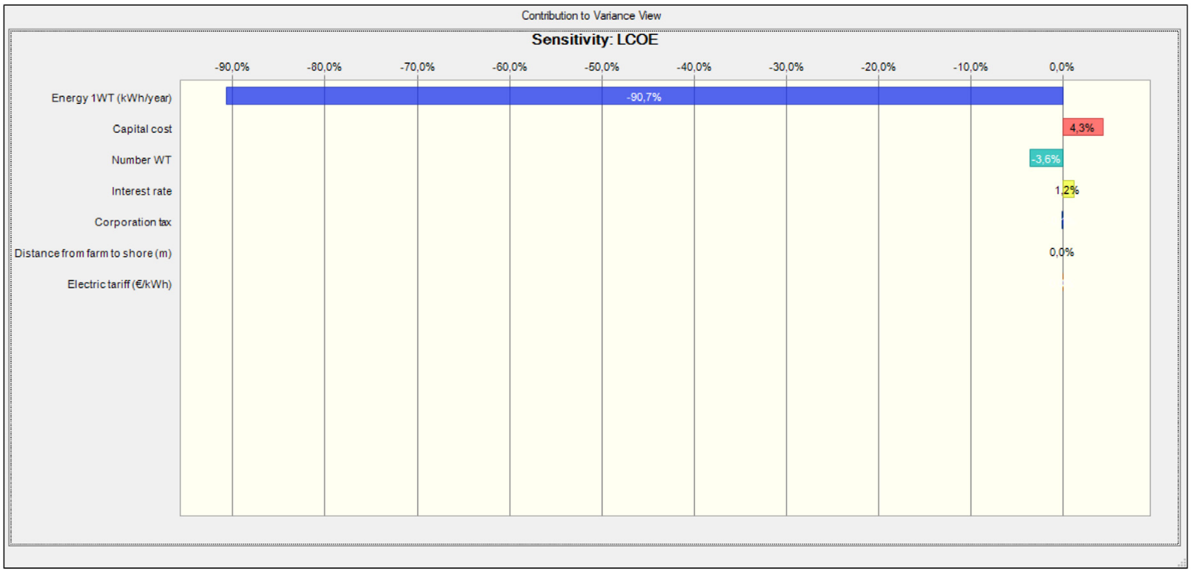

Fig. 18. LCOE sensitivity chart.
Source: Own elaboration.

Table 5
Most probable values for the input variables.

Input	Case of study A15 Scotland (UK)	Units
Distance from farm to shore	15,000	m
Number of OWT	18	Wind turbines
Energy produced by 1 OWT	58,556,749.80	kWh/year
Electric tariff	0.150	€/kWh
Capital cost	6%	–
Corporate tax	25%	–
Interest rate	5%	–

wind generator, the capital cost and the number of offshore wind turbines, representing them −90.7%, 4.3% and −3.6% respectively. Therefore, if energy is increased the LCOE is reduced, if capital cost is increased LCOE is increased and if number of offshore wind turbines are increased LCOE is reduced. Consequently, the most relevant variable considering the LCOE is the energy produced, which indicates the important of the location of the farm in these terms.

5. Conclusions

This work has developed a sensitivity analysis to study the most relevant parameters that affects to the economic feasibility of an offshore wind farm. The main purpose was to analyze how the input variables such as number of offshore wind turbines, the energy produced by one wind generator, the interest rate, the capital cost, the electric tariff, etc. affect to the output variables: Internal Rate of Return (IRR), Net Present Value (NPV), Discounted Pay-Back Period (DPBP) and Levelized Cost Of Energy (LCOE) of the considered offshore wind farm.

The sensitivity analysis studied the variations of outputs when the inputs are varying, converting the spreadsheet in a lab, modeling uncertainty under several scenarios and considering Montecarlo simulation.

Moreover, this document considered only a location with good values of LCOE for the SATH® platform. This location is called A15 and it is located in Scotland (UK).

Results show the most relevant inputs in terms of their influence on NPV, IRR and DPBP are the electric tariff, the energy generated and the number of offshore wind generators. Regarding NPV, there are other input variables such as the capital cost, the interest rate or the corporation tax that have less importance. Regarding IRR and DPBP, the corporation tax has also a little influence on its calculation.

On the other hand, the most important inputs in terms of calculating the LCOE are the energy produced by one offshore wind turbine, the capital cost and the number of offshore wind generators, being the most important one the energy produced, which represents more than 90% of the influence.

This study gave us an important knowledge about what are the most important variables that have influence in the economic calculation of a floating offshore wind energy farm in the Atlantic Area of the European Union, which as a great importance in terms of their future installation. Moreover, the study indicates that the relevant variables are very similar independently of the material of which is build the floating offshore wind platform.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: David Cordal Iglesias reports financial support was provided by European Regional Development Fund though the Interreg Atlantic Area Programme.

Data availability

The data that has been used is confidential.

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Table 6
Statistics for the input variables.

Assumption	Corporation tax		Number WT		Energy 1WT (kWh/year)	
Statistic	Assumption values	Triangular distribution	Assumption values	Triangular distribution	Assumption values	Triangular distribution
Trials	5.000	'—	5.000	'—	5.000	'—
Base Case	25,00%	25,00%	18	18	58.556.749,80	58.556.749,80
Mean	24,98%	25,00%	18	18	58.568.563,52	58.556.749,80
Median	24,98%	25,00%	18	18	58.588.777,75	58.556.749,80
Mode	'—	25,00%	'—	18	'—	58.556.749,80
Standard Deviation	2,02%	2,04%	1,46	1,47	4.735.909,41	4.781.138,60
Variance	0,04%	0,04%	2,13	2,16	22.428.837.973. 811,10	22.859.286.314. 265,30
Skewness	−0,0226	0	−8,23E−04	0	−0,0055	2,90E−10
Kurtosis	2,46	5,4	2,42	5,4	2,41	5,4
Coeff. of Variation	0,0808	0,0816	0,0811	0,0816	0,0809	0,0816
Minimum	20,05%	20,00%	14,5	14,4	46.994.502,47	46.845.399,84
Maximum	29,97%	30,00%	21,54	21,6	70.021.523,43	70.268.099,76
Mean Std. Error	0,03%	'—	0,02	'—	66.975,87	'—

Assumption	Distance from farm to shore (m)		Electric tariff (€/kWh)		Interest rate		Capital cost	
Statistic	Assumption values	Triangular distribution	Assumption values	Triangular distribution	Assumption values	Triangular distribution	Assumption values	Triangular distribution
Trials	5.000	'—	5.000	'—	5.000	'—	5.000	'—
Base Case	15.000	15.000	0,15	0,15	5,00%	5,00%	6%	6%
Mean	15.008	15.000	0,15	0,15	5,00%	5,00%	6%	6%
Median	15.013	15.000	0,15	0,15	5,00%	5,00%	6%	6%
Mode	'—	15.000	'—	0,15	'—	5,00%	'—	6%
Standard Deviation	1.232	1.225	0,01	0,01	0,41%	0,41%	0%	0%
Variance	1.517.828	1.500.000	0	0	0,00%	0,00%	0%	0%
Skewness	0,0073	0	0,0074	0	0,0041	0	−0,0155	0
Kurtosis	2,34	5,4	2,33	5,4	2,35	5,4	2,4	5,4
Coeff. of Variation	0,0821	0,0816	0,0827	0,0816	0,0819	0,0816	0,0802	0,0816
Minimum	12.046	12.000	0,12	0,12	4,01%	4,00%	5%	5%
Maximum	17.929	18.000	0,18	0,18	5,99%	6,00%	7%	7%
Mean Std. Error	17	'—	0	'—	0,01%	'—	0%	'—

Table 7
Percentiles for the inputs variables.

Assumption	Corporation tax		Number WT		Energy 1WT (kWh/year)	
Percentile	Assumption values	Triangular distribution	Assumption values	Triangular distribution	Assumption values	Triangular distribution
0%	20,05%	20,00%	14,5	14,4	46.994.502,47	46.845.399,84
10%	22,25%	22,24%	16,02	16,01	52.101.886,10	52.082.874,76
20%	23,18%	23,16%	16,69	16,68	54.275.152,57	54.252.307,91
30%	23,90%	23,87%	17,19	17,19	56.002.320,95	55.916.972,51
40%	24,46%	24,47%	17,63	17,62	57.413.744,34	57.320.349,69
50%	24,98%	25,00%	18	18	58.585.712,94	58.556.749,80
60%	25,54%	25,53%	18,39	18,38	59.798.446,45	59.793.149,91
70%	26,10%	26,13%	18,79	18,81	61.179.692,38	61.196.527,09
80%	26,76%	26,84%	19,3	19,32	62.796.337,09	62.861.191,69
90%	27,69%	27,76%	19,98	19,99	64.942.948,69	65.030.624,84
100%	29,97%	30,00%	21,54	21,6	70.021.523,43	70.268.099,76

Assumption	Distance from farm to shore (m)		Electric tariff (€/kWh)		Interest rate		Capital cost	
Percentile	Assumption values	Triangular distribution	Assumption values	Triangular distribution	Assumption values	Triangular distribution	Assumption values	Triangular distribution
0%	12.046	12.000	0,12	0,12	4,01%	4,00%	5%	5%
10%	13.345	13.342	0,13	0,13	4,44%	4,45%	5%	5%
20%	13.882	13.897	0,14	0,14	4,63%	4,63%	6%	6%
30%	14.319	14.324	0,14	0,14	4,77%	4,77%	6%	6%
40%	14.669	14.683	0,15	0,15	4,89%	4,89%	6%	6%
50%	15.013	15.000	0,15	0,15	5,00%	5,00%	6%	6%
60%	15.326	15.317	0,15	0,15	5,11%	5,11%	6%	6%
70%	15.696	15.676	0,16	0,16	5,22%	5,23%	6%	6%
80%	16.145	16.103	0,16	0,16	5,37%	5,37%	6%	6%
90%	16.696	16.658	0,17	0,17	5,56%	5,55%	7%	7%
100%	17.929	18.000	0,18	0,18	5,99%	6,00%	7%	7%

Table 8
Statistics for the outputs variables.

	Forecast values			
	DPBP	NPV	LCOE	IRR
Trials	5.000	5.000	5.000	5.000
Base Case	7	920.746.987,90	56,12	21,62%
Mean	6,91	923.125.417,34	56,61	21,55%
Median	7	906.956.039,91	56,22	21,53%
Mode	6	808.886.792,88	56,25	22,82%
Standard Deviation	1,19	204.698.246,30	4,89	2,75%
Variance	1,41	41.901.372.036.920.700,00	23,93	0,08%
Skewness	1,11	0,3657	0,3367	0,0679
Kurtosis	4,8	2,89	2,69	2,63
Coeff. of Variation	0,1716	0,2217	0,0864	0,1274
Minimum	5	327.873.160,29	44,69	13,40%
Maximum	13	1.819.082.717,72	74,36	30,96%
Mean Std. Error	0,02	2.894.870,36	0,07	0,04%

Table 9
Percentiles for the outputs variables.

Percentile	Forecast values			
	DPBP	NPV	LCOE	IRR
0%	5	327.873.160,29	44,69	13,40%
10%	6	669.132.898,87	50,44	17,96%
20%	6	744.230.671,47	52,26	19,13%
30%	6	802.455.135,99	53,75	19,98%
40%	6	853.595.920,62	55,03	20,79%
50%	7	906.857.381,79	56,22	21,53%
60%	7	963.290.424,53	57,44	22,29%
70%	7	1.021.221.092,75	59,03	23,08%
80%	8	1.095.617.397,68	60,86	23,94%
90%	8	1.201.148.759,07	63,27	25,15%
100%	13	1.819.082.717,72	74,36	30,96%

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