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PROGETTO

PROGETTO PRELIMINARE PER LA REALIZZAZIONE E L'ESERCIZIO DI UN PARCO EOLICO OFFSHORE FLOTTANTE DENOMINATO "ELYMO" UBICATO NELLO STRETTO DI SICILIA

ELABORATO

Titolo:

RELAZIONE PRELIMINARE SULLA PRODUCIBILITA' DEL SITO

Tav: / Doc: R_0006

Scala / Formato: -/ A4

Codice elaborato: PP_R_0006-Relazione_preliminare_producibilità.pdf

REV.	DATA	DESCRIZIONE	ELABORAZIONE	VERIFICA	APPROVAZIONE
00	05/2022	prima emissione	ND	ND	GRV

Details

A.1.1 Prepared for:

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Version control

Version	Description	Date	Drafted	Reviewed	Approved
V00	Initial version	25/02/2022	NF	IP	MG

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1. FOREWORD

GR Value Management S.r.l. (the "**Client**") engaged Vector Renewables Italia S.r.l. (formerly Windfor S.r.l.) as "**Technical Advisor**" (or "**TA**") to perform a Preliminary Energy Yield Assessment based on re-analysis data of a planned offshore wind farm named Stretto di Sicilia (the "**Project**"), located in Sicilia, Italy.

Being the assessment based on re-analysis data characterized by a higher level of uncertainty compared to a measurement on site, the presented energy figures shall be considered as preliminary, and they should be updated when a full year measurement campaign onsite is available.

On the basis of the resulting long-term wind distributions, the expected production of the wind farm has been assessed, using the WAsP wind flow model and WindPRO 3.5. As requested by the **Customer**, the current document will present only the key figures of the wind regime and energy yield assessment undertaken on the proposed Stretto di Sicilia wind farm, in the form of summary tables.

It is stressed that this summary report is not intended to be a thorough report; therefore, the details of the analysis undertaken, and any related assumptions are not provided herein, as this is beyond the agreed scope of work.

2. SITE AREA

The **Client** has supplied the site limits for the **Project**, as shown in Figure 1:

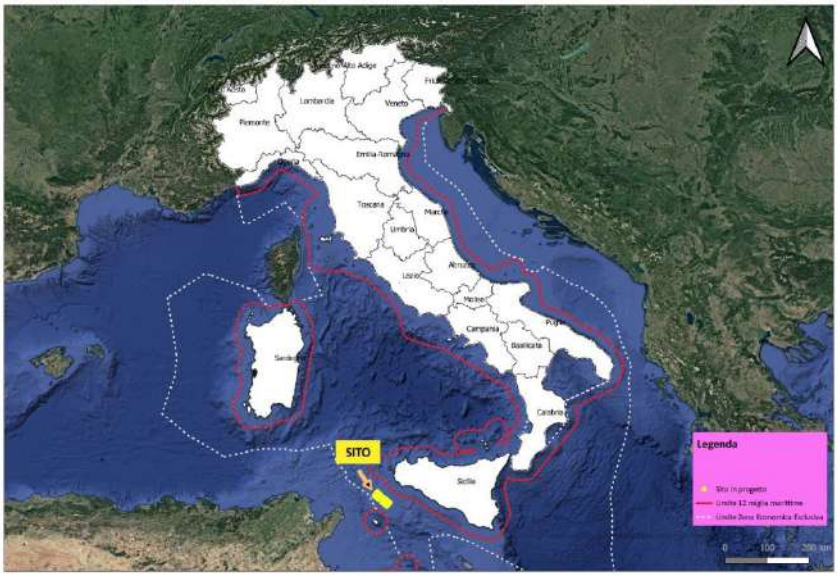


Fig. 1: Site area of the proposed wind farm

The wind farm is located at about 45 km from the Italian coast and a layout has been provided by the **Client** including 86 positions leading to an overall wind farm capacity of 1.032 MW, assuming a 12 MW turbine model.

2.1. Wind turbine model

Due to the lack of wind turbines technical specifications, including power and thrust coefficient curves, the current assessment has been carried out by considering a reference offshore wind turbine model with a swept area in the range of approximately 40000 m^2.

For the purposes of this preliminary analysis, the power and thrust curve has been considered at the air density at sea level, equal to 1.225 kg/m^3 and adjusted to the site air density estimated for the **Project** of 1.19 kg/m^3 according to the IEC 61400-12 method correction.

For the following analysis, the hub height of approximately 140 m was assumed in order to maintain a buffer of 25 m between the sea surface and the lower tip blade.

3. WIND RESOURCE ASSESSMENT

Since no measurements are available for the **Project**, for the current study the **Client** has requested to use re-analysis data to initialise the wind flow model WAsP and extrapolate the wind conditions to the wind turbine locations.

The **Technical Advisor** has acquired and used some long-term nodes of 10 years re-analysis data downscaled at the site, created using mesoscale modelling, with 3 km resolution, based on ERA5 climate re analysis data produced by the European Centre for Medium-Range Weather Forecasts (ECMWF).

Such datasets were evaluated and interpolated to account for horizontal wind speed gradients and potential wind direction turns across the site. Due to lack of information on the wind resource close the Project area, no adjustment has been applied to the mesoscale data. Therefore, caution is advised in the interpretation and use of the following results since re-analysis data do not replace an on-site measurement campaign and necessarily imply a high degree of uncertainty.

The re-analysis data are 10-year long and therefore can be considered as long-term data and they are provided every 10 m height from 50 m up to 200 m.

The following figure shows the energy and the wind rose for twelve sectors and wind speeds bins representative of the site.

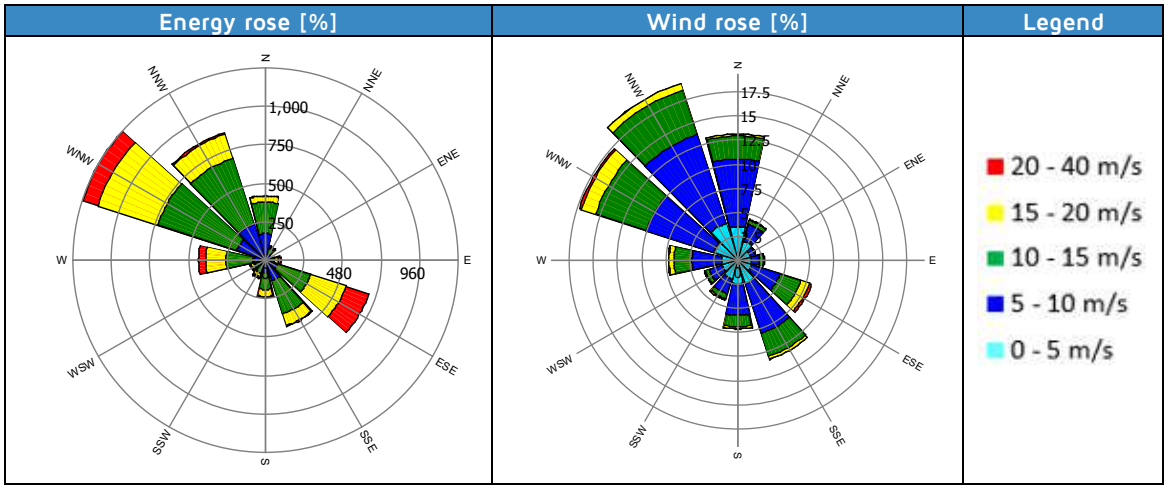


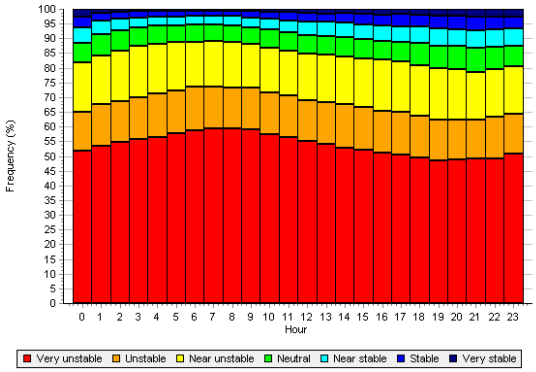
Fig. 2 – Site representative energy and wind roses for twelve sectors and wind speeds bins at hub height

3.1. Atmospheric stability

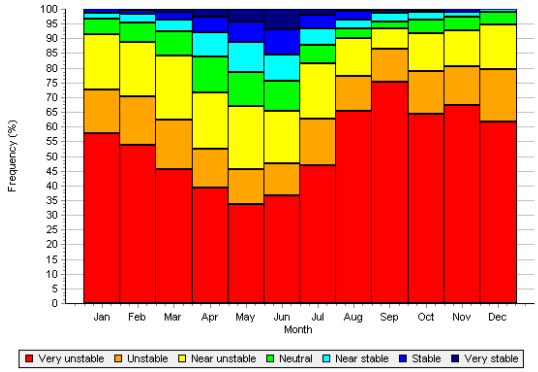
The atmospheric stability essentially depends on the variation of the air temperature with the altitude (vertical thermal gradient) and, defined the adiabatic gradient as the heating or cooling speed of a particle of dry air moving vertically equal to about 1°C every 100 m of altitude, three macro cases can be identified:

- If the vertical thermal gradient is less than the adiabatic gradient: the air moving up is warmer than the surrounding one and less dense, and therefore tends to "float" on the atmosphere and continue to rise. In this case, the atmosphere is unstable.
- If the vertical thermal gradient is greater than the adiabatic gradient: the air moving up is colder and therefore denser than the surrounding one, so it stops its upward movement. In this case the atmosphere is stable.
- The air temperature varies as does the adiabatic gradient: the motion of the air is stopped with the cause that induced it. In this case the atmosphere is neutrally stable.

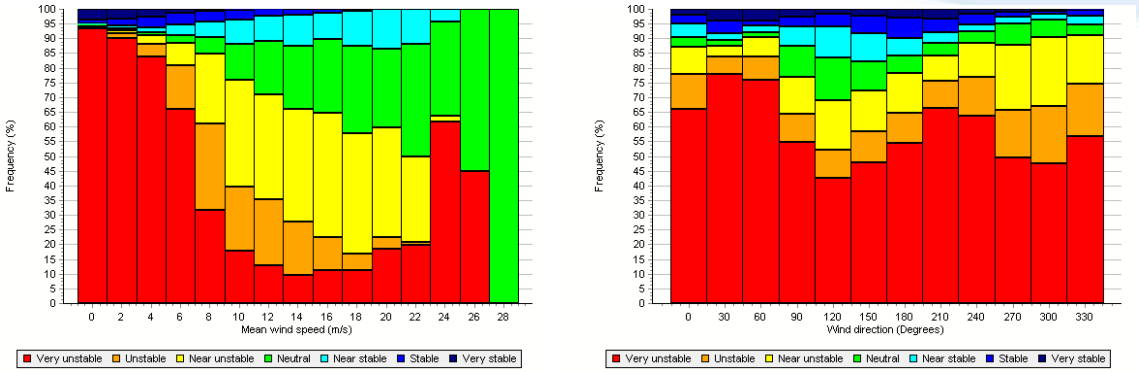
The figures below show the atmospheric stability conditions resulting at the site. The atmospheric stability conditions are divided into 7 classes according to the Monin-Obukhov length (L) from Very Unstable to Very Stable.



Frequency of stability class by hour



Frequency of stability class by month



Frequency of stability class by wind speed

Frequency of stability class by wind direction

Fig. 3: Atmospheric Stability Analysis at the site

The stability of the atmosphere is important since the wind flow models, commonly used in wind energy applications, operate in the hypothesis of a neutrally stable atmosphere. This is substantially admissible as the calculation concerns the most intense wind regimes and no significant thermal excursions occur; in this case, formulas relating to neutral stability conditions of the lower atmosphere are used.

However, it should be borne in mind that this choice can lead to an overestimation of the vertical wind profile on flat terrains, where the alternation of stable atmosphere conditions at night and unstable atmosphere during the day prevail over cases of neutral atmosphere.

In offshore sites, the atmospheric conditions on the sea are very different from the mainland. The previous figure highlights indeed very unstable conditions.

3.2. Vertical Profile

The wind shear estimated by the WAsP model between e.g. the heights of 160 m and 100 m is equal to 0.14 while the "measured" wind shear of the re-analysis data, representative of the site, is equal to 0.07. The difference is probably due to the very unstable atmospheric conditions described in the previous paragraph. Given that the re-analysis nodes have been downscaled onsite, it is deemed that the "measured" wind shear is more representative of the conditions of the site.

In the following figure, the modelled and "measured" wind shears are compared:

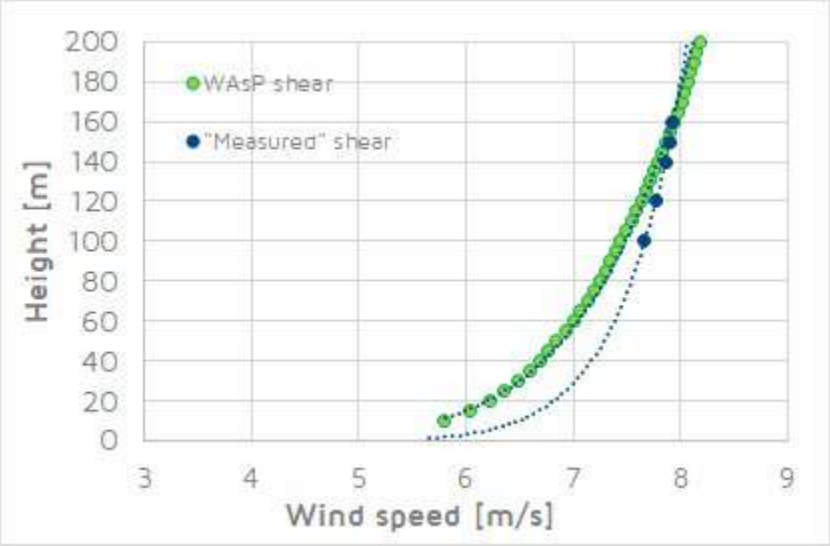


Fig. 4: Comparison of modelled and "measured" wind shear

3.3. Wind Resource Map

The figure below shows the wind map estimated on the site area at the hub height by initialising the wind flow model from the re-analysis nodes downscaled onsite.

Fig. 5: Wind resource map at hub height

4. WIND FARM LAYOUTS

Two layouts have been assessed for the **Project**:

- Layout provided by the **Client** including 86 wind turbines
- Layout designed by the **TA**, including a lower number of turbines (n. 68) in the same wind farm area with the aim of keeping the overall wind farm capacity within the limit provided of 1032 MW. This additional layout has been added given that the turbine model under assessment is characterized by a higher nominal power than the initial **Client**'s assumption.

The metric coordinates of the two layouts are shown in the following tables:

UTM WGS84 Zone 33		
Turbine ID	**Longitude [m]**	**Latitude [m]**
1	228266	4137403
2	230020	4135915
3	231773	4134427
4	233526	4132937
5	235280	4131450
6	237033	4129962
7	247554	4121031
8	249308	4119542
9	251061	4118054
10	252815	4116565
11	254568	4115078
12	256321	4113588
13	229754	4139156
14	231508	4137668
15	233262	4136180
16	235014	4134691
17	236768	4133203
18	238522	4131715
19	249043	4122784
20	250796	4121296
21	252549	4119807
22	254302	4118318
23	256056	4116830
24	257810	4115342

UTM WGS84 Zone 33		
Turbine ID	Longitude [m]	Latitude [m]
25	231243	4140910
26	232996	4139422
27	234750	4137933
28	236503	4136445
29	238256	4134957
30	240010	4133468
31	248777	4126026
32	250530	4124537
33	252284	4123049
34	254037	4121560
35	255791	4120072
36	257545	4118584
37	259298	4117096
38	261051	4115607
39	232731	4142663
40	234485	4141176
41	236238	4139687
42	237992	4138199
43	239745	4136710
44	241498	4135221
45	250265	4127780
46	252019	4126291
47	253773	4124802
48	255526	4123314
49	257279	4121826
50	259033	4120337
51	260787	4118849
52	262540	4117361
53	234219	4144417
54	235973	4142929
55	237726	4141440
56	239480	4139952
57	241233	4138463
58	242986	4136975
59	251754	4129533
60	253507	4128045
61	255261	4126556

UTM WGS84 Zone 33		
Turbine ID	Longitude [m]	Latitude [m]
62	257014	4125068
63	258768	4123579
64	260521	4122091
65	262275	4120603
66	264029	4119114
67	235708	4146170
68	237461	4144682
69	239215	4143194
70	240968	4141705
71	242722	4140217
72	244475	4138729
73	253242	4131287
74	254996	4129798
75	256750	4128310
76	258503	4126821
77	260257	4125332
78	262010	4123844
79	263764	4122356
80	265517	4120868
81	259563	4113854
82	258075	4112101
83	238787	4128473
84	240275	4130226
85	251489	4132775
86	250001	4131021

Tab. 1: Stretto di Sicilia wind farm coordinates as provided by the Client

The distances among the turbines of the provided layout are approximately 10 rotor diameters both in-row and between the rows.

The location of the proposed turbines in red are shown in the figure below:

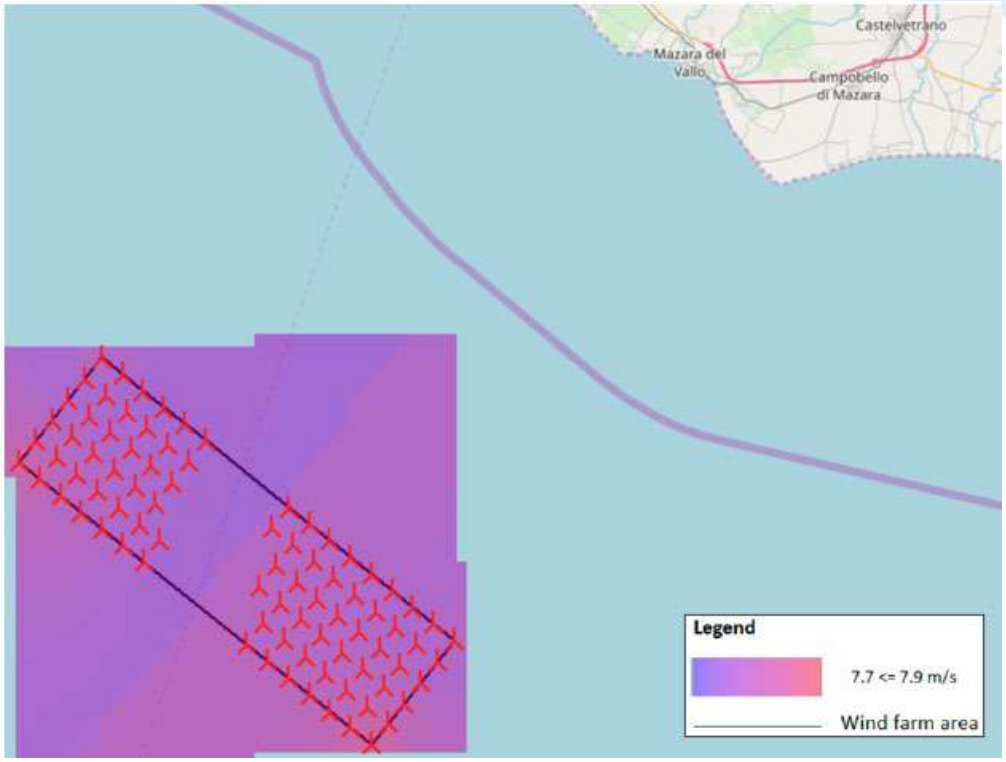


Fig. 6: Layout provided by the Client

UTM WGS84 Zone 33		
Turbine ID	Longitude [m]	Latitude [m]
1	228306	4137404
2	229568	4138808
3	230830	4140213
4	232092	4141617
5	233354	4143022
6	234615	4144426
7	235877	4145831
8	230838	4135281
9	232099	4136686
10	233361	4138091
11	234622	4139496
12	235884	4140901
13	237145	4142306
14	238406	4143711
15	233370	4133159
16	234631	4134564
17	235892	4135969
18	237153	4137374
19	238413	4138779
20	239674	4140185
21	240935	4141590
22	235902	4131036
23	237162	4132441
24	238423	4133847
25	239683	4135253
26	240944	4136658
27	242204	4138064
28	243464	4139470
29	238434	4128913
30	239694	4130319
31	250363	4128727
32	251596	4130156
33	252829	4131586
34	247951	4120874
35	249184	4122304
36	250417	4123734
37	251650	4125163

UTM WGS84 Zone 33		
Turbine ID	Longitude [m]	Latitude [m]
38	252883	4126593
39	254116	4128023
40	255349	4129453
41	250473	4118739
42	251706	4120169
43	252938	4121600
44	254171	4123030
45	255403	4124460
46	256636	4125890
47	257868	4127321
48	252995	4116605
49	254227	4118035
50	255459	4119466
51	256691	4120896
52	257923	4122327
53	259155	4123757
54	260387	4125188
55	255516	4114470
56	256748	4115901
57	257980	4117332
58	259212	4118763
59	260443	4120194
60	261675	4121625
61	262906	4123056
62	258038	4112335
63	259269	4113766
64	260501	4115198
65	261732	4116629
66	262963	4118060
67	264194	4119492
68	265425	4120923

Tab. 2: Stretto di Sicilia wind farm coordinates as designed by the TA

The distances among the turbines of the proposed layout are about 14 rotor diameters between the rows and about 8 rotor diameters in-row. Given the lower number of turbines within the same wind farm area, it was possible to increase the distance between the rows in order to reduce the wake losses along the prevailing wind directions.

The location of the layout designed by the **TA** in red are shown in the figure below:

Fig. 7: Layout designed by the TA

5. PRELIMINARY EXPECTED ENERGY YIELD ASSESSMENT

Being the assessment based on re-analysis data characterized by a higher level of uncertainty compared to a measurement on site, the presented energy figures shall be considered only as preliminary, and they should be updated when a full year measurement campaign onsite is available.

The expected energy production of the Stretto di Sicilia wind farm has been estimated using the time series representative of the long-term wind regime of the site, as described in Section 3, and extrapolated to the desired hub height adopting the WAsP model propagation as embedded in WindPRO 3.5. The so-called "time-varying calculation concept" has been selected in order to avoid the influence of the Weibull fit. The energy production accounts for the losses due to wake effects and to the site air density. The wake model implemented in the analysis is the N. O. Jensen (RISO/EMD) based on the offshore wake decay of 0.05, constant for all the sectors.

The tables hereunder contain the following information for each wind turbine:

Site ID: ID number of the wind turbine in the tables

X [m]: longitude in **UTM WGS84 Zone 33** coordinates

Y [m]: latitude in **UTM WGS84 Zone 33** coordinates

Elev. [m]: elevation above sea level (ASL)

HH [m]: hub height

V [m/s]: average wind speed estimated by the model at hub height

Gross [GWh]: expected gross output

Net [GWh]: expected output net of wake losses

Loss [%]: percent of production lost due to wake losses

Site ID	X [m]	Y [m]	Elev. [m]	HH [m] (approx.)	V [m/s]	Gross [GWh]	Net [GWh]	Loss [%]
1	228266	4137403	0	143.0	7.76	55.86	54.99	1.55
2	230020	4135915	0	143.0	7.76	55.83	53.40	4.35
3	231773	4134427	0	143.0	7.75	55.76	52.73	5.43
4	233526	4132937	0	143.0	7.75	55.68	52.31	6.05
5	235280	4131450	0	143.0	7.75	55.61	52.10	6.32
6	237033	4129962	0	143.0	7.74	55.55	52.05	6.30
7	247554	4121031	0	143.0	7.73	55.61	53.92	3.03
8	249308	4119542	0	143.0	7.73	55.67	52.66	5.41
9	251061	4118054	0	143.0	7.73	55.74	52.25	6.26
10	252815	4116565	0	143.0	7.73	55.82	52.12	6.62
11	254568	4115078	0	143.0	7.73	55.89	52.15	6.70
12	256321	4113588	0	143.0	7.73	55.95	52.28	6.57
13	229754	4139156	0	143.0	7.76	55.81	54.26	2.79
14	231508	4137668	0	143.0	7.76	55.78	52.53	5.82
15	233262	4136180	0	143.0	7.75	55.71	51.73	7.14
16	235014	4134691	0	143.0	7.75	55.64	51.25	7.89
17	236768	4133203	0	143.0	7.74	55.58	51.09	8.07
18	238522	4131715	0	143.0	7.74	55.53	51.18	7.83
19	249043	4122784	0	143.0	7.73	55.59	52.68	5.24
20	250796	4121296	0	143.0	7.72	55.65	51.60	7.29
21	252549	4119807	0	143.0	7.72	55.71	51.14	8.21
22	254302	4118318	0	143.0	7.73	55.78	51.01	8.55
23	256056	4116830	0	143.0	7.73	55.85	51.11	8.49
24	257810	4115342	0	143.0	7.73	55.91	51.40	8.06
25	231243	4140910	0	143.0	7.75	55.65	53.85	3.24
26	232996	4139422	0	143.0	7.75	55.64	52.13	6.31
27	234750	4137933	0	143.0	7.75	55.60	51.36	7.62
28	236503	4136445	0	143.0	7.74	55.56	50.90	8.39
29	238256	4134957	0	143.0	7.74	55.53	50.85	8.43
30	240010	4133468	0	143.0	7.74	55.49	51.16	7.80
31	248777	4126026	0	143.0	7.73	55.52	52.77	4.94
32	250530	4124537	0	143.0	7.72	55.57	51.52	7.28
33	252284	4123049	0	143.0	7.72	55.62	50.97	8.36
34	254037	4121560	0	143.0	7.72	55.67	50.70	8.93
35	255791	4120072	0	143.0	7.72	55.71	50.61	9.16
36	257545	4118584	0	143.0	7.72	55.76	50.78	8.93
37	259298	4117096	0	143.0	7.72	55.79	51.10	8.41
38	261051	4115607	0	143.0	7.72	55.81	51.73	7.32

Site ID	X [m]	Y [m]	Elev. [m]	HH [m] (approx.)	V [m/s]	Gross [GWh]	Net [GWh]	Loss [%]
39	232731	4142663	0	143.0	7.74	55.44	53.55	3.41
40	234485	4141176	0	143.0	7.74	55.45	51.91	6.39
41	236238	4139687	0	143.0	7.74	55.47	51.26	7.60
42	237992	4138199	0	143.0	7.74	55.48	50.91	8.23
43	239745	4136710	0	143.0	7.74	55.47	50.97	8.11
44	241498	4135221	0	143.0	7.74	55.46	51.34	7.43
45	250265	4127780	0	143.0	7.72	55.50	52.30	5.77
46	252019	4126291	0	143.0	7.72	55.54	51.21	7.81
47	253773	4124802	0	143.0	7.72	55.59	50.76	8.69
48	255526	4123314	0	143.0	7.72	55.62	50.57	9.08
49	257279	4121826	0	143.0	7.72	55.64	50.55	9.16
50	259033	4120337	0	143.0	7.71	55.65	50.72	8.86
51	260787	4118849	0	143.0	7.71	55.64	51.05	8.26
52	262540	4117361	0	143.0	7.71	55.64	51.67	7.12
53	234219	4144417	0	143.0	7.73	55.32	53.44	3.40
54	235973	4142929	0	143.0	7.73	55.34	51.94	6.14
55	237726	4141440	0	143.0	7.73	55.38	51.39	7.21
56	239480	4139952	0	143.0	7.73	55.41	51.18	7.63
57	241233	4138463	0	143.0	7.74	55.42	51.23	7.57
58	242986	4136975	0	143.0	7.73	55.42	51.62	6.86
59	251754	4129533	0	143.0	7.72	55.48	51.65	6.90
60	253507	4128045	0	143.0	7.72	55.52	51.19	7.80
61	255261	4126556	0	143.0	7.72	55.56	50.95	8.30
62	257014	4125068	0	143.0	7.71	55.58	50.80	8.60
63	258768	4123579	0	143.0	7.71	55.59	50.83	8.57
64	260521	4122091	0	143.0	7.71	55.58	51.01	8.22
65	262275	4120603	0	143.0	7.70	55.56	51.33	7.61
66	264029	4119114	0	143.0	7.70	55.54	51.96	6.46
67	235708	4146170	0	143.0	7.73	55.29	53.62	3.02
68	237461	4144682	0	143.0	7.73	55.31	52.46	5.14
69	239215	4143194	0	143.0	7.73	55.34	52.10	5.86
70	240968	4141705	0	143.0	7.73	55.37	51.98	6.12
71	242722	4140217	0	143.0	7.73	55.39	52.08	5.98
72	244475	4138729	0	143.0	7.73	55.40	52.49	5.25
73	253242	4131287	0	143.0	7.72	55.46	52.18	5.93
74	254996	4129798	0	143.0	7.72	55.50	51.91	6.48
75	256750	4128310	0	143.0	7.72	55.53	51.79	6.75
76	258503	4126821	0	143.0	7.71	55.55	51.74	6.86

Site ID	X [m]	Y [m]	Elev. [m]	HH [m] (approx.)	V [m/s]	Gross [GWh]	Net [GWh]	Loss [%]
77	260257	4125332	0	143.0	7.71	55.56	51.80	6.77
78	262010	4123844	0	143.0	7.70	55.55	52.00	6.39
79	263764	4122356	0	143.0	7.70	55.53	52.31	5.81
80	265517	4120868	0	143.0	7.70	55.52	52.92	4.69
81	259563	4113854	0	143.0	7.73	55.94	51.98	7.08
82	258075	4112101	0	143.0	7.73	55.98	52.66	5.93
83	238787	4128473	0	143.0	7.74	55.51	52.26	5.86
84	240275	4130226	0	143.0	7.74	55.49	51.64	6.95
85	251489	4132775	0	143.0	7.73	55.43	53.02	4.35
86	250001	4131021	0	143.0	7.73	55.45	52.79	4.80
				Average	**7.73**	**55.59**	**51.85**	**6.72**
					Total	**4780.85**	**4459.37**	

Tab. 3 - Stretto di Sicilia energy production – Layout provided by the Client

Site ID	X [m]	Y [m]	Elev. [m]	HH [m] (approx.)	V [m/s]	Gross [GWh]	Net [GWh]	Loss [%]
1	228306	4137404	0	143.0	7.76	55.86	55.21	1.15
2	229568	4138808	0	143.0	7.76	55.83	54.61	2.18
3	230830	4140213	0	143.0	7.75	55.72	54.27	2.61
4	232092	4141617	0	143.0	7.74	55.55	53.96	2.86
5	233354	4143022	0	143.0	7.73	55.39	53.77	2.93
6	234615	4144426	0	143.0	7.73	55.31	53.72	2.88
7	235877	4145831	0	143.0	7.73	55.29	53.92	2.49
8	230838	4135281	0	143.0	7.76	55.80	53.87	3.44
9	232099	4136686	0	143.0	7.75	55.76	53.08	4.80
10	233361	4138091	0	143.0	7.75	55.67	52.72	5.30
11	234622	4139496	0	143.0	7.74	55.54	52.51	5.46
12	235884	4140901	0	143.0	7.73	55.42	52.48	5.31
13	237145	4142306	0	143.0	7.73	55.36	52.64	4.91
14	238406	4143711	0	143.0	7.73	55.33	53.10	4.03
15	233370	4133159	0	143.0	7.75	55.69	53.31	4.27
16	234631	4134564	0	143.0	7.75	55.65	52.42	5.80
17	235892	4135969	0	143.0	7.75	55.59	52.14	6.21
18	237153	4137374	0	143.0	7.74	55.52	52.05	6.26
19	238413	4138779	0	143.0	7.74	55.45	52.15	5.96
20	239674	4140185	0	143.0	7.73	55.40	52.40	5.43
21	240935	4141590	0	143.0	7.73	55.38	52.98	4.32
22	235902	4131036	0	143.0	7.75	55.59	53.06	4.55
23	237162	4132441	0	143.0	7.74	55.56	52.24	5.98
24	238423	4133847	0	143.0	7.74	55.53	52.09	6.19
25	239683	4135253	0	143.0	7.74	55.49	52.23	5.87
26	240944	4136658	0	143.0	7.74	55.45	52.40	5.49
27	242204	4138064	0	143.0	7.73	55.42	52.69	4.93
28	243464	4139470	0	143.0	7.73	55.40	53.31	3.76
29	238434	4128913	0	143.0	7.74	55.52	53.11	4.35
30	239694	4130319	0	143.0	7.74	55.50	52.61	5.22
31	250363	4128727	0	143.0	7.73	55.48	53.37	3.80
32	251596	4130156	0	143.0	7.72	55.47	53.32	3.87
33	252829	4131586	0	143.0	7.72	55.46	53.57	3.40
34	247951	4120874	0	143.0	7.73	55.62	54.43	2.12
35	249184	4122304	0	143.0	7.73	55.60	53.69	3.43
36	250417	4123734	0	143.0	7.72	55.58	53.25	4.20
37	251650	4125163	0	143.0	7.72	55.56	52.84	4.90
38	252883	4126593	0	143.0	7.72	55.54	52.42	5.63

Site ID	X [m]	Y [m]	Elev. [m]	HH [m] (approx.)	V [m/s]	Gross [GWh]	Net [GWh]	Loss [%]
39	254116	4128023	0	143.0	7.72	55.53	52.51	5.43
40	255349	4129453	0	143.0	7.72	55.51	52.98	4.55
41	250473	4118739	0	143.0	7.73	55.71	53.46	4.04
42	251706	4120169	0	143.0	7.72	55.69	52.56	5.62
43	252938	4121600	0	143.0	7.72	55.66	52.20	6.23
44	254171	4123030	0	143.0	7.72	55.63	51.97	6.58
45	255403	4124460	0	143.0	7.72	55.60	51.99	6.49
46	256636	4125890	0	143.0	7.72	55.57	52.17	6.12
47	257868	4127321	0	143.0	7.71	55.55	52.81	4.93
48	252995	4116605	0	143.0	7.73	55.82	53.20	4.69
49	254227	4118035	0	143.0	7.73	55.79	52.29	6.27
50	255459	4119466	0	143.0	7.72	55.74	51.95	6.80
51	256691	4120896	0	143.0	7.72	55.68	51.77	7.02
52	257923	4122327	0	143.0	7.71	55.62	51.86	6.77
53	259155	4123757	0	143.0	7.71	55.59	52.11	6.25
54	260387	4125188	0	143.0	7.71	55.56	52.81	4.95
55	255516	4114470	0	143.0	7.73	55.92	53.24	4.80
56	256748	4115901	0	143.0	7.73	55.89	52.40	6.25
57	257980	4117332	0	143.0	7.72	55.81	52.08	6.69
58	259212	4118763	0	143.0	7.72	55.70	51.93	6.77
59	260443	4120194	0	143.0	7.71	55.61	52.02	6.46
60	261675	4121625	0	143.0	7.70	55.56	52.31	5.85
61	262906	4123056	0	143.0	7.70	55.54	53.03	4.53
62	258038	4112335	0	143.0	7.73	55.98	53.51	4.42
63	259269	4113766	0	143.0	7.73	55.95	52.90	5.45
64	260501	4115198	0	143.0	7.73	55.86	52.66	5.72
65	261732	4116629	0	143.0	7.72	55.71	52.53	5.71
66	262963	4118060	0	143.0	7.71	55.59	52.62	5.35
67	264194	4119492	0	143.0	7.70	55.54	52.91	4.73
68	265425	4120923	0	143.0	7.70	55.52	53.61	3.45
				Average	**7.73**	**55.60**	**52.86**	**4.93**
					Total	**3780.74**	**3594.34**	

Tab. 4 - Stretto di Sicilia energy production – Layout designed by the TA

The next step in the analysis is to assess the energy losses (electrical, production and power losses) to determine the energy that will be available for input into the power grid. In this preliminary phase an assumption of the plant loss is deemed equal to **15%**, including the losses relating to the availability of the plant (wind turbines, BOP and grid), performance of wind turbines, electrical and environmental losses and excluding potential limitations. A more detailed assessment can be carried out in a more advanced design phase and once all the supply and O&M contracts for the project have been signed, or in the discussion phase.

The following table summarizes the results obtained:

Scenario	Number of turbines	Gross Production (at generators' terminals)	Net Production (deliverable to grid)
		[GWh/year]	[GWh/year]
Layout provided by the **Client**	86	4459.37	3790.46
Layout designed by the **TA**	68	3594.34	3055.19

Tab. 5 - Gross and net energy production

The expected net production estimates (deliverable to grid) shown in the table above, represent the so-called $P_{50\%}$, i.e. the production calculated with the average wind conditions, also called central estimate.

6. CONCLUSIONS

The wind resource assessment for the Stretto di Sicilia site has been performed on the basis of the long-term re-analysis wind data downscaled at site. Based on the results from the analysis of these data, the following conclusions are made concerning the site wind regime end energy production assessment:

1. Taking into account the complexity of an offshore wind assessment and the data source used in this study, the production figures shall be considered as preliminary being subject to a higher level of uncertainty compared to an analysis carried out with an on-site measurement. For this reason, the results shall be used only to evaluate the potential wind resource of the site and caution is advised in the interpretation and use of the provided values.
2. The preliminary results shall be backed by a measurement campaign. We therefore recommend the installation of a measuring mast in a position representative of the whole wind farm and at a height of at least 3/4 of the hub of the wind turbines, or the installation of a Lidar device, in order to reduce the uncertainties associated to vertical extrapolation.
3. Due to the lack of wind turbines technical specifications, including power and thrust coefficient curves, the current assessment has been carried out by considering a reference offshore wind turbine model with a swept area in the range of approximately 40000 m^2.
4. Results related to an additional layout designed by the **Technical Advisor** has been added in the current study, given that the turbine model under assessment is characterized by a higher nominal power than the initial **Client**'s assumption. Such layout has been designed by considering a lower number of turbines in the same wind farm area with the aim of keeping the overall wind farm capacity within the limit provided of 1032 MW. This allowed to keep distances between rows at about 14 rotor diameters, leading to lower wake effects along the prevailing wind direction.
5. It is suggested to approach the manufacturers from the earliest stages of the **Project** development in order to obtain the technical specifications for offshore wind turbines currently available for the Italian market and any requirements to ensure the suitability of the wind turbine for the project.
6. For the purposes of providing P50 values, in this preliminary phase an assumption of wind farm losses is equal to **15%**, including the losses related to the availability of the plant (wind turbines, BOP and grid), performance of wind turbines, electrical and environmental losses and excluding potential limitations. A more detailed

assessment can be carried out in a more advanced design phase and once all the supply and O&M contracts for the project have been signed, or in the discussion phase.