Data in Brief xxx (xxxx) xxx

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Complete Dataset to be used as a workbench to evaluate the profitability of an offshore wind farm

Q1 Q2 Angel G. Gonzalez-Rodriguez [a,b,*], Javier Serrano-Gonzalez [a,b], Manuel Burgos-Payan [a,b], Jesus Riquelme-Santos [a,b]

[a] University of Jaen, Spain
[b] University of Seville, Spain

ARTICLE INFO

Article history:
Received 23 March 2022
Revised 8 June 2022
Accepted 14 June 2022
Available online xxx

Keywords:
Component costs
Cable characteristics
CAPEX
Wind data
Bathymetry

ABSTRACT

The presented data collection has been used in the paper *Multi-objective optimization of a uniformly distributed offshore wind farm considering both economic factors and visual impact*, but can be used for a realistic evaluation of the annual energy production of an offshore wind farm and/or the calculation of the project investment cost. It contains realistic wind data, a bathymetric map, the definition of the coast shoreline and forbidden zones, as well as the acquisition and installation cost for the most important components influencing the investment and operation costs.

1 Specifications table

DOI of original article: 10.1016/j.seta.2022.102148
* Corresponding author.:
E-mail address: agaspar@ujaen.es (A.G. Gonzalez-Rodriguez).

https://doi.org/10.1016/j.dib.2022.108396

Table 2
Values for probability, and Weibull parameters (scale factor A at 62 m and shape factor WeibK) for every sector.

	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
freq (%)	3.8	4.3	5.5	8.3	8.7	6.7	8.4	10.5	11.4	12.2	13.9	6.1
$Weib_A$ (m/s)	8.71	9.36	9.29	10.27	10.89	10.49	10.94	11.23	11.93	11.94	12.17	10.31
$Weib_K$	2.08	2.22	2.41	2.37	2.51	2.75	2.61	2.51	2.33	2.35	2.58	2.01

Subject	mental Engineering.
Specific subject area	nic evaluation of an offshore wind farm
Type of data	
	Map
	Wind rose
How the data were acquired	globalwindatlas.info and https://www.researchgate.net/publication/348571118_A_Minimalistic_Predictio
	Wind data obtained from a from a real square lattice mast erected in 1999. It has four measurement levels, although only those
	Characteristics and prices of electrical components from reports, articles, thesis, and catalogues [1]
	Power and Thrust curve for Vestas V80 from [2]
	Macro-economic data and energy price recovered from [3], and originally obtained from [4][5][6][7]
Data format	f existing tables for wind data and power curve
	Analyzed: Economic data have been obtained from different countries and years, and have been converted into euros at 2017
	Captured: From geographical maps.
Description of data collection	costs from different countries and years, obtained data from manufacturers or existing projects we
	A customized application captured the coordinates from the map of Figure 2, and create a set of arrays containing the coordinate
Data source location	all
	• Horns Rev 1:
	• Denmark:
	• Latitude: 55° 29' 9.5"; Longitude: 7° 50' 23.9"; (423974, 6151447) - (429431, 6147543) Depth: -10 m; Distance from shore: 18 k
Data accessibility	: Mendeley Data [8]
	• Data identification number: DOI:10.17632/btzfbjh49b.1
	• Direct URL to data: https://data.mendeley.com/datasets/btzfbjh49b/1
Related research article	***has been accepted and is in press:*** Angel G. Gonzalez-Rodriguez, Javier Serrano-Gonzalez, Manuel Burgos-Pa

Value of the Data

- These data are useful as a complete set of values for the evaluation of technical, economic or environmental issues in a real offshore wind farm. Specifically, bathymetric and wind data are related to Horns Rev I. Often, searching for coherent values related to the site, or to the costs and characteristics of offshore wind farm components is a tedious and hard task required prior to test any algorithm or method. By using these data, researchers can focus on developing their ideas.
- Researcher working in the areas of layout optimization, macro-siting, electrical infrastructure design, noise reduction, visual impact.
- Results obtained after using these data can be compared the obtained values with those obtained from e.g. [4] or [3]

Data Description

Table 2 presents the wind rose (frequency for every wind direction) as well as the mean of the Weibull parameters for every wind direction at Horns Rev. Figure 1 represents this table, and specifies the probability that corresponds to certain speed intervals. In this figure, only values between cut-in speed and cut-out speed are represented.

Please cite this article as: A.G. Gonzalez-Rodriguez, J. Serrano-Gonzalez and M. Burgos-Payan et al., Complete Dataset to be used as a workbench to evaluate the profitability of an offshore wind farm, Data in Brief, https://doi.org/10.1016/j.dib.2022.108396

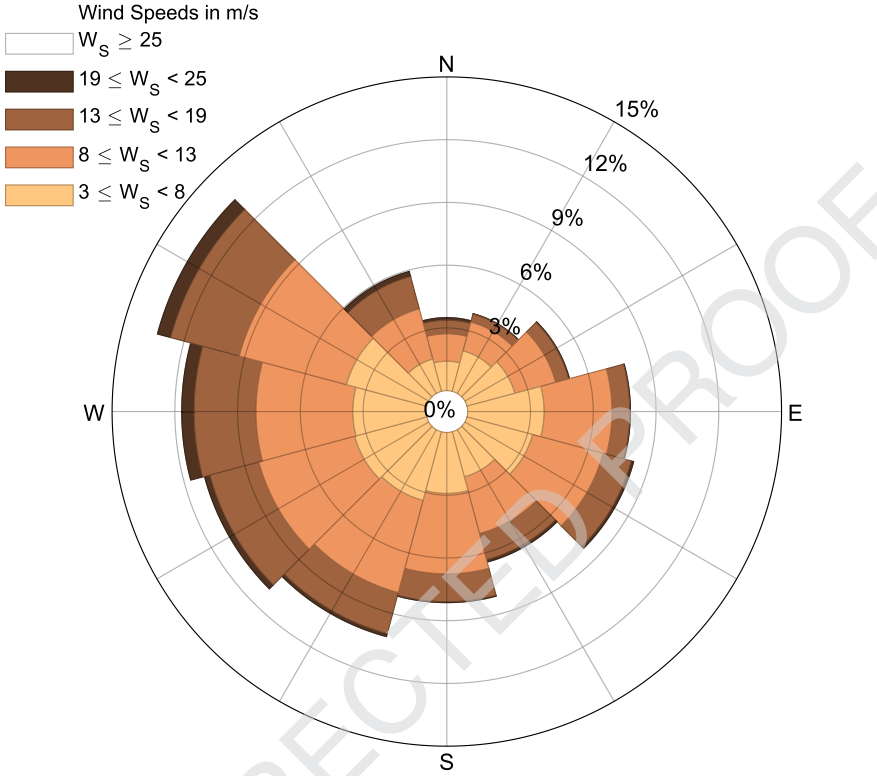

Fig. 1. Wind rose obtained from [2]. Only values between cut-in speed and cut-out speed are represented

Table 3
Power and Thrust curve for Vestas V80

Wind speed (m/s)	1	2	3	4	5	6	7	8	9	10	11	12	13
Power (kW)	0	0	0	66	154	282	460	696	996	1341	1661	1866	1958
Thrust coef	0	0	0	0.818	0.806	0.804	0.81	0.81	0.807	0.793	0.739	0.709	0.409
Wind speed (m/s)	14	15	16	17	18	19	20	21	22	23	24	25	
Power (kW)	1988	1997	1999	2000	2000	2000	2000	2000	2000	2000	2000	2000	
Thrust coef	0.314	0.249	0.202	0.17	0.14	0.119	0.102	0.088	0.077	0.067	0.06	0.05	

Table 3 shows the power and thrust curve for a wind turbine model Vestas V80.

Table 4 presents required data to calculate the yearly cash flow obtained by selling the produced energy, after subtracting the operation and maintenance costs.

Table 5 contains the main costs in an offshore wind farm, which are the acquisition and installation of turbines and foundations.

Table 6 contains the cost of secondary non-electrical components necessary to calculate the investment cost. Table 7 lists price and characteristics for different model of medium-voltage cables, to be used for connecting turbines in a row.

Table 8 lists price and characteristics for high-voltage cables with different capacities, to be used as transmission cables, both offshore and onshore.

Table 9 presents the remaining components of the electrical infrastructure.

Figure 2 represents the map site, including depth curves (D1, D2, D3, D4, D5 and D6), forbidden zones (F1, F2, F3), concession area (C1), and coast shoreline. It also includes possible locations for observers in order to evaluate the visual or noise impact.

Please cite this article as: A.G. Gonzalez-Rodriguez, J. Serrano-Gonzalez and M. Burgos-Payan et al., Complete Dataset to be used as a workbench to evaluate the profitability of an offshore wind farm, Data in Brief, https://doi.org/10.1016/j.dib.2022.108396

Table 4
Items affecting the yearly cash flow

Concept	Cost
O&M Costs	15 € /MWh
Increase	5% per year
Surface and insurances	included in O&M
Price of energy	130 € /MWh
Increase	0% per year
Availability	95%
Life Time	20 years
Interest rate	9.40%
Inflation	1.5 %

Table 5
Main costs affecting the investment

Concept	Cost
Turbines	
Acquisition	765 k€ /MW
Installation	405 k€ /MW
Foundations	
Reference price	450 € /MW at 15 m depth, Zone 1
Increase	+2 % per metre depth +30 % for zone 2 +60 % for zone 3
Vessels mob demob	430 k

Table 6
Secondary non electrical items affecting the investment and decommissioning

Concept	Cost
Design and management	95 kMW
SCADA	50 k€ /turbine
Decommission	120 k€ /MW

Tables 10, 11, and 12 list the sequence of points defining the depth curves, forbidden/concession areas, and coast shoreline, respectively, which are visualized in Figure 2.

The Excel file in [8] has several sheets with these data:

ographic. Size of the workspace, number of sectors for the wind rose, roughness height, reference height, the wind rose, and value of Weibull parameters for each sector.

Economic. Type of currency, interest rate, inflation, life time, energy price, availability, decommissioning cost, SCADA cost and O&M costs.

lgorithm. Typical values for a genetic or evolutive algorithm.

Turbine. Rated capacity, diameter, rotor height, price, installation cost, power curve, thrust curve.

ndations. Mobilitation/demobilitation cost, foundation cost, cost increment as a function of the depth and the load-bearing capacity.

ical Data. All data related to cables and electrical infrastructure.

Depths. Depth curves obtained from the bathymetric charts.

Soil. Curves defining the different types of soil as a function of the load-bearing capacity.

orb Conc. Curves defining the forbidden zones (e.g. too close to the coast or extraction areas) as well as the concession areas.

Coast. Curve defining the coast shoreline.

Impact. Sensitive positions where impact can be measured, as well as the observation height.

Experimental design, materials and methods

Please cite this article as: A.G. Gonzalez-Rodriguez, J. Serrano-Gonzalez and M. Burgos-Payan et al., Complete Dataset to be used as a workbench to evaluate the profitability of an offshore wind farm, Data in Brief, https://doi.org/10.1016/j.dib.2022.108396

Table 7
Acquisition cost of inner array cables.

Cross area mm^2	Fixed losses W/m	Variable losses W/A^2m	I_{max} A	Price € /m
A95	0	7.14E-4	380	128
A150	6	4.35E-4	430	192
A400	24	1.92E-4	680	321
A630	34	1.23E-4	780	481
A800	50	0.86E-4	900	506
B95	0	8.33E-4	260	384
B150	6	5E-4	360	417
B400	8	1.72E-4	640	514
B630	10	1.11E-4	790	535
B800	12	0.86E-4	900	616
Additional cable length for connections:				
				40 m/turbine

Table 8
Acquisition cost of export and HV onshore cable

			Export cable		Onshore cable	
Voltage (kV)	Section (mm^2)	Var.Loss W/A^2m	Capac. (MVA)	Cost (€ /m)	Capac. (MVA)	Cost (€ /m)
220	500	6E-5	250	843	273	233
220	630	5E-5	273	946	297	266
220	800	4E-5	295	1061	314	299
220	1000	3E-5	314	1214	348	367

Table 9
Electrical items affecting the investment

Concept	Cost
Acq. MV cables	see Tab.7
Installation	120 € /m
Acq. export cables	see Tab.8
Installation	170 € /m
Acq. onshore cables	see Tab.8
Inst. onshore cables	400 € /m
Offshore substation	76 k€ /MW
Offshore trafo	19 k€ /MW
Vessels mob demob	430 k€
Reactive Compens.	128 kMVA
Onshore substation	49 k€ /MW
Onshore trafo	11 k€ /MW
Conn. to grid	200 k€ /MW
Shoreline	1.65 M€
OWF Power factor	0.85

The economic and technical data have been obtained from a deep review of technical reports, articles, and thesis. The source of this information is in [1].

Wind data regarding Horns Rev site has been obtained from [2]. This data were obtained from a real square lattice mast erected in 1999 at Horns Rev. It had four measurement levels, although only those from 62 meters (the highest one) have been used. Since this is not the tower height, it is necessary to adjust the scale parameter A from the measurement height ($z_{ref} = 62\ m$) to the hub height ($z_{hub} = 70\ m$) due to the wind shear effect. The relationship between scale factors, and in general between wind speeds, at different heights is given by

$$A = A_{ref}\frac{\ln(z_{hub}) - \ln(z_0)}{\ln(z_{ref}) - \ln(z_0)} \quad (1)$$

Please cite this article as: A.G. Gonzalez-Rodriguez, J. Serrano-Gonzalez and M. Burgos-Payan et al., Complete Dataset to be used as a workbench to evaluate the profitability of an offshore wind farm, Data in Brief, https://doi.org/10.1016/j.dib.2022.108396

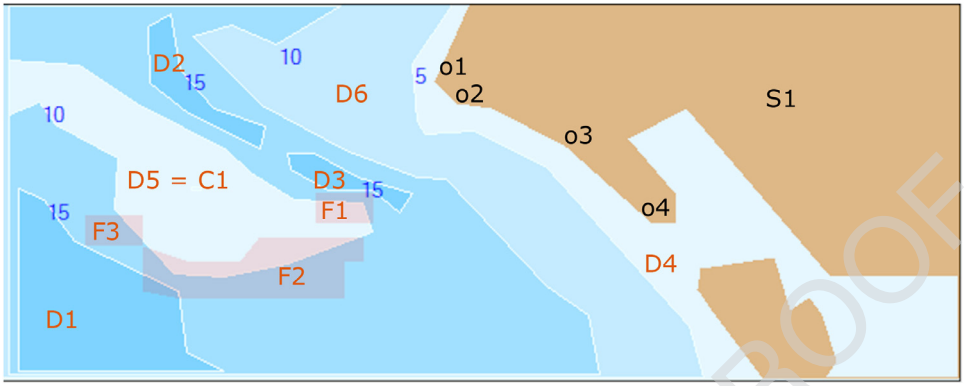

Fig. 2. Site map for Horns Rev I with depth curves (Dx), forbidden zones (Fx), concession area (C1), coast shoreline (S1) and observer positions (ox). Obtained from [8].

Table 10
Sequence of points defining the depth curves. Coordinates given in percentage (%)

Depth	15	Symbol in map: D1
(2.0, 50.5)-(4.7, 47.5)-(7.9, 36.3)-(18.7, 23.4)-(19.6, 7.1)-(23.5, 2.0)-(2.0, 2.0)-(2.0, 50.5)		
Depth	15	Symbol in map: D2
(17.9, 96.7)-(18.9, 82.0)-(22.5, 71.8)-(27.7, 67.0)-(27.2, 61.2)-(19.7, 70.6)-(15.8, 78.4)-(15.6, 93.1)-(17.9, 96.7)		
Depth	15	Symbol in map: D3
(33.0, 59.9)-(37.5, 53.3)-(43.1, 49.2)-(41.8, 44.2)-(38.9, 49.7)-(34.3, 49.7)-(30.5, 55.3)-(30.1, 59.9)-(33.0, 59.9)		
Depth	5	Symbol in map: D4
(47.3, 99.8)-(43.2, 83.8)-(43.6, 68.3)-(44.5, 64.7)-(49.4, 65.7)-(57.0, 55.8)-(71.9, 14.0)-(73.4, 0.3) -(0.3, 0.3)-(0.3, 99.8)-(47.3, 99.8)		
Depth	10	Symbol in map: D5
(1.1, 70.1)-(4.3, 73.4)-(5.9, 67.3)-(12.5, 58.6)-(12.1, 44.7)-(18.3, 27.7)-(23.5, 26.9)-(30.1, 30.2)-(38.9, 39.1) -(38.0, 46.7)-(30.7, 47.2)-(26.2, 54.6)-(23.8, 60.7)-(14.4, 72.8)-(8.4, 83.0)-(1.1, 84.5)-(1.1, 70.1)		
Depth	10	Symbol in map: D6
(35.7, 99.0)-(29.0, 88.6)-(24.2, 93.7)-(20.2, 90.9)-(27.4, 72.3)-(36.1, 60.4)-(43.6, 53.3)-(46.7, 53.0)-(57.0, 24.4) -(61.4, 17.0)-(62.6, 1.0)-(1.0, 1.0)-(1.0, 99.0)-(35.7, 99.0)		

Table 11
Sequence of points defining the forbidden zones and the concession area. Coordinates given in percentage (%)

Forbidden	Symbol in map: F1
(33.0, 49.0)-(39.0, 49.0)-(39.0, 41.0)-(33.0, 41.0)-(33.0, 49.0)	
Forbidden	Symbol in map: F2
(15.0, 35.0)-(15.0, 23.0)-(19.0, 21.0)-(36.0, 21.0)-(36.0, 31.0)-(38.0, 31.0)-(38.0, 37.0) -(27.0, 37.0)-(25.0, 31.0)-(20.0, 31.0)-(15.0, 35.0)	
Forbidden	Symbol in map: F3
(9.0, 43.0)-(9.0, 35.0)-(15.0, 35.0)-(15.0, 43.0)	
Concession	Symbol in map: C1
(1.1, 70.1)-(4.3, 73.4)-(5.9, 67.3)-(12.5, 58.6)-(12.1, 44.7)-(18.3, 27.7)-(23.5, 26.9)-(30.1, 30.2)-(38.9, 39.1) -(38.0, 46.7)-(30.7, 47.2)-(26.2, 54.6)-(23.8, 60.7)-(14.4, 72.8)-(8.4, 83.0)-(1.1, 84.5)-(1.1, 77.2)-(1.1, 70.1)	

Table 12
Sequence of points defining the coast shoreline. Coordinates given in percentage (%)

Coast	Symbol in map: S1
(100.0, 100.0)-(100.0, 0.0)-(79.6, 0.0)-(74.3, 18.3)-(72.7, 23.6)-(73.0, 28.9)-(80.8, 32.2) -(82.4, 18.0)-(84.4, 21.3)-(85.7, 17.0)-(87.3, 4.6)-(86.0, 0.0)-(100.0, 0.0)-(100.0, 27.4) -(86.6, 27.2) -(71.6, 71.8)-(65.5, 63.7)-(70.5, 48.5)-(70.5, 41.4)-(68.0, 41.1)-(59.1, 61.4) -(51.4, 71.8) -(47.8, 72.8)-(45.4, 78.7)-(49.1, 100.0)	

Please cite this article as: A.G. Gonzalez-Rodriguez, J. Serrano-Gonzalez and M. Burgos-Payan et al., Complete Dataset to be used as a workbench to evaluate the profitability of an offshore wind farm, Data in Brief, https://doi.org/10.1016/j.dib.2022.108396

being z_0 the roughness length for the terrain. Its usual value taken for offshore sites is 0.005, which is also consistent with the wind profiles presented in [2].

The power and thrust curve for Vestas V80 has been obtained from [2].

Bathymetry has been obtained from globalwindatlas.info and [9].

Macro-economic data and energy price recovered from [3], and originally obtained from [4][5][6][7]

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Complete Dataset to be used as a workbench to evaluate the profitability of an offshore wind farm (Mendeley Data)

CRediT Author Statement

Angel G. Gonzalez-Rodriguez: Conceptualization, Methodology, Software, Validation, Investigation, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft; **Javier Serrano-Gonzalez:** Validation, Data curation, Investigation, Writing – review & editing; **Manuel Burgos-Payan:** Project administration, Funding acquisition, Writing – review & editing; **Jesus Riquelme-Santos:** Formal analysis, Supervision, Funding acquisition, Writing – review & editing.

Acknowledgment

This work was supported by CERVERA research program of CDTI under the research Project HySGrid+ (CER-20191019).

Appendix A. Input data to the algorithm

Wind data have been obtained from [2]. The measurement height is 62 m, and roughness height is 0.005.

Ethics statements

The authors comply with the ethical guidelines contained in Data in Brief's Guide for Authors.

This work did not involve human subjects.

This work did not involve animal experiments.

This work did not involve data collected from social media platforms.

References

[1] A.G. Gonzalez-Rodriguez, Review of offshore wind farm cost components, Energy Sustain. Dev. 37 (2017) 10–19, doi:10.1016/j.esd.2016.12.001.
[2] A. Sommer, Wind resources at Horns Rev, Tech-wise A/S (2002) 1–69. https://www.yumpu.com/en/document/view/4469663/wind-resources-at-horns-rev
[3] A.G. Gonzalez-Rodriguez, J. Serrano-Gonzalez, M. Burgos-Payan, J.M. Riquelme-Santos, Realistic optimization of parallelogram-shaped offshore wind farms considering continuously distributed wind resources, Energies 14 (10) (2021), doi:10.3390/en14102895.

[4] G. Gerdes, T. Albrecht, S. Zeelenberg, Case Study: European Offshore Wind Farms - A Survey for the Analysis of the Experiences and Lessons Learnt by Developers of Offshore Wind Farms, Technical Report, Deutsche WindGuard GmbH, 2005. https://tethys.pnnl.gov/sites/default/files/publications/A_Survey_for_the_Analysis_by_Developers_of_Offshore_Wind_Farms.pdf
[5] J.A. Voormolen, H.M. Junginger, W.G. van Sark, Unravelling historical cost developments of offshore wind energy in Europe, Energ. Policy 88 (2016) (2016) 435–444, doi:10.1016/j.enpol.2015.10.047.
[6] R. Green, N. Vasilakos, The economics of offshore wind, Energ. Policy 39 (2) (2011) 496–502, doi:10.1016/j.enpol.2010.10.011.
[7] Douglas-Westwood, Offshore wind assessment for Norway, Technical Report, The Research Council of Norway, 2010.
[8] Gonzalez, A. (2021). Input data for optimization. Mendeley Data, V1. 10.17632/btzfbjh49b.1
[9] J.N. Sørensen, G.C. Larsen, A minimalistic prediction model to determine energy production and costs of offshore wind farms, Energies 14 (2) (2021), doi:10.3390/en14020448.

Please cite this article as: A.G. Gonzalez-Rodriguez, J. Serrano-Gonzalez and M. Burgos-Payan et al., Complete Dataset to be used as a workbench to evaluate the profitability of an offshore wind farm, Data in Brief, https://doi.org/10.1016/j.dib.2022.108396