TECHNICAL DESIGN OF PROJECT

WIND FARM “POLEMISTIS”

INSTALLED CAPACITY: 44MW

LOCATED IN THE MUNICIPALITIES OF KOMOTINI & ARRIANE, MUNICIPAL UNITS OF KOMOTINI & ORGANI, REGIONAL UNIT OF RHODOPE, EASTERN MACEDONIA AND THRACE REGION, GREECE

Developer:

wpd think energy

WPD AIOLIKI ENERGEIA 1

Signed by:
Aris Liaskos Managing Director
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Environmental Consultant of EIA:

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DETAILED DESCRIPTION OF THE PROJECT DESIGN

44 MW Wind Farm at the location 'Polemmistis', in the Municipal Units of Komotini and Organi,

Municipalities of Komotini and Arrianon, Regional Unit of Rodopi,

Region of Eastern Macedonia and Thrace.

A wind farm is an infrastructure project that aims to generate electricity from the renewable source of wind. The power plants are wind turbines, which convert the energy of the wind into electricity.

The project under study has been designed according to the following principles:

(a) the energy efficiency shall be at a satisfactory level,

(b) its construction requires the least possible interventions and has the least possible impact on the environment; and

(c) its operation has the least possible impact on avifauna

In the context of the comprehensive analysis of the project, the following sections provide a detailed description of the infrastructure works and technical characteristics of the W/F and its connection with the National Grid.

The proposed power generation facility will have a total installed capacity of 44 MW and will include eleven (11) VESTAS V-150 type WTGs, with a nominal capacity of 4.00 MW each, in forested areas mainly and in small parts of private agricultural land at the Greek-Bulgarian border, ~7 km north of the settlement of 'Drymi'.

Each wind turbine consists of a 125 m high metal tower, on top of which the wind turbine's spindle rests. The main equipment of the wind turbine is mounted on the nacelle, consisting of the main shaft on which the hub and the rotor of the 150 m diameter wind turbine, the speed multiplier and the generator are mounted. The total height of the wind turbine (tower, nacelle, rotor) is 200 m. Further details of the components of each wind turbine are given in the manufacturer's technical brochure attached in the Annex.

The WTGs shall be spaced at an appropriate distance from each other which is greater than a minimum distance equal to 2,5 times the diameter of the WTG impeller (2,5 x 150 = 375 m), in order to avoid aerodynamic shading and high wind turbulence and to optimise their energy efficiency, reducing their wear and tear and increasing the lifetime of the installation, and less than the maximum distance equal to 5 times the diameter of the blade of the turbine (5 x 150 = 750 m)

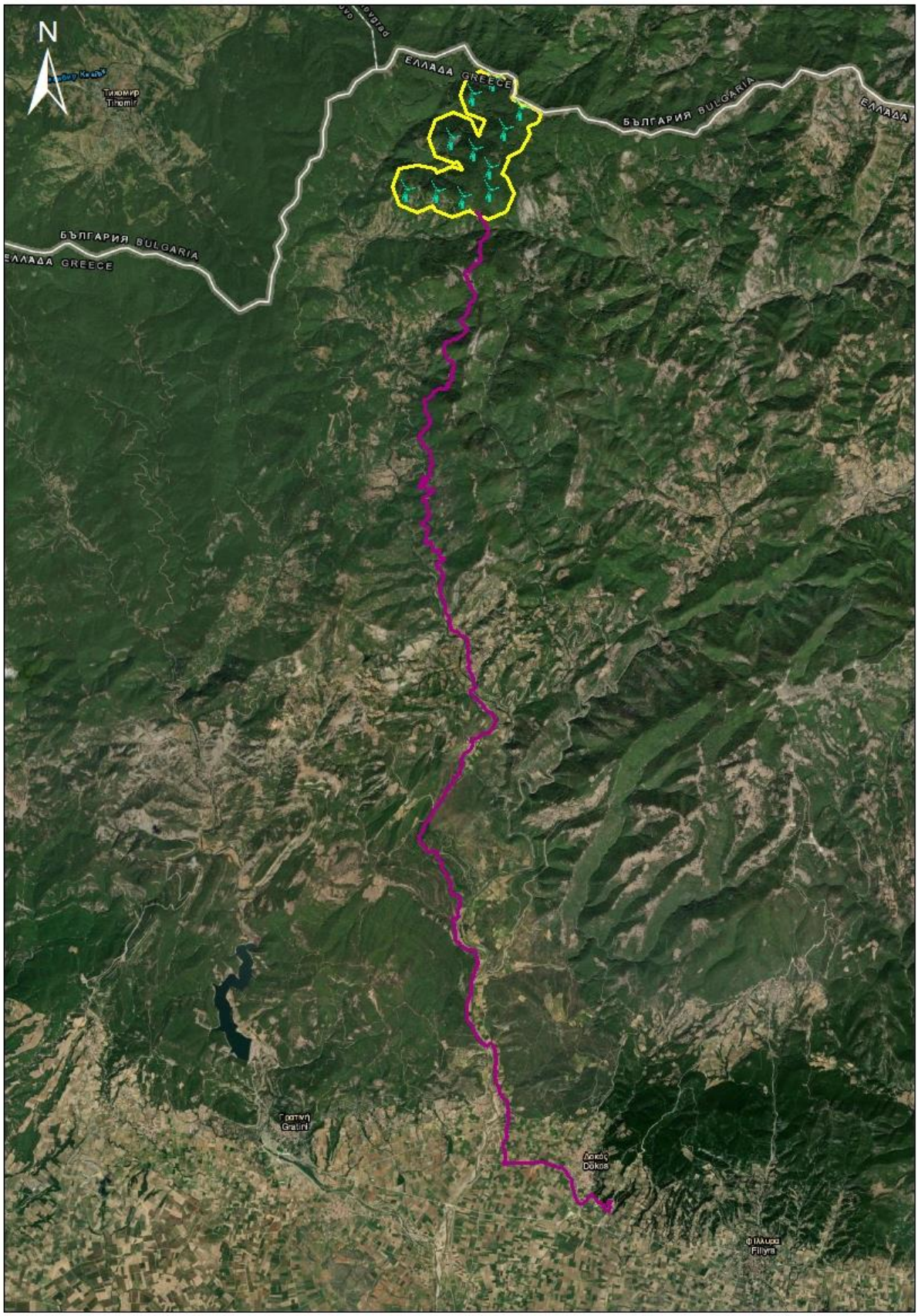
The following data were taken into account for **the placement of the WTGs:**

- Terrain topography and possible presence of local obstacles/ anomalies,
- Prevailing wind directions, mean and median wind speed,
- Soil morphology and foundation suitability WTG,
- Restrictions in the relevant legislation on keeping distances from roads, settlements and other places of use.

The project under study is developed within a polygon of 3760.964 acres, for which the issuance of the amended Producer's Certificate by RAE is expected (the original issued Producer's Certificate is attached to the Annex to the Documents).The interventions concern:

- Access road deck improvement
- Deck improvement and construction of a short length of new internal road network
- Excavation of foundations for WTG
- Excavation of Low/Medium Voltage and Low Voltage and Low Voltage cable ducts parallel to the internal roads,
- Landscaping of squares around the locations of the WTGs,
- Backfilling/landscaping,
- Excavation of MV cabling channel up to the existing voltage boosting substation 'Flamburo'

The existing road will be used to access the project, then new road sections will be built or existing road sections of the local network will be improved to connect the WTG. The length of the road network that will be required is 11,182.63m.



Project location

(the polygon is shown in yellow, the Medium Voltage line and the Substation in purple)

DETAILED DESCRIPTION OF THE PROJECT

Wind turbines

Wind turbines are devices that harness the energy provided by the wind. Compared to conventional methods of generating electricity, wind turbine technology is competitive, especially when environmental and social benefits are taken into account. Wind turbine technology is relatively simple. It does not consist of complex systems and bulky electrical and mechanical installations like a conventional power plant and does not require constant supervision by human resources.

The project under study consists of 11 WTGs of indicative type VESTAS V-150, with a power of 4.0 MW each. Each wind turbine consists of a 125 m high metal tower, on top of which the wind turbine's spindle rests. The main equipment of the wind turbine is mounted on the nacelle, consisting of the main shaft on which the hub and the rotor of the wind turbine, the speed multiplier and the generator are mounted. The rotor has a diameter of 150m and consists of three blades.

The wind turbine pylon is steel, cylindrical with a slight taper. The pylon is closed to the external environment. Access to the interior is through a metal door located at the base of the tower. The pylon has a metal staircase inside which allows access to the wind turbine shaft. It is divided internally in height by metallic platforms, which serve to ensure the safety of maintenance personnel.

The wind turbine fuselage consists of a steel frame and the housing which is made of polyester material. The fuselage is closed to the outside environment and is mounted on the wind turbine tower by means of a crown-coil system so as to allow the fuselage to rotate 360 degrees relative to the wind turbine tower.

Access to the shell is achieved from inside the tower through a metal staircase. In addition, at the base of the fuselage and outside the wind turbine tower there is a hatch and lifting and lowering equipment for the transport of tools and spare parts. This hatch can also be used as an escape hatch in case of emergency.

At the base of the wind turbine and inside the tower is the central electrical panel and the wind turbine controller through which the connection of the wind turbine to the power grid and the control of all the functions of the wind turbine are made respectively.

All the connections of the electrical panel, both the main and the secondary ones, are properly protected in accordance with the regulations in force, in particular by the use of fuses and automatic circuit breakers, which protect the installation both in case of overload and in case of short-circuit.

The kinetic energy of the wind is converted through the rotor of the wind turbine into mechanical work, which in turn is converted into electricity through the wind turbine's electrical generator.

The wind turbine control system controls a set of parameters and ensures the safe and uninterrupted operation of the system.

Each WTG is equipped with a two-phase asynchronous generator. The generator is connected to the grid via a Grid Streamer which allows it to operate at variable speeds. The converter also controls the frequency as well as the quality of the power generated. The wind turbine has a lightning protection system (with protection level LPL1) to protect the entire wind turbine and all its subsystems. The WTG shall have a grounding system which connects all its metal parts to the grounding system of the wind turbine. The Grounding System shall consist of a grounding conductor installed in the ground and vertical electrodes (grounding rods) placed at selected points.

Wind farm siting

The wind farm under study is developed in a polygon on the Greek-Bulgarian border.

The 11 wind turbines that will form the Wind Farm will be placed at the locations with coordinates shown in below:

Table : Geographical coordinates of the positions of the WTGs (ΕΓΣΑ 87 - WGS 84)

A/A	ΕΓSA '87		WGS '84	
	X	Y	λ	ϕ
WTG 1	630595,345	4572505,875	25,56156865	41,29598652
WTG 2	631145,480	4572498,203	25,56813529	41,29582813
WTG 3	631611,673	4572399,368	25,57367994	41,29486222
WTG 4	632086,755	4572507,258	25,57937545	41,29575600
WTG 5	631401,593	4573456,765	25,57140032	41,30441762
WTG 6	631803,477	4573236,410	25,57615139	41,30236786
WTG 7	632092,086	4572914,405	25,57952756	41,29942119
WTG 8	632351,354	4573615,171	25,5827758	41,30568854
WTG 9	631782,911	4574235,508	25,57612249	41,31136737
WTG 10	632147,963	4574494,530	25,58053834	41,31363988
WTG 11	632648,666	4573973,357	25,58640421	41,30886485

Table : Geographical coordinates of polygons of the WIND FARM Installation (ΕΓSA '87)

Coordinates of Polygon vertices (WTG 1 - WTG 11)		
A/A	**X**	**Y**
A1	630340,39	4572569,003
A2	630474,242	4572892,15
A3	630800,301	4572950,714
A4	631120,538	4572892,15
A5	631150,436	4572819,97
A6	631435,524	4572938,057

A7	631600,897	4572869,557
A8	631533,783	4573031,583
A9	631454,494	4572998,741
A10	631131,346	4573132,593
A11	630997,494	4573455,741
A12	631131,346	4573778,888
A13	631454,494	4573912,741
A14	631777,641	4573778,888
A15	631897,236	4573490,161
A16	631924,723	4573501,547
A17	631909,262	4573538,872
A18	632007,618	4573776,326
A19	631697,178	4573904,914
A20	631563,326	4574228,062
A21	631697,178	4574551,21
A22	631963,948	4574661,71
A23	631995,53	4574635,541
A24	632095,357	4574592,211
A25	632278,661	4574553,648
A26	632323,445	4574559,506
A27	632343,474	4574551,21
A28	632403,43	4574406,464
A29	632579,587	4574479,266
A30	632573,746	4574317,073
A31	632561,039	4574245,57
A32	632494,721	4574175,972
A33	632532,548	4574129,074
A34	632632,824	4574099,366
A35	632675,722	4574045,398
A36	632832,335	4574008,214
A37	633041,031	4573890,63
A38	632971,879	4573727,924
A39	632778,187	4573647,694
A40	632823,262	4573538,872
A41	632675,457	4573225,351
A42	632418,065	4573103,33
A43	632433,526	4573066,004
A44	632323,157	4572799,551
A45	632403,339	4572766,338
A46	632537,192	4572443,19
A47	632403,339	4572120,042
A48	632080,293	4571994,779
A49	631757,044	4572120,042
A50	631743,894	4572151,788
A51	631435,524	4572024,057
A52	631112,376	4572157,909
A53	631082,478	4572230,09

A54	630797,39	4572112,003
A55	630474,242	4572245,855
A1	630340,39	4572569,003

Table : Geographical coordinates of characteristic points of MV network waypoints

A/N	x	y	ϕ	λ
1	631846	4572132	41.29241939	25.57642858
2	631954	4572001	41.29122631	25.57769559
3	632078	4571790	41.28930399	25.57912728
4	632007	4571636	41.28792353	25.57824651
5	631894	4571192	41.28394942	25.5768029
6	631662	4571029	41.28252179	25.57399848
7	631715	4570903	41.28137636	25.574602
8	631841	4570603	41.27865034	25.5760368
9	631695	4570041	41.27361895	25.57417295
10	631272	4569624	41.26993343	25.56904041
11	631362	4568971	41.26403924	25.56996399
12	631048	4568349	41.25848358	25.56608892
13	630909	4567916	41.25460716	25.56433606
14	630839	4567174	41.24794355	25.56333738
15	630910	4566934	41.24576978	25.56413488
16	631001	4566415	41.24107628	25.56511209
17	631297	4565873	41.23614715	25.56852912
18	631276	4565546	41.2332108	25.56820114
19	631680	4564465	41.22340746	25.57278538
20	631757	4563485	41.21457373	25.57349569
21	632207	4562971	41.20987205	25.57874898
22	631592	4562269	41.20365368	25.57126091
23	630828	4560806	41.1906026	25.56185039
24	631524	4559410	41.17791708	25.56983984
25	631886	4558577	41.17035976	25.57397204
26	632037	4557108	41.15710561	25.57545999
27	632131	4557161	41.15757042	25.57658849
28	632438	4555964	41.14674202	25.57998724
29	632351	4554984	41.13792633	25.57873637
30	633416	4554921	41.13718847	25.59141467
31	633710	4554263	41.13121189	25.59477442
32	633923	4554441	41.13277785	25.59734285
33	634159	4554248	41.13100575	25.60010899
34	634240	4554136	41.12998473	25.60105518

DETAILED DESCRIPTION OF ANCILLARY AND SUPPORTING INSTALLATIONS AND WORKS

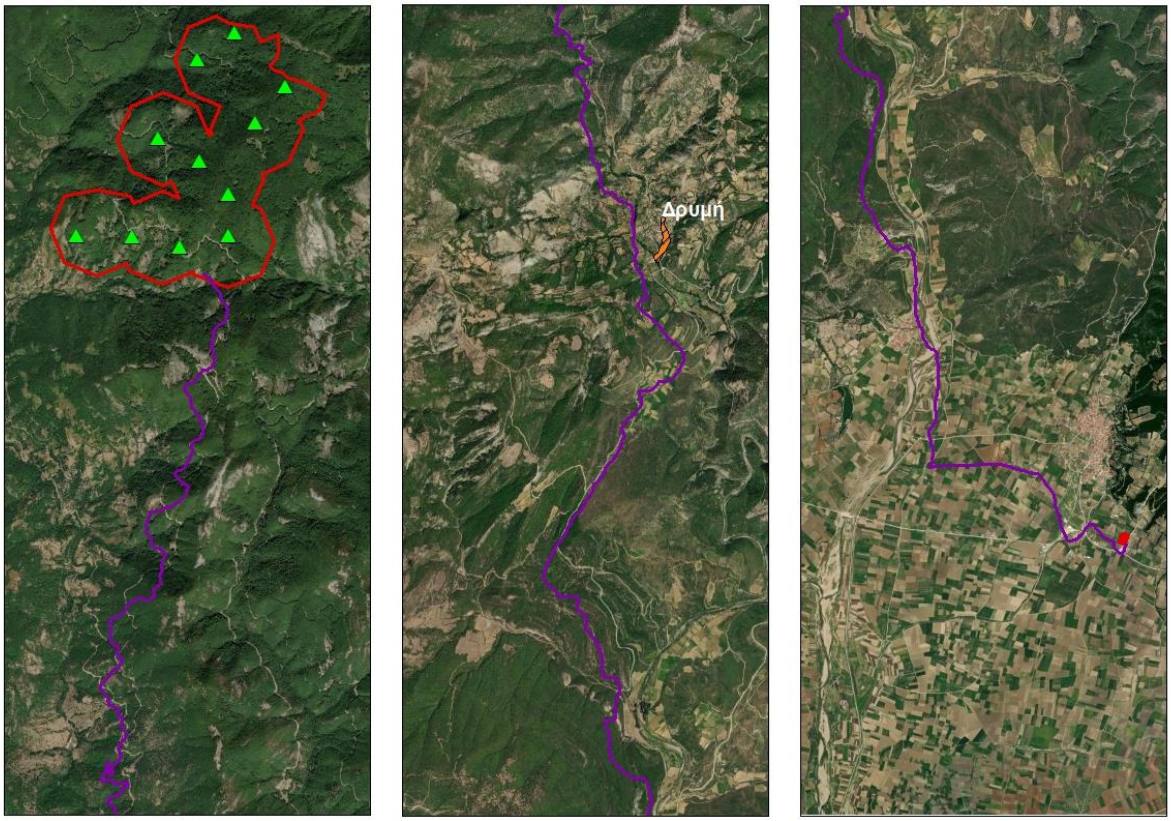
Electricity Interconnection Projects

The WTGs of the project under study will be interconnected to the underground medium voltage line through autonomous voltage step-up transformers (step-up transformers). The transformers are to be installed inside the WTGs at the base of the pylons for their uninterrupted and safer maintenance and operation. From the main switchboard of the WTGs, the M.T. cables will run underground, following the layout of the internal roads.

In the design of the considered ASDP, the construction of a control house is not foreseen.

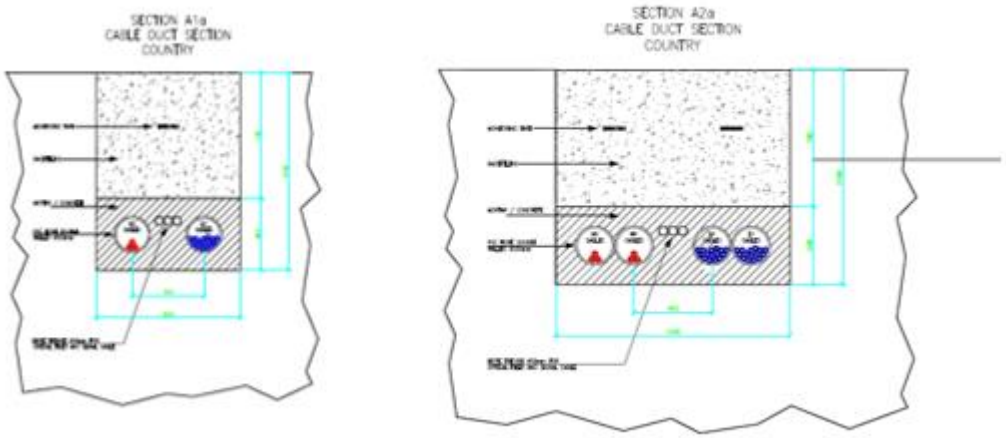
MV Interface Line

For the transmission of the energy produced by the wind turbines of the wind farm under consideration to the Voltage Raising Substation, the construction of a 20kV medium voltage interconnection line is required. The total length of the interconnection line will be 25.15 km, which will run underground along the existing rural-forestry and rural roads.



Route of MV Interconnection Line

The MT cables for the interconnection of the WIND FARM up to the existing 33/150kV 'Flamburo' substation will be routed in an underground trench. The underground line will be built along the existing rural-woodland and rural road network. For this purpose, a trench will be excavated with dimensions of 0.80 m x 1.10 m (WxH), in accordance with the PPC's STANDARD CONSTRUCTION MANUAL (STC) and the needs of the project. In the length where the joint routing of two circuits is required, the width of the hook will be 1.20m. The communication cable will be routed in the same hook, while the channel of the internal network of the AP will also be traversed by a grounding conductor, which will be connected to the grounding system of the WTGs. Sand, marking tape, excavation products or gravel will be used to cover the cables where required.



Typical cross section of single and double line cable crossing channel construction

The trenches where the interconnection cables will be installed will be opened during the earthworks phase and will contain (except for MV cables) the following categories of cables:

- Communication cables
- Earthing conductor

Substation Voltage Booster

The Medium Voltage interconnection line will end at the existing 20/150kV "Flamburo" Voltage Raising Substation (VS), which is connected to the 150kV/2B GM "Orestiada - Kehros - Kerveros - Iasmos".

In order to connect the project under consideration to the substation in question, some extension works are required. The extension works required for the connection to the substation "Flambouros" include, indicatively, extension of 150kV yokes and installation of two complete 150kV gates for the

connection of 150kV overhead transmission lines. The above equipment is indicative and will be finalised, as well as the final location of the PS and the final route of the new transmission line, during the Tender of Connection Conditions phase. In case of any variations from what is proposed by the EIS, an Amendment File will be prepared to harmonize the EIS with the proposal of the ADMIE.

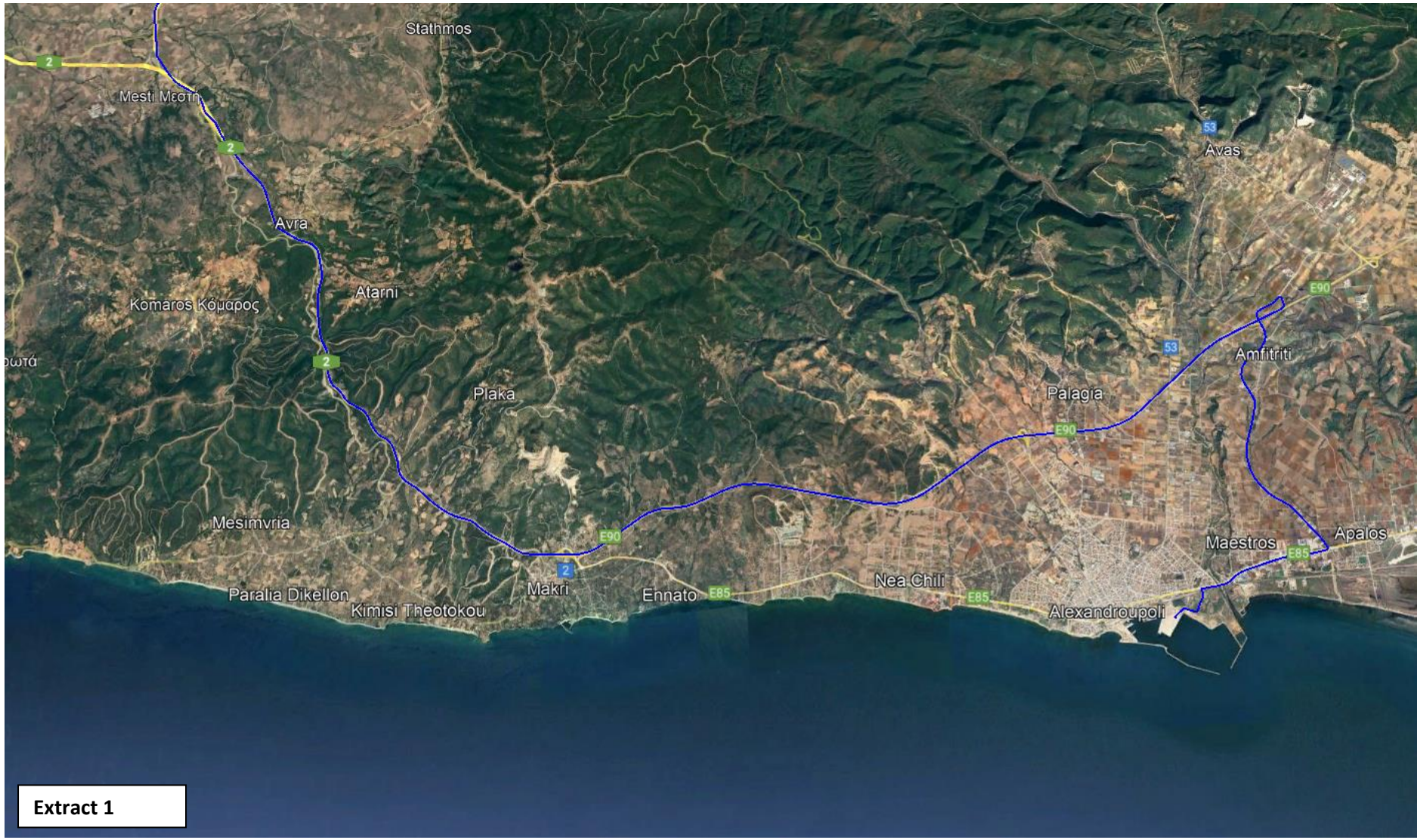
Connections to the Road Network - Transport of equipment to the installation sites of the WTGs

General

Wind farms require special transport solutions, according to the specifications of the wind farm manufacturer, in order to avoid any damage during transport. The design of new roads and the testing of existing roads were carried out for the worst-case scenario, i.e. the transport of the blades of the wind turbines in terms of maximum length, the pylons in terms of maximum width and the fuselage in terms of maximum weight and height.

The port of Alexandroupolis is the closest port to the W/F. As a special purpose port (commercial), it is suitable as it offers the appropriate facilities for the approach of suitable transport and storage facilities. Furthermore, the road connection from the port to the main roads in the area is direct.

Specifically, the transport of the project equipment will start from the port of Alexandroupolis and will follow a route from Republic Avenue to the National Road Alexandroupolis - Synoron. After 6.6 km it will enter the Egnatia Odos and follow a 30 km route up to the junction at the height of the settlement of Mestis Komotini. It then enters the Provincial Road Komotini - Alexandroupolis where it follows a 25 km route up to the junction at the height of Anthohori. It enters the local road of Anthochorio and follows a 7 km northward route until the junction at the settlement of Gratini in Komotini, where it enters the Provincial Road of Komotini - Bulgarian Borders. It travels a distance of 14 km and then enters the Local Road around the settlement of Drimi where it continues north for a further 11 km until it reaches the starting point of the access road works.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Paralia Dikellon
Kimisi Theotokou
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Nea Chili
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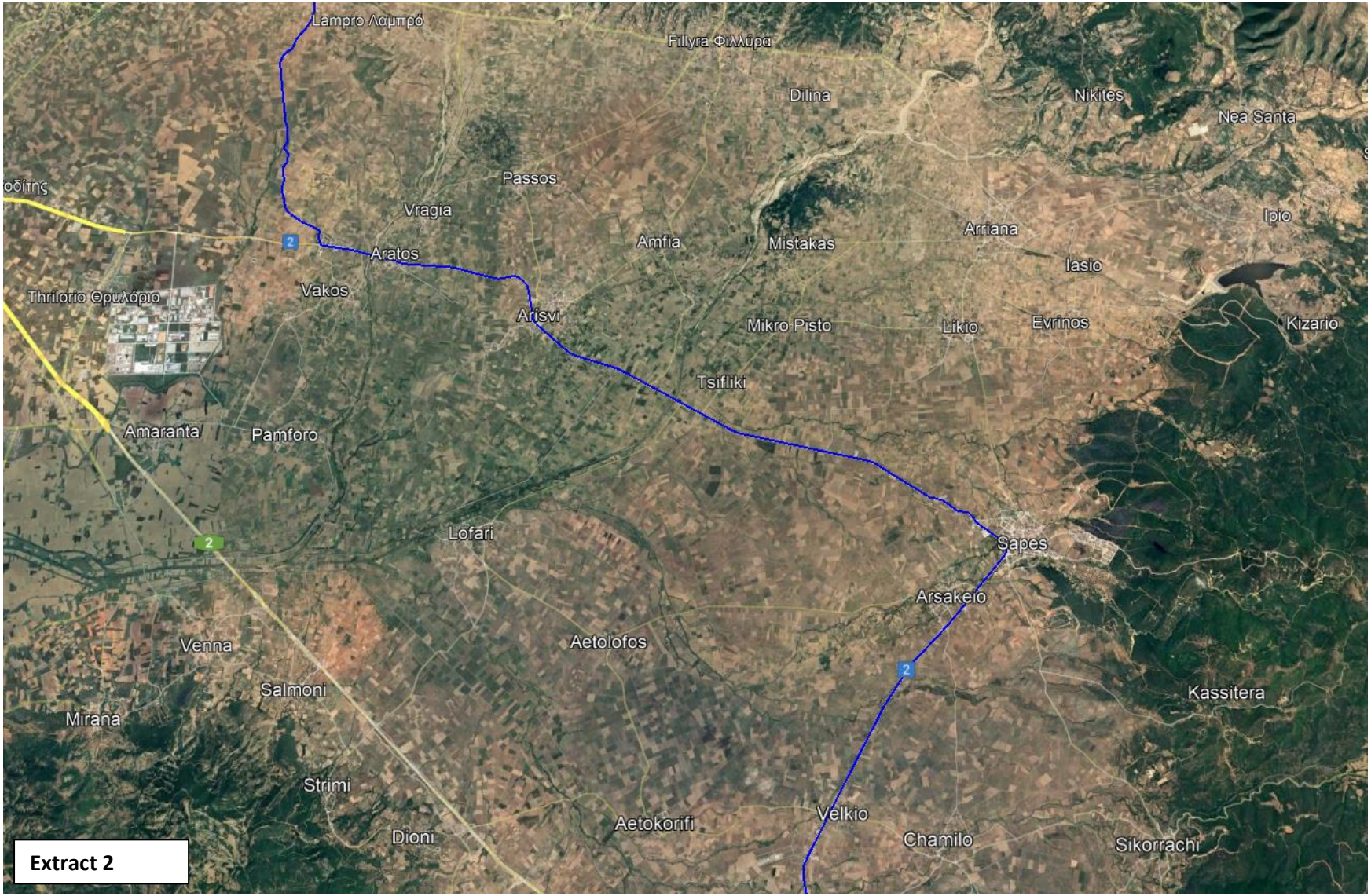
Extract 1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Passos
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Ipio
Iasio
Aratos
Vakos
Thrilorio Θρυλόριο
Arisvi
Mikro Pisto
Likio
Evrinos
Kizario
Tsifliki
Amaranta
Pamforo
Lofari
Sapes
Arsakeio
Venna
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Aetokorifi
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Dioni
Chamilo
Sikorrachi
Extract 2


Kardamos Καρδαμος
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Drania
Megali Ada
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Sinikismos Nimfeas
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Ardeia
Kato Virsini
Paterma
Ano Drosini
Pandrosos
Simvola
Tichiro
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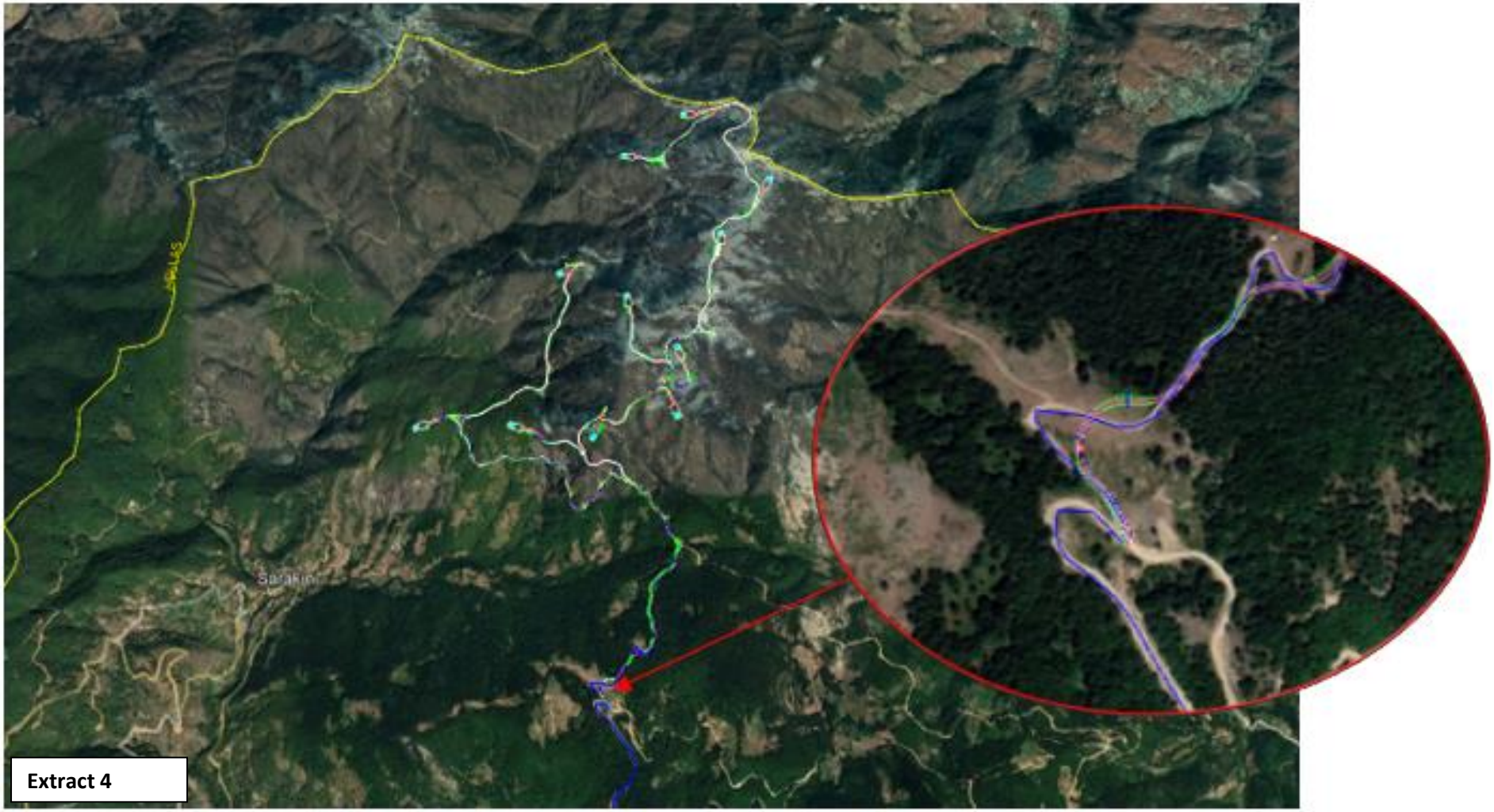
Extract 3



Route to be followed by the transport vehicles for the transport of the equipment (Start: Extract 1 - End: Extract 4)

Access to the W/F will generally be via the existing road network in the area. However, where this is not sufficient, improvements to existing roads and/or the construction of new roads will be carried out.

The geometric elements of the roads must ensure the passage of the vehicles that will transport the wind turbine components, but at the same time the required strength to withstand the weight of the wind turbine components.

Both the installation of the WTGs and the access roads and internal roads are located in agricultural and forest areas. The terrain has very low gradients and the longitudinal gradients of the roads are also very low and do not cause any problems for the movement of transport vehicles. When designing the roads, an effort was made to use existing roads as far as possible to minimise interference with farmland or woodland.

Geometric data of roads - standard cross-section

The existing road will be used for the approach to the project, then new road sections will be built or existing road sections of the local network will be improved to connect the WTG. The length of the road network that will be required is **11,182.63m.**

The geometric elements of the roads should be such as to allow the passage of vehicles carrying the components of the wind turbines selected for installation. The choice of the transport vehicle depends on the dimensions of the wind turbine components and the way in which they are to be transported. The critical dimension is the length of the blades. If the wing is transported in a horizontal position , without the blade lifter device , then the length of the tractor is of the order of 65.0 m.

The geometric requirements of the access roads for the transport of the elements of the specific WTG are as follows:

- The minimum width of the roads within the installation polygons of the WTG is 4.0m., with a minimum free width from any kind of obstacles on either side of 0.50m. In the present study the width of the roads within the polygons is 5.0m.
- For transport routes outside the installation polygons, i.e. access routes, the minimum required width of the routes is 5.0m with a clearance of 0.80m wide on either side of obstacles.
- *Maximum longitudinal slope 14%.* As mentioned, the terrain is mountainous-mountainous, but the slopes do not exceed the maximum permissible number.

- *Minimum radius of curvature.* The radii depend on the length of the vehicle. As mentioned since no blade lifter is used for this particular WTG the length of the tractor will be of the order of 65.0m. This study contains a variety of horizontal radii of curvature (large and small) to avoid requiring major interventions on the roadway while protecting the environment as much as possible. The minimum horizontal curve used has a radius of 35.0 m.
- The strength of the road surface shall be such that it can withstand a minimum axle load of 12 tonnes.
- Where the roads meet half canyons, culverts will be constructed so that stormwater runoff is unobstructed.

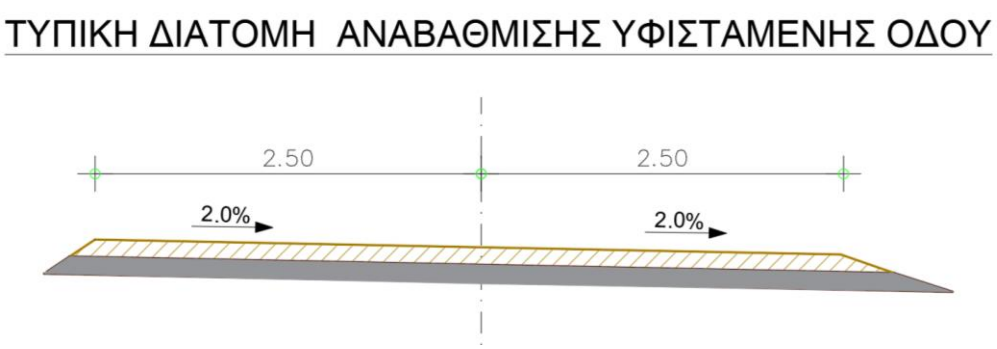
In terms of pavement condition, access roads are divided into three categories.

- Existing roads with full pavement.

  These are the roads of the National - Provincial or Municipal road network, which also serve the traffic of heavy vehicles. The pavement of these roads does not require any additional reinforcement in order to accept the loads of the transport vehicle .

- Existing roads without complete pavement.

  These are agricultural or forest roads which are usually paved with one or more layers of aggregate (torrent or quarry material). These roads are also used by heavy agricultural vehicles, but it is not certain that their strength will be such that they will be able to withstand the specific load. After inspection of some sections, upgrading work will be required. It is estimated that by laying another 10cm thick layer of 10cm thick crushed material of PTP O150 well compacted, these sections will be able to meet the loads of the transport vehicle.



- Opening of new roads

  The length of new openings is generally short. It is proposed to construct the pavement of the new roads with: one layer of 10 cm thick average crushed material of PTP O150 and one layer of 10 cm thick of PTP O155 (STP 05-03-03-00). In order to determine the thickness of the pavement more accurately, soil bearing capacity tests will be carried out at the specified locations.

The following table shows the limiting values of each road, i.e. the length, the minimum horizontal radius, the maximum longitudinal gradient (see plan "Horizons - O.01,O.02,O.03,O.04")

Road sections

a/a	Street	Length	Min R horizontal	Max s
		m	m	%
1	L01	3211,48	35	14,00
2	L02	1408,34	50	14,00
3	L03	577,96	70	13,04
4	L04	133,47	100	14,00
5	R01	717,29	50	14,00
6	R02	3330,29	50	14,00
7	R03	58,22	40	8,50
8	R04	109,24	50	10,50
9	R05	244,80	50	14,00
10	R06	478,55	50	14,00
11	R07	117,00	100	14,00
12	R08	98,36	100	12,18
13	B01	135,99	50	7,30
14	B02	81,59	50	7,50
15	B03	80,00	-	2,50
16	B05	37,87	50	9,00
17	B06	63,98	35	0,00
18	B07	97,32	50	6,50
19	B08	116,17	50	1,72
20	B09	84,71	50	5,00
Total		11182,63		

The project consists of the following road sections, where the following applies to each road:

Road L01 is the main road in the north-western part of the project, where it starts at the existing road and ends at the square of WTG 1. The longitudinal gradient of the road is steep in sections with a maximum gradient of 14 %. The total length of the road is 3211.48 m. Transport vehicles will move in the right of way.

L02 starts on L01 and ends at the square of A/F 5. The longitudinal gradient of the road is steep in parts with a maximum gradient of 14,0 %. The total length of the road is 1408,34 m. Transport vehicles will move in the right direction.

The L03 road starts at R02 and ends at the square of WTG 9. The longitudinal gradient of the road is steep in parts with a maximum gradient of 13,04 %. The total length of the road is 577,96 m. The transport vehicles will move in the right direction.

Road L04 is a road section for the reversal of vehicles, starting and ending at Road L01 . The longitudinal gradient of the road is steep with a maximum gradient of 14.0 %. The total length of the road is 133.47 m.

The R01 road starts at L01 and ends at the square of WTG 2. The longitudinal gradient of the road is steep in sections with a maximum gradient of 14.0%. The total length of the road is 717.29m. Transport vehicles will move in the correct direction.

R02 is the main road in the north-eastern section, starting from R01 and ending at the square of A/F 10. The longitudinal gradient of the road is steep in parts with a maximum gradient of 14.0%. The total length of the road is 3330.29m. Transport vehicles will move in the correct direction.

Road R03 is a reversing road, starting from R02 and ending at the extension of WTG 3 Square. The longitudinal gradient of the road is moderate with a maximum gradient of 8.50%. The total length of the road is 58.22m.

Road R04 starts from R02 and ends at the square of WTG 4. The longitudinal gradient of the road is moderate with a maximum gradient of 10.50%. The total length of the road is 109.24m. The transport vehicles will move in the correct direction.

The R05 road starts from the R02 road and ends at the square of WTG 7. The longitudinal gradient of the road is steep in parts with a maximum gradient of 14.0%. The total length of the road is 244.80 m. Transport vehicles will move in the correct direction.

The **R06 road** starts from the R02 road and ends at the square of WTG 6. The longitudinal gradient of the road is steep in sections with a maximum gradient of 14.0%. The total length of the road is 478.55m. Transport vehicles will move in the correct direction.

The R07 road starts from the R02 road and ends at the square of WTG 8. The longitudinal gradient of the road is steep with a maximum gradient of 14.0%. The total length of the road is 117.00 m. The transport vehicles will move in the correct direction.

The R08 road starts from the R02 road and ends at the square of WTG 11. The longitudinal gradient of the road is steep with a maximum gradient of 12,18 %. The total length of the road is 98,36 m. The transport vehicles will move in the right direction.

Road B01 is a reversing road section, starting from Road R02 and ending at Road B02. The longitudinal gradient of the road is moderate with a maximum gradient of 7,30 %. The total length of the road is 135,99 m.

Road B02 is a reversing road section starting from Road R02 and ending at Road B01. The longitudinal gradient of the road is moderate with a maximum gradient of 7,50 %. The total length of the road is 81,59 m.

Street B03 is the extension of the WTG 8 square for the crane setup. The longitudinal gradient of the road is gentle with a maximum gradient of 2.50 %. The total length of the road is 80.00 m.

Road B05 is a road section for the reversal of vehicles in the A/F 5 square, starting on L02 and ending in the A/F 5 square. The longitudinal gradient of the road is moderate with a maximum gradient of 9,00 %. The total length of the road is 37,87 m.

Road B06 is a road section for the reversal of vehicles from A/F 5 Square, starting from the extension of A/F 5 Square and ending at L02. The longitudinal gradient of the road is gentle with a maximum gradient of 0.00%. The total length of the road is 63.98 m.

Road B07 is a reversing road, starting from the extension of WTG 3 Square and ending at R02. The longitudinal gradient of the road is moderate with a maximum gradient of 6.50%. The total length of the road is 97.32 m.

Street B08 is a turnaround road, starting at L03 and ending at B09. The longitudinal gradient of the road is gentle with a maximum gradient of 1.72%. The total length of the road is 116.17 m.

Road B09 is a reversing roadway, starting at B08 and ending at L03. The longitudinal gradient of the road is moderate with a maximum gradient of 5.00%. The total length of the road is 84.71 m.

In general, the new roads follow the optimal route in relation to the terrain. The sequence of straight line - arc - straight line is followed. The radii of the arcs shall be suitable to allow the roads to be used by long vehicles carrying the pylons and blades of the wind turbines to be installed in the OP. Where necessary, widening has been applied to the inside of the curves with a small radius. The detailed elevations i.e. polygonal vertices and radii applied for each street are shown in the tables below (see plan "Elevations - O.01,O.02,O.03,O.04").

L01

Top	X	Y	R (m)
K1	631716,057	4570903,408	0
K2	631712,253	4570924,403	50
K3	631686,172	4570960,370	50
K4	631548,755	4571061,709	50
K5	631747,593	4571055,718	50
K6	631772,489	4571089,948	50
K7	631784,696	4571119,512	50
K8	631813,229	4571139,255	50
K9	631830,994	4571193,602	50
K10	631907,032	4571186,739	50

K11	631957,458	4571278,651	80
K12	631940,785	4571327,694	70
K13	631940,272	4571364,444	80
K14	631916,840	4571418,732	50
K15	631936,959	4571498,803	50
K16	631933,455	4571566,271	50
K17	632010,418	4571639,216	50
K18	632063,399	4571653,388	50
K19	632064,551	4571720,561	100
K20	632097,969	4571797,266	90
K21	632023,954	4571868,685	50
K22	632010,059	4571944,852	50
K23	631977,903	4571978,009	50
K24	631942,930	4572014,559	50
K25	631926,092	4572074,111	50
K26	631876,792	4572088,460	50
K27	631855,269	4572129,386	50
K28	631774,739	4572163,682	50
K29	631721,069	4572219,836	35
K30	631691,248	4572166,305	50
K31	631652,818	4572142,713	50
K32	631651,192	4572088,974	50
K33	631609,971	4572048,242	100
K34	631586,821	4572034,640	100
K35	631464,626	4571923,882	50
K36	631491,605	4572096,796	50
K37	631473,898	4572128,130	100
K38	631463,305	4572188,670	150
K39	631464,254	4572263,637	50
K40	631374,561	4572268,754	50
K41	631341,678	4572323,391	50
K42	631262,870	4572305,026	50
K43	631225,808	4572312,153	50
K44	631182,026	4572299,114	50
K45	631100,354	4572329,724	50
K46	631055,868	4572289,586	50
K47	631015,690	4572295,204	50
K48	630953,902	4572267,905	50
K49	630910,325	4572350,404	50
K50	630910,034	4572399,223	50
K51	630886,405	4572442,587	50
K52	630854,927	4572469,017	50
K53	630850,553	4572523,587	50
K54	630786,846	4572574,512	50
K55	630732,103	4572554,129	0

L02

Top	X	Y	R (m)
K1	630853,256	4572489,866	0
K2	630847,559	4572560,939	50
K3	630963,850	4572582,736	50
K4	631031,600	4572630,340	100
K5	631129,204	4572668,816	50
K6	631142,416	4572712,449	50
K7	631229,648	4572759,922	50
K8	631339,204	4572699,108	50
K9	631335,000	4572800,000	50
K10	631343,658	4572885,848	50
K11	631330,000	4572920,000	50
K12	631328,643	4572983,041	100
K13	631355,714	4573098,032	50
K14	631400,700	4573126,664	50
K15	631401,615	4573167,168	50
K16	631464,758	4573296,305	50
K17	631421,723	4573365,874	70
K18	631484,069	4573489,327	50
K19	631500,829	4573496,492	0

L03

Top	X	Y	R (m)
K1	632377,976	4574532,169	0
K2	632349,468	4574512,198	250
K3	632282,229	4574461,186	70
K4	632231,757	4574450,217	70
K5	632168,037	4574366,740	70
K6	632120,028	4574340,454	200
K7	632092,642	4574323,337	100
K8	631983,665	4574197,011	75
K9	631925,232	4574207,694	0

L04

Top	X	Y	R (m)
K1	630891,783	4572569,228	0
K2	630873,578	4572565,816	100
K3	630793,445	4572576,970	100
K4	630760,303	4572564,629	0

R01

Top	X	Y	R (m)
K1	631843,295	4572137,178	0
K2	631835,162	4572145,352	50

K3	631783,128	4572180,009	50
K4	631762,259	4572246,991	50
K5	631675,932	4572274,774	65
K6	631594,852	4572216,333	50
K7	631551,703	4572316,189	100
K8	631509,726	4572358,346	200
K9	631463,127	4572393,354	50
K10	631429,698	4572390,000	50
K13	631352,856	4572381,644	80
K11	631295,272	4572445,174	50
K12	631282,157	4572449,331	0

R02

Top	X	Y	R (m)
K1	631566,426	4572287,276	0
K2	631565,725	4572318,975	50
K3	631503,691	4572410,508	70
K4	631617,750	4572501,636	100
K5	631675,034	4572501,657	50
K6	631764,262	4572452,891	50
K7	631822,458	4572576,227	70
K8	631980,337	4572671,712	50
K9	632055,948	4572728,322	100
K10	632060,988	4572810,545	60
K11	632018,073	4572863,609	50
K12	632042,328	4572970,289	65
K13	632149,979	4572976,922	75
K14	632215,116	4573036,492	75
K15	632220,276	4573102,572	75
K16	632288,009	4573211,265	100
K17	632266,905	4573285,390	100
K18	632286,267	4573382,289	100
K19	632286,318	4573421,217	100
K20	632312,232	4573478,962	100
K21	632328,240	4573555,501	65
K22	632290,564	4573645,275	50
K23	632355,032	4573669,082	50
K24	632403,978	4573728,753	60
K25	632518,435	4573713,814	95
K26	632591,595	4573932,358	60
K27	632516,370	4573996,766	100
K28	632510,824	4574066,305	100
K29	632357,388	4574321,134	60
K30	632504,254	4574366,963	100
K31	632584,079	4574461,495	65
K32	632468,030	4574554,858	65

K33	632251,630	4574500,336	0

R03

Top	X	Y	R (m)
K1	631673,300	4572542,942	0
K2	631659,926	4572509,914	40
K3	631691,193	4572492,825	0

R04

Top	X	Y	R (m)
K1	631968,890	4572664,789	0
K2	632021,185	4572696,417	50
K3	632048,913	4572619,541	0

R05

Top	X	Y	R (m)
K1	631999,599	4572686,134	0
K2	632025,077	4572705,209	50
K3	632200,550	4572611,372	55
K4	632139,660	4572777,412	0

R06

Top	X	Y	R (m)
K1	632058,779	4572774,516	0
K2	632063,437	4572850,499	50
K3	631965,454	4572815,144	60
K4	631829,492	4572887,326	50
K5	631832,869	4573087,819	50
K6	631831,513	4573094,125	0

R07

Top	X	Y	R (m)
K4	632290,030	4573426,839	0
K2	632322,627	4573461,159	100
K1	632339,896	4573550,767	0

R08

Top	X	Y	R (m)
K3	632539,483	4573778,437	0
K2	632566,651	4573810,303	100
K1	632591,972	4573860,925	0

B01

Top	X	Y	R (m)

K1	632174,987	4572999,793	0
K2	632193,264	4573016,508	50
K3	632306,197	4572996,069	0

B02

Top	X	Y	R (m)
K1	632217,421	4573066,014	0
K2	632213,273	4573012,886	50
K3	632257,735	4573004,839	0

B03

Top	X	Y	R (m)
K1	632347,346	4573549,792	0
K2	632336,489	4573470,533	0

B05

Top	X	Y	R (m)
K1	631451,868	4573425,566	0
K2	631460,837	4573443,325	50
K3	631455,153	4573462,391	0

B06

Top	X	Y	R (m)
K1	631485,377	4573497,499	0
K2	631449,287	4573482,070	35
K3	631436,647	4573524,475	0

B07

Top	X	Y	R (m)
K1	631627,371	4572498,432	0
K2	631659,208	4572508,487	50
K3	631684,654	4572570,415	0

B08

Top	X	Y	R (m)
K1	631962,832	4574203,928	0
K2	632007,020	4574195,688	50
K3	632046,816	4574133,729	0

B09

Top	X	Y	R (m)
K1	632027,271	4574164,160	0
K2	632018,324	4574209,858	50
K3	632027,061	4574247,315	0

As for the technical works that will need to be built, in places where the roads meet half-gravels, drains will be built so that rainwater runoff can be unobstructed. These are twenty-eight (28) culverts, the characteristics of which are shown in the table below (see plan "Horizontal plan - O.01,O.02,O.03,O.04").

a/a	Culvert	Street	H.T.	Press	Dimensions
1	SOLL. OH.	R01	70	Tubular	Φ1000
2	SOLL. OH.	R01	640	Tubular	Φ1000
3	SOLL. OH.	R02	200	Tubular	Φ1000
4	SOLL. OH.	R02	350	Tubular	Φ1000
5	SOLL. OH.	R02	640	Tubular	Φ1000
6	SOLL. OH.	R02	930	Tubular	Φ1000
7	SOLL. OH.	R02	1160	Tubular	Φ1000
8	SOLL. OH.	R02	1460	Tubular	Φ1000
9	SOLL. OH.	R02	2340	Tubular	Φ1000
10	SOLL. OH.	R02	2960	Tubular	Φ1000
11	SOLL. OH.	R02	3160	Tubular	Φ1000
12	SOLL. OH.	R06	220	Tubular	Φ1000
13	SOLL. OH.	R06	460	Tubular	Φ1000
14	SOLL. OH.	L01	200	Tubular	Φ1000
15	SOLL. OH.	L01	660	Tubular	Φ1000
16	SOLL. OH.	L01	1140	Tubular	Φ1000
17	SOLL. OH.	L01	1480	Tubular	Φ1000
18	SOLL. OH.	L01	1650	Tubular	Φ1000
19	SOLL. OH.	L01	1980	Tubular	Φ1000
20	SOLL. OH.	L01	2320	Tubular	Φ1000
21	SOLL. OH.	L01	2860	Tubular	Φ1000
22	SOLL. OH.	L01	3000	Tubular	Φ1000
23	SOLL. OH.	L02	320	Tubular	Φ1000
24	SOLL. OH.	L02	580	Tubular	Φ1000
25	SOLL. OH.	L02	860	Tubular	Φ1000
26	SOLL. OH.	L03	197	Tubular	Φ1000
27	SOLL. OH.	L03	287	Tubular	Φ1000

28	SOLL. OH.	L03	480	Tubular	Φ1000

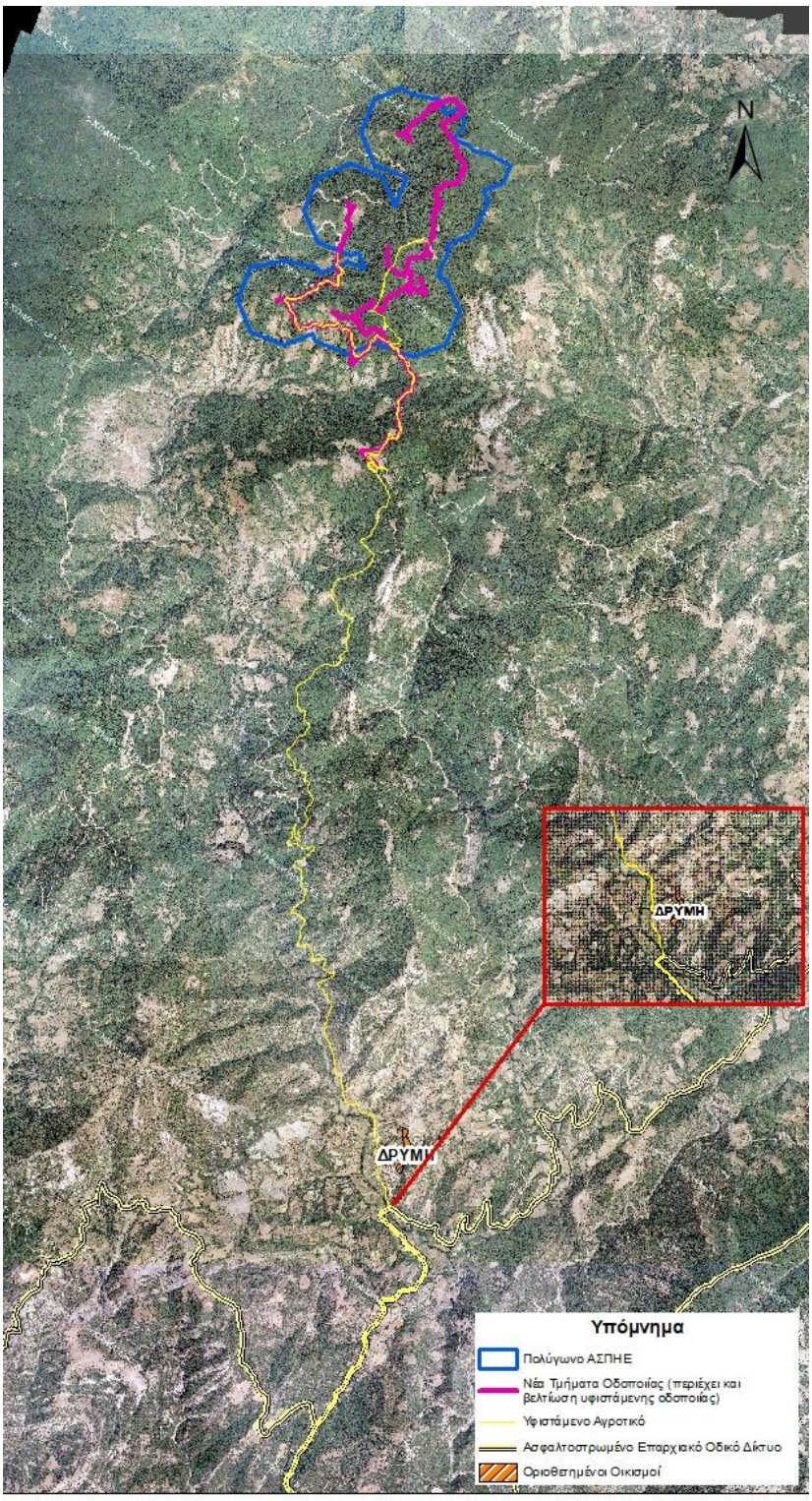
The locations of the roads and culverts are shown on the "Grading" plans O.01, O.02, O.03, O.04, attached as an appendix to this study.

Description of the connection of the installation polygon of the WTG installation with the external road network

The connection of the polygon with the external road network is made using the existing rural and forestry network.

The existing rural-forestry network is fully utilised and the required new widenings are small in length and are mainly carried out to create suitable turning and turning curves for vehicles.

The existing rural-forestry network is connected to the provincial road network. The connection point is in the western part of the settlement of Drimi.



Access road network to the studied ESDP

Configuration of the installation site of WTG

The space required for the installation of the WTG is divided into two categories.

- Permanent occupation .

This is the area required for the foundation of the WTG plus a free safety lane around the foundation, the installation area of the assembly crane, which must remain free after the crane has been removed for future repairs or maintenance, and the area occupied by the access road.

- Temporary occupation.

  These are the spaces required for the temporary storage of the WTG components i.e. the blades, pylon sections, etc.

The exact determination of the dimensions of the spaces is not possible at this stage of the design, because it depends to a large extent on the method of transport and assembly of the WTG components. It may be possible to transfer certain elements (e.g. the pylon sections) in sections and assemble them, followed by the transfer of the blades, which will be placed in the space occupied by the pylon elements. However, it may be possible to transport and deposit the whole of the elements, followed by assembly.

In general, however, the required spaces for the specific WTGs are as follows.

- Foundation. The space occupied by the foundation and the safety walkway around it is a square with a side of approximately 25.0 m.
- Assembly crane area with increased strength flooring. It depends on the type of crane , but a typical dimension is a square with a side of 20,0 m.
- Place of deposition of the pillar elements. It is a function of the number of parts into which the pylon is divided. A rectangle of 30 x 35 m will in most cases cover the deposition needs.
- Space for depositing the wings. Calculated rectangle of dimensions 85x15 m.
- Free lane for crane assembly. Usually parallel to the access road, it is an obstacle-free area 10 m wide and more than 150 m long.
- Access road zone. In this case, existing forest roads are used to the maximum extent possible for access to the WTG, as well as new road markings.

The square footage for these WTGs is therefore taken as the sum of the individual areas, i.e. approximately 4-5 acres (except for WTG 8 which is estimated at approximately 3.3 acres.

TOTAL ESTIMATE OF THE AREA OCCUPIED BY THE PROJECT

The project under study is developed within a polygon licensed by RAE. For ease of description and understanding of the occupation of the project below, we define it as:

Access zone: this is the zone that defines the area where surface clearing of vegetation for the opening of access roads will take place and includes the area of trenches/fills.

Installation squares of the wind **turbine**: they have a certain area for each wind turbine according to the guidelines of the construction company and the local morphology of the soil, where surface cleaning is carried out for the construction of the wind turbines. The area of the plazas for the specific wind turbines is estimated at approximately 4-5 acres per wind turbine, except for wind turbine 8 which is estimated at approximately 3.3 acres.

Area of intervention: The area of intervention is the sum of the access area and the WTG installation areas and is calculated in the following table.

The area of occupation of the WTG squares is shown in the table below:

Square occupation area

a/a	WTG	Total Occupied Area
		m2
1	WTG 01	4.913,78
2	WTG 02	5.288,11
3	WTG 03	4.354,47
4	WTG 04	4.373,09
5	WTG 05	4.609,81
6	WTG 06	4.991,82
7	WTG 07	4.847,01
8	WTG 08	3.334,24
9	WTG 09	5.041,59
10	WTG 10	4.207,36
11	WTG 11	4.334,60
	Groups	**50.295,88**

The area occupied by the streets is shown in the table below:

Area of road occupation

a/a	Street	Total Occupied Area	Surface area of existing local road network	New Occupation Surface
		m2	m2	m2
1	L01	35.355,65	22.313,58	13.042,07
2	L02	15.708,74	4.993,82	10.714,92
3	L03	6.470,87	0,00	6.470,87
4	L04	1.149,27	369,00	780,27
5	R01	7.530,49	128,46	7.402,03
6	R02	33.285,78	49,32	33.236,46
7	R03	703,87	0,00	703,87
8	R04	1.525,53	0,00	1.525,53
9	R05	2.562,49	0,00	2.562,49
10	R06	4.506,08	23,60	4.482,48
11	R07	1.318,89	0,00	1.318,89
12	R08	787,00	0,00	787,00
13	B01	758,37	0,00	758,37
14	B02	733,20	0,00	733,20
15	B03	785,26	0,00	785,26
16	B05	309,00	0,00	309,00
17	B06	963,24	0,00	963,24
18	B07	931,07	0,00	931,07
19	B08	1.905,63	0,00	1.905,63
20	B09	973,30	0,00	973,30
	Groups	**118.263,73**	**27.877,78**	**90.385,95**

Therefore, the total area occupied by the project (including the existing roads) is 50.295,88+118.263,73=168.559,61 m2 , while the area occupied by the new surfaces of the project as a whole (without the existing roads with their cross-section) is 50.295,88+90.385,**95=140.682 m .²**

The following table presents the total occupied area of the project under study, as obtained from detailed area measurement, both for the wind turbines and the access road works. The next table shows the encroachment of the projects on forested land for which encroachment approval is required. The areas belong to the AD and DA codes, while no intervention is identified on areas with a DA code.

For the accompanying medium-voltage interconnection projects within forested areas, if they run underground and along existing roads, no intervention approval is required, but only notification of the relevant forestry authority, in accordance with Article 4, paragraph 6 of Law 4951/2022.

Intervention on land subject to forestry legislation (for AD and DA codes)

Project Department		Intervention surface (m²)
Roads	**Length (m)**	
Improvement	3.664	18.320
New drilling	7.033,63	35.168,15
Construction squares		50.295,88
Total	**10.967,63**	**103.784,03**

All the works are reflected in the draft General Project Schedule - T01 which is attached to the annex of this study.

CONSTRUCTION PHASE

Work schedule

According to the project design at this stage, the construction of the project will have a total duration of 16 months. The construction phase of the project includes the following stages:

- Opening of new roads and improvement of existing access roads
- Installation of WTG (landscaping, foundation, erection)
- Trial period of operation

ID	Task Name	Duration	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14	Month 15	Month 16
1	Διάνοιξη νέων δρόμων και βελτίωση υφιστάμενων οδών πρόσβασης	4 mons																
2	Εγκατάσταση Α/Γ (διαμόρφωση πλατειών, θεμελίωση, ανέγερση)	8 mons																
3	Εγκατάσταση Υ/Σ και διασύνδεση με ΕΣΜΗΕ	4 mons																
4	Δοκιμαστική περίοδος λειτουργίας	2 mons																

Estimated duration of project construction

Construction works

Opening of access roads and access roads - External and internal road construction of installation sites

The road works concern access to the wind farm site and, in particular, access to each of the wind turbine sites, in order to provide safe access for trucks, cars, cranes and motorized equipment required during transport, erection of the equipment during the construction phase and during the maintenance of the wind farm during the operation phase.

As mentioned in the previous paragraph, due to the fact that the area where the WTGs are located is predominantly forested land with existing forest roads, except for some road sections on private land, the road works required are small in scale. The works that will be required can be summarised as follows:

- Cleaning of the surface soil layer to a thickness of 15-20cm.
- Laying of paving materials in a thickness of 10 to 30 cm.
- Agglomeration of paving materials

Wind Turbine Installation

The following sub-projects are required for the installation of the WTGs:

- Landscaping of squares WTG
- Foundation
- Transportation and erection

Landscaping of WTG squares

The installation square, with an average area of 4,572 sq.m., will be formed at the location of each WTG.The square will be used both for the temporary deposition of the individual parts of the WTG (pillars, fuselage, fins) and as a place for the assembly and support of the crane with which the WTG will be erected.

Any irregularities in the ground will be remedied by backfilling and appropriate compaction to achieve a relatively flat surface.

In the study of the WTG squares it was considered that:

- ✓ The part of the street in front of the square will also be used during the construction
- ✓ The heavy and small volume parts of the WTG (Nacelle, Hub) will be stored in the square
- ✓ Clearing of surface vegetation to a thickness of 20cm will be required
- ✓ There will be synchronisation during erection between erectors and conveyors.

- ✓ Due to the large construction loads, the use of a large crane (500 t) is required, which requires a specially designed assembly - disassembly lane, which has been provided in each square.
- ✓ It is envisaged that transport vehicles will have the ability to stop or return within the plaza area, where appropriate.
- ✓ The locations of the squares are almost flat so no significant earthworks will be required

Foundation of WTG

The base - foundation of the wind turbine pylon is of circular plan in the shape of a flattened cone... Then a suitable system of anchor bolts and iron reinforcement will be installed. The excavation products will be used after concreting for backfilling the foundations. The concrete will be of high quality, type C25/30.

The products of the excavation will remain a short distance from the foundation and will be used after the excavation of the foundation for backfilling.

Transport and erection of equipment

The main parts of a wind turbine to be built are:

- Pillar, conical
- Fuselage, in which all the mechanisms of electricity generation are contained
- an impeller, consisting of the hub to which the three blades are attached

All the necessary preparations (site layout, foundation construction) and the necessary preparation of the auxiliary material will have already been made at the installation site, so that the construction can start immediately and during the arrival of the equipment by road at the installation site.

The erection process consists of the following stages:

- Assembly of the blades on the hub
- Deposition of the shell near the foundation area
- Erection of the first section (base) of the pylon
- Preparation of the second piece of each pillar and its erection
- Erection-connection of the fuselage
- Assembling the impeller to the ground
- Erection-attachment of the impeller

For the correct and safe execution of the construction works, a crane of appropriate lifting capacity (up to 500 tons) and a smaller crane of up to 80 tons for secondary works will be used. The crane can successfully lift all the main parts of the wind turbine, which will be transported to the erection sites by road. The erection crew will consist of three (3) experienced technicians and two (2) support staff.

Interconnection with the Electric Power Transmission System

For the electrical interconnection of the wind turbine, an underground network will be constructed from which the Medium Voltage (MV) cables, the low voltage cables and the grounding network will be routed. From the WTGs the underground cable will leave and connect to the MV panels.

The cable channel will be parallel to the internal roads of the wind farm and approximately 1-2 meters away from them where possible, thus avoiding additional change of the ground surface. The width of the channel will be approximately 0.8 metres, while the depth of the excavation will be approximately 1 metre, as required by the electrical regulations for Medium Voltage cabling.

The construction work of the wiring channels includes the backfilling of the channels with two layers of 20 cm of suitable sand or suitable fine-grained soil with good conductivity for the protection of the wiring and the improvement of the grounding.

After the completion of the cable laying works, the channels will be backfilled and compacted with excavation products cleaned of stones up to the level of the natural ground. Part of the excavated material will be deposited on one side of the channel and close to it for easy reuse for backfilling in the next stage, i.e. after the laying of the cables

Voltage boosting S/S

The design and development of the considered UPS, does not foresee the construction of a new voltage boosting substation. The Wind Farm will be connected to the existing substation 'Flamburo' at 20/150 KV in the location 'Flamburo', in the Municipality of Arrianon, P.E. Rodopi.

Supporting facilities (Excavation storage area - storage rooms - construction sites)

Construction sites will be established at each WTG site being constructed. The construction sites will be temporary and within the WTG installation areas, where the machinery and the necessary personnel will be located.

A construction crew will be present during the shaping of each platform, as well as during the assembly and erection of each WTG, as required by law and the manufacturer. The main operations envisaged include cleaning of the intervention surface, earthworks for the foundation of the WTG. The earthworks will be carried out in such a way as to achieve immediate reuse of the excavated material in the configuration areas.

Within the installation squares and the polygon of the PS, there will be temporary storage bins for the management of the sedimentation. As regards road paving, it is planned to use the materials produced by the excavation work, provided that they are deemed suitable for the needs of the project and after the removal of unsuitable products from the excavation mix.

A mobile crusher will be used to reuse a quantity of excavated material to create aggregate for road paving.

Necessary construction materials

For the construction of the WTG under study and the accompanying works, the main materials to be used are presented in the following paragraphs . The above mentioned materials will be procured commercially and transported on site to the project.

Concrete quantities

The concrete for the foundations of the WTGs will come from licensed concrete manufacturing plants. For the foundations of the wind turbines, reinforced concrete is required to anchor the pylons, with a total volume of approximately 66,000 m .^{3}

Quantities of aggregates (paving and cable channel)

In the new road openings, with a total length of 11,182 m, a 0.10 m thick sub-base layer and a 0.10 m thick base layer are constructed.The total volume of the crushed material is:

(5,40*0,10+5,0*0,10)*11.182,63 = 11.630,0 k.m.

We estimate that along 50 % of the existing rural-forest roads in use, which have a total length of 3,690 m, the construction of another 0.10 m thick pavement layer will be required:

50%*3.960*5,0*0,10 = 990,0 k.m.

The total volume of broken paving material is therefore in the order of 12.620 m³.

Also, the trench where the cables for the interconnection of the WIND FARM with the Voltage Raising Substation will be partially filled with quarry sand. The quantity of sand is estimated at 4.024 m^3 (trench width: 25.150 m x trench width: 0.40cm or 0.70cm as appropriate x sand layer thickness: 40cm).

Water needs

Living arrangements for workers. The water requirements for the living quarters of workers on the construction sites during the construction phases of the project are estimated at 15 persons x 20 Lt/worker/day = 0.3m^3 /day for the peak day. This quantity will be met with quota quality water from licensed water carriers and bottled water suppliers.

Material leakage. During the construction phases, quantities of water will be required for the wetting of materials at construction sites and in the occupation zones of the works in order to control the release of dust from earthen surfaces and materials. Considering the humid climate in the project area and the small size of the earthworks, these quantities are estimated to be very small and will certainly not result in significant impacts to the water resources of the area and will be covered by licensed water carriers.

Energy needs

Electricity requirements during construction will be met by either site power or a generator.

Waste water discharges

Urban wastewater. During the construction phase of the project, urban wastewater is expected to be generated from the living quarters of workers at the construction sites. It is estimated that the maximum urban wastewater generation will be equal to the drinking water consumption of the workers as calculated earlier i.e. 0.3 m^3 /day peak. For the convenience of the staff, it is proposed to install chemical latrines within the construction sites which will be regularly transported and evacuated to the nearest Wastewater Treatment Plant under the responsibility of the project proponent.

Waste from the maintenance of machinery, vehicles and E/M equipment: Although the maintenance of machinery will be carried out off-site in licensed workshops, during the construction phase of the works, waste may nevertheless be generated by the construction machinery and vehicles on site, mainly from any spillages from them and from the site's E/M equipment (transformers, inverters, capacitors, filters, etc.). This waste mainly concerns hazardous waste oils and liquid fuels, which are classified under the codes ECA.

Waste will be collected in special watertight containers that will be kept in a rain-protected area with a watertight floor within the construction site and then collected by licensed collectors-transporters, who will ultimately dispose of it through approved alternative management systems at appropriate facilities for further management. To deal with accidental pollution or spills, the site will be equipped with appropriate cleanup-absorbent materials, which will be readily available in the event a spill is identified as discussed in Chapter 10 herein.

ECW codes for waste that may be generated by the maintenance of construction site machinery and E/M equipment during the construction phase of the project.

ECA code	Category of waste
13 02	**Waste gearbox and lubrication engine oils**
13 02 05*	non-chlorinated engine, gearbox and mineral-based lubricating oils
13 02 06*	synthetic engine, gearbox and lubricating oils; and
13 02 08*	Other engine, gearbox and lubricating oils
13 03	**Waste insulation and heat transfer oils**

ECA code	Category of waste
13 03 06*	Chlorinated mineral-based insulating or heat transmission oils
13 03 07*	non-chlorinated mineral-based insulating and heat transmission oils
13 03 08*	synthetic insulating and heat transmission oils
13 03 09*	directly biodegradable insulation and heat transfer oils
13 03 10*	Other insulating and heat transmission oils
13 07	**Liquid fuel waste**
13 07 01*	diesel fuel and diesel fuel
13 07 02*	petrol
13 07 03*	other fuels (including blends)
16 01	**Waste from vehicle maintenance**
16 01 13*	brake fluids

Source: European Waste List (EWC) according to the Annex to Decision 2000/532/EC, as amended by Commission Decisions 2001/118/EC, 2001/119/EC and 2001/573/EC.

Surplus or waste materials or solid waste

Municipal Solid Waste (MSW)

During the construction phase of the projects, municipal solid waste (MSW) is expected to be generated from workers living on the construction sites. This waste is classified under the ESW codes of the table below**.** The maximum daily MSW generation during project construction (100% site occupancy) is estimated at a maximum of 15 persons x 0.4 kg/person/day = 6 kg/day peak. This quantity will be collected in bins to be placed inside the construction site. From these bins they will be collected under the responsibility of the project operator and disposed of in the nearest municipal bins or bins for recyclable materials nearest to the project, where they will be collected by the municipal collection network or the collection agencies for recyclable materials.

ESW codes of the MSW expected to be generated during the construction phase of the project

ECA code	Category of waste
20 01	**Separately collected fractions of household waste**
20 01 01	papers and cardboard
20 01 02	glasses
20 01 08	biodegradable kitchen and leisure waste
20 01 38	wood
20 01 39	plastics
20 01 40	metals
15 01	**Waste from packaging**
15 01 01	Paper and paperboard packaging
15 01 02	Plastic packaging
15 01 06	Mixed packing
15 01 07	Glass packaging

Source: Annex I of the HAC 36259/1757/E103/2010 & European Waste List (EWC) according to the Annex to Decision 2000/532/EC, as amended by Decisions 2001/118/EC, 2001/119/EC and 2001/573/EC of the European Commission.

During the construction of a project, waste may be generated from all types of earthworks and refers to the excess of excavated materials after some of them have been reused for the needs of the project. This waste is managed in appropriate MSW facilities, following a contract between the project promoter and a MSW PPA.

From all the works of drilling of the project road and the underground cable trench, as well as the foundations of the WTG of the W/F, the following earthworks result, as shown below.

Aggregated table of partitioning

a/a	Street	Length (m)	Trench (m)^3	Backfill (m)^3	Plant Lands (m)^3	Paving (m)^3
1	L01	3+211,48	26815	25475	10955	3473
2	L02	1+408,34	18553	11217	4948	1523
3	L03	0+577,96	9822	9587	2245	626
4	L04	0+133,47	401	1739	463	143
5	R01	0+717,29	14999	1573	2332	782
6	R02	3+330,29	29943	19886	10462	3681
7	R03	0+058,22	444	856	235	63
8	R04	0+109,24	281	3124	510	154
9	R05	0+244,80	3530	2667	856	265
10	R06	0+478,55	7651	3484	1487	520
11	R07	0+117,00	3425	928	415	127
12	R08	0+098,36	110	636	307	132
13	B01	0+135,99	28	1286	391	145
14	B02	0+081,59	215	461	213	87
15	B03	0+080,00	1212	337	256	103
16	B05	0+037,87	1826	0	122	42
17	B06	0+063,98	0	2192	303	68
18	B07	0+097,32	0	3434	414	103
19	B08	0+116,17	229	6721	705	124
20	B09	0+084,71	125	1391	337	91
21	WT01		9297	5736	1428	781
22	WT02		4250	4107	1566	781
23	WT03		2939	8164	1557	781
24	WT04		16561	264	1302	717
25	WT05		7242	3812	1519	781
26	WT06		4637	4023	1474	745
27	WT07		4760	4162	1430	756
28	WT08		4091	876	992	587
29	WT09		6138	2033	1439	781
30	WT10		3171	2679	1206	679
31	WT11		4313	1484	1180	686
Sum		**11182,63**	**187008**	**134334**	**53049**	**20327**
Proximity			**42**	**16**	**1**	**23**

Total		**187050**	**134350**	**53050**	**20350**
Balance		**32350**			

Based on the above table from the total of the project's road construction and the landscaping of the WTG squares, **187,050 m³** of excavated earth and semi-buried materials will result, of which **154,700 m³** will be used as backfill materials. The remaining quantity amounts to **32,350 m³** and will be managed as MSW by a lender if not reused in the project.

It is noted that the plant land will be reused in the project for planting needs and slope lining.

The road paving will require 20,350 m3 of crushed material, which will be taken from the excess of the excavations after using the mobile crusher.

ECI codes for excavation waste that can be generated during the construction phase of a project such as the one under study

ECA code	Category of waste
17 05	**Dirt, stones and rubble from excavations**
17 05 04	soils and stones
17 05 06	excavation rubble

Source: Annex I of the HAC 36259/1757/E103/2010 & European Waste List (EWC) according to the Annex to Decision 2000/532/EC, as amended by Commission Decisions 2001/118/EC, 2001/119/EC and 2001/573/EC

Air pollutant emissions

Expected impacts to the air environment from the project during the construction phase include the following:

- Dust from the management of materials and earthworks (excavation work, loading and unloading of soil and aggregates, etc.) and the construction of new works
- Dust from vehicle traffic on unpaved roads
- Exhaust fumes from the movement of construction machinery on site
- Exhaust fumes from vehicles transporting construction materials to and from the construction site.

Dust emissions

During project construction, emissions and ultimately dust concentrations in the project area will increase due to the following activities or factors:

-Movement of vehicles. Dust release is due to the application of mechanical force (vehicle weight) on loose soil resulting in dusting and scaling on the surface of the materials. According to the U.S. Environmental Protection Agency (USEPA), dust emissions from vehicle traffic depend on:

The average speed of the vehicles

The traffic load

The average weight of vehicles

The average number of wheels of vehicles

The percentage of sludge in the soil

- Wind drift of dust particles. The worst case for dust generation is the prevalence of strong winds in dry conditions. According to the USEPA, dust emissions from wind action depend primarily on the number of days when wind speed exceeds 5 m/sec and other factors, such as the number of days with precipitation (greater than 0.25 mm) during which no dust emissions are considered to be released.

-Groundworks , earthworks management. The addition of aggregates to a pile or their transport from a pile, as well as their continuous deposition, are sources of dust generation. The emissions generated in this case depend mainly on:

-The percentage of soil in sludge

-The average wind speed

-The fall height

-The moisture content in the material

Due to the humid climate in the project area even during the summer period and the increased soil moisture, combined with the very small amount of excavation and earthworks in general, no significant dust emission is expected. In addition, the paving materials to be used are of large diameter and therefore do not favour their suspension and transport over long distances. In addition, the application of the measure of wetting at the earthworks sites during the dry season will ensure to the maximum extent possible that no appreciable quantities of dust are generated. It is also worth noting that the nearest settlement to the work sites is Sarakini, which is more than 1000m away and has an altitude difference (from the settlement to the work sites) of approximately 180m.

However, it is appropriate to calculate the expected dust emissions (PM_{10}). The worst case is the settlement mentioned above (i.e. Sarakini) which is located closer to the work sites than the others. Also, of the construction phases, the most unfavourable is the road improvement and construction phase in relation to the construction of the WTGs, as it is closer to the settlement.

The methodology used and the values of the factors are taken from EPA's Compilation of Air Pollutant Emission Factors (AP-42).

Work to improve or construct new roadways and plazas shall include surface soil clearing, aggregate hauling, aggregate placement and compaction. Because the terrain is mountainous with significant slopes, it is estimated that in one day (10 hours of work) a 5 m wide dirt road can be fully improved/constructed over a 100 m length in one day (10 hours of work). This implies transporting 100 m of aggregate[3] i.e. 6.5 trips or 0.75 trips per hour of a 30 tonne truck. It also requires the operation of a loader for 6 hours, an earth shaper for 5 hours and a road roller for 4 hours.

Table of basic machinery

Description	Number of machines	Model
Land shaper	1	CAT 12Or similar
Four-axle truck	2	MAN TGS 41.440 or similar
Loader	1	LIEBHERR 564 or similar
Road roller	1	Volvo SD115 or similar

1. For the loading and unloading of bulk materials:

$$E = \kappa \times 0{,}0016*(U/2{,}2)^1{,}3/(M/2)^1{,}4$$

Where: E = Emission factor PM10, kg/t of transported material

k = 0,35, aerodynamic diameter multiplier for PM 10 particles

U = Average wind speed, m/s

M = Moisture content, (%)

2. For condensation:

$$Er = 0.75x(0.45x\ s^1.5/(M^1.4))$$

Where:

Er = PM10 emission rate, kg/hr

s = Percentage of sludge in the soil

M = Moisture percentage,

3. For the road opening:

$$Er = 0.75x(0.051 \times s^2*0.282)$$

Where:

Er = PM10 emission rate, kg/km

s = average vehicle speed

4. For the movement of machinery on construction roads (earth roads):

$$E = 0.282 \times 1.5\ (s/12)^{0.9}\ (W/3)^{0.45}$$

Where:

E = PM10 emission rate, kg/km

s = Percentage of sludge on the road

W = Average weight of heavy vehicles

Daily PM10 dust emissions from construction/improvement works on roads and squares

CONSTRUCTION WORKS	WORK DATA		PM10	UNIT OF MEASUREMENT	OBSERVATIONS
Loading of dumps on a truck	quantity of landfill (ton) =	440	0.0812	kg	Loader operation
	k=	0.35			
	wind speed (m/s) =	5.3			
	soil moisture percentage =	10			
Pavement compaction	machinery operating hours =	5	0.0200	kg	roller operation
	percentage of sludge in soil =	2			
	soil moisture percentage =	50			
Pavement paving	total distance travelled (km) =	0.2	0.1747	kg	grader function
	average speed (mi/hr) =	9			
Moving machinery on construction roads	average distance travelled (km) =	2	3.7189	kg	Movement of any vehicle on the construction roads
	percentage of sludge in soil =	20			
	Average vehicle weight (tn)	29			
TOTAL			3.99	kg	

So for the conservative scenario of simultaneous operation of all machines in a day, about 4kg of dust is emitted in the form of $PM_{.10}$

Dust emissions from mobile crusher operation

Capacity calculation. The crusher will produce 20.000 m^3 . According to the schedule the crusher's operating time is 4 months or 4 x 25 = 100 days. So 20.000 m^3 /100 days = 200 m^3 /day are required.

For the production of 200 m^3 /day is required:

200 m^3 /day/1.71=116.95 m^3 /day of in situ rock.

To this quantity should be added 116.95 m^3 /day x 8.7% = 10.17 m^3 /day of in situ rock which is removed by the specifier.

Therefore for the production of 200 m^3 /day are required:

116.95 m^3 /day + 10.17 m^3 /day = 127.12 m^3 /day of in situ rock

Calculating dust emissions. Dust is generated by the operation of the crushers during the following phases:

- material falling into the feeder of the assembly
- breakage of the material
- dropping of material near the ends of the conveyor belts
- sifting mainly of fine fractions (sand)

According to literature data in a crusher, the amount of dust produced is equal to the amount of peppercorns, which is estimated to be 0.4% of the capacity of the plant.

The amount of powder produced is equal to:

200 m^3 /day x 2 tn/m^3 x 0.4%=1.6 tn/day

Considering that the working day is 8 hours, the dust emission is 55.56 gr/sec.

The above quantity is produced without taking into account the dust retention by the filter system that the unit is equipped with. Considering that the plant is equipped with bag filters whose efficiency is around 98%, the dust emissions amount to 1,11 gr/sec.

6.1.1.1 Exhaust gases from manufacturing machinery

During the construction phase of the project, trucks and site machinery are expected to slightly pollute the air in the immediate project area with pollutants such as CO, NOx, SO_2 and smoke. The same construction scenario as before is considered here as the worst-case scenario.

The calculation of the pollutants emitted from the exhaust gases of the site machinery was carried out using the NONROAD_AIRPOL program in Excel spreadsheets. The methodology used by the program to estimate pollutants is based on the USEPA's NONROAD model methodology. Emission factors for pollutants (gr/kwh) were taken from the EU directive on diesel emissions from construction machinery and vehicles and, where not available, from USEPA literature. The factors correspond to Standard Stage II or III for machinery in service after 2003.

EU Stage II/III Emission Standards for Nonroad Diesel Engines						
Cat.	net power	Date	CO	HC	NOx	PM
	kW		g/kWh	g/kWh	g/kWh	g/kWh
Stage II						

E	130 ≤ P ≤ 560	2002.01	3.5	1.0	6.0	0.2
F	75 ≤ P < 130	2003.01	5.0	1.0	6.0	0.3

The sulphur content of the fuel was assumed to be 0.2% by weight and the emission results are presented in the following table.

Emissions of air pollutants during the construction/improvement phase of access roads and squares

a/a	Machine description	Number of machines	Ageing factor	Partial operation coefficient	Machine operation time (h)	Maximum Daily Emission (kg)					
						HC	CO	NOx	PM10	CO2	SO2
1	Grader (14t)	1	0.30	0.60	5.0	**1.65**	**0.33**	**1.97**	**0.09**	**386.84**	**0.47**
2	Vibrating roller (9t)	1	0.25	0.68	4.0	**1.03**	**0.21**	**1.23**	**0.06**	**210.23**	**0.26**
3	Heavy truck 29 tn	2	0.35	0.39	6.0	**5.33**	**1.54**	**9.10**	**0.24**	**3287.91**	**4.03**
4	Tire loader (22t)	1	0.50	0.46	6.0	**1.80**	**0.52**	**3.07**	**0.09**	**801.46**	**0.98**
TOTAL MAXIMUM DAILY EMISSIONS (kg/day)						**9.80**	**2.60**	**15.36**	**0.48**	**4686.44**	**5.74**

Noise and vibration emissions

Noise

Noise during the construction of a project comes from the operation of construction machinery. In this study, noise from construction operations is assessed according to ISO 9613-2 "Acoustics - Attenuation of Sound during Propagation Outdoors" and the assessment index will be LeqA. Due to the proximity of the settlement of Sarakini to the construction sites, a detailed noise calculation was performed at the closest residences for the worst case scenario of road construction/improvement.

The iNoise v2023 software from DGMR Software was used to calculate the isothermal curves from the operation of construction machinery. The software can simulate noise propagation from point, area and linear sources.

According to ISO 9613-2 the basic equation for calculating the noise level at a receiver is as follows:

$$\text{Οκτάβα Επιπέδου Θορύβου} = L_w - A_{geo} - A_{atm} - A_{gr} - A_{bar}$$

L_W - Sound power of noise source

The noise level produced by a source is measured in dBA. The software has a large database of noise from various manufacturing machines for different functions. The noise levels in the database are derived from measurements within the European IMAGINE project.

A_{geo} - Geometric Damping

The damping of the spherical propagation of the sound wave from a point source is proportional to the distance and is given by the equation $A_{geo} = 20 \times log(d) + 11$, where d is the distance from the source.

A_{atm} - Atmospheric Absorption

The propagation of sound through the atmosphere is dampened by the conversion of sound energy into heat. This attenuation depends on the temperature and relative humidity of the air, and increases at higher frequencies. It is equal to the product of the distance from the source multiplied by the atmospheric absorption coefficient α (dB/m). The values of the coefficient α, as shown in the table below, correspond to an air temperature of 10 °C and a relative humidity of 70 %. These values are corrected for local climatic conditions.

Atmospheric damping coefficient as a function of sound frequency

	Central Frequency Octave (Hz)							
	63	125	250	500	1000	2000	4000	8000
Atmospheric Absorption Coefficient (dB/m)	0.000122	0.000411	0.00104	0.00193	0.0037	0.00966	0.0328	0.117

Agr - Effect of soil surface type

The effect of the type of ground surface concerns the reflection of sound waves on the ground and their contribution to the sound waves propagating directly from the source to the receiver. It depends on the height of the source and the receiver, but also on the variations in altitude between them. In this respect, it is taken into account by means of the variable G, which ranges from 0 for 'hard surfaces' (such as cement, water, ice and generally non-porous surfaces) to 1 for porous surfaces (such as agricultural land).

Abar - Amortization Due to Obstacles

Each obstacle between the noise source and the receiver reduces the volume of the sound depending on the relative height of each of them and the frequency of the sound. In this study, there are no obstacles between the construction sites and the receptor, such as tall buildings, forest with tall trees, etc.

More specifically, the following assumptions were made for the calculation of construction noise:

- The operating time of the site is 10 hours from 07.00-17.00
- It was considered, in the interests of safety, that the various construction operations are carried out simultaneously.
- It is assumed that in one day (10 hours of work) a 5 m wide dirt road can be fully improved/constructed over a length of 100 m. This implies transporting 100 m of aggregate[3] i.e. 6.5 trips or 0.75 trips per hour of a 30 tonne truck. It also requires the operation of a loader for 6 hours, an earth shaper for 5 hours and a road roller for 4 hours. The productive hours of operation of the machines range from 5 to 7 hours
- The simulation of the linear sources was done by discretization into individual sections of 5-15m length

The following table shows the results of noise calculations at the nearest receptors, at two different heights: 1.8m and 4m from the ground, corresponding to the ground floor and the 1^{o} floor of a house. As can be seen, the noise level at the nearest houses in the nearest settlement (Sarakini) is less than 60 dBA even for the most conservative scenario of simultaneous operation of several machines. 65

dBA is exceeded only at the machinery operating locations. Noise levels are even lower in the other settlements (Drymi, Ardea, Ano Drosini)

Noise levels at the receptors of the Sarakini settlement during the construction/improvement phase of the access roads and squares (the receptor has been placed at the nearest house to the project)

Recipient	X	Y	H m	Lp (dBA)
H1	630238.549	4571889.288	1.8	58.4
			4	58.5

Vibrations

Vibrations during the construction phase are expected mainly during the compaction phase of the pavement layers.

The threshold of vibration perception for humans is usually in the PPV (peak particle velocity) range from 0.14 mm/s to 0.3 mm/s. Vibrations above these values may cause discomfort or interfere with work activities (BS5228-2:2009).

The relationship for calculating the maximum particle velocity from roller operation and assessing vibration effects used by BS5228-2:2009+A1:2014 is:

$$v_{res} = k_s \sqrt{n_d} \left[\frac{A}{x + L_d} \right]^{1.5}$$

where Vres is the particle velocity (mm/s), Ks is a coefficient, n_d is the number of vibrating drums Ld is the drum width, A is the height of the drum oscillation (mm) and x is the distance of the receiver from the roller.

For the specific roller to be used, A = 1.2mm Ld = 2.13 m n_d = 1. The coefficient Ks is given by the following values:

$k_s = 75$ (50%)
$k_s = 143$ (33.3%)
$k_s = 276$ (5%)

For a probability of exceeding the estimated value of 5% (high reliability of the estimate) and assuming a distance of 60 m to a hypothetical receptor, the particle velocity v = 0.74 mm/s, while for a distance of 1,000 m it is 0.011 mm/s.

The speed at 60 m is already less than the 1 mm/s limit set by BS5228-2:2009+A1:2014 and the 1.5 mm/s limit set by Eurocode 3 for a working time of 6-26 days for disturbance to humans. It is also well below the 20 mm/s limit set by BS5228-2 for protection of residential buildings. Obviously the velocity at the nearest settlement of Saracen (greater than 1,000 m distance) is negligible.

Electromagnetic radiation emissions

No electromagnetic radiation emissions are expected during the construction of the project, as no fixed installations or machinery that will continuously emit radiation will be used.

PHASE OF OPERATION

Detailed Description of the Project Operation and Management

Once all the above-mentioned works have been carried out and before the final connection of the station to the network, a trial period of operation of the station (1.5 - 2 months) will be carried out, in order to improve any failures concerning the electrical and mechanical equipment used, in order to ensure the smooth and uninterrupted operation of the station.

The wind farm will then operate as an independent power producer and will be interconnected with the National Electricity Transmission System of ADMIE.

All maintenance work on the park will be carried out in accordance with the technical manuals provided by the contractor. In addition, the availability of a complete range of spare parts has been taken into account in order to avoid any delays in the repair of breakdowns. Trained personnel will work in the AP and each year the installation will be inspected by the manufacturer's personnel to confirm that the equipment is well maintained and for technical support issues.

Main operating characteristics of wind turbines

The WTG control system takes measurements from all elements such as wind direction and speed and adjusts the operation of the WTG accordingly by adjusting the rotation speed of the rotor.

The pre-wind system of the WTG is in operation continuously. The wind indicator continuously records the wind direction at hub height. In the event that the orientation of the fuselage (average minute value) deviates from the wind direction by more than a certain angle , the upwind motors are activated to change the orientation of the fuselage. The movement of the spindle is checked and its complete rotations are recorded in order to avoid twisting of the cables.

In case the average wind speed reaches 25m/s then the turbine will stop. The turbine will only start again if the average wind speed remains at 24m/s for a certain period of time.

Starting procedure

The wind turbine is in start-up position when:

- The main switch is on
- The control panel is open
- The start/stop switch is in the start position
- The control system does not detect an error

The wind turbine will start generating when for three consecutive minutes, the average wind speed exceeds the starting speed (3m/s). When the rotor reaches the minimum rotation speed then the wind turbine will supply power to the grid.

SCADA System and Communication Network W/F

The wind farm will install a complete Supervisory Control, Monitoring and Measurement System (SCADA - supervisory control and data acquisition), which will include a central computer, printer, modem, interface etc., peripheral units with processor (RTU) in each WTG and each meteorological mast) and the necessary specialized software for the operation of the control and measurement system.

Material, Energy and Water Inputs

Water needs

No water consumption activity is included during the operational phase of the project. For staff needs, the quantities required are certainly small, considering the small number of employees, and will be covered by bottled water suppliers.

Energy needs

The use of electricity is required for the starting needs of the WTG and the operation of the auxiliary equipment. The power supply of the WTGs is provided by the fields and the M.T. cables, which in normal operation carry the energy produced.

Solid Waste Outputs

The only source of municipal waste generation is the facility's maintenance staff. This waste will be collected in small bins or containers at selected locations on the facility and will be transported by the developer to the nearest municipal bins, where it will be picked up by the City's waste collection vehicles. Solid waste will also be generated from the packaging of spare parts, which will be collected in line with staff waste and disposed of in the municipal recycling bins. This waste will be removed from the premises of the W/F at regular intervals.

Other solid waste resulting from the maintenance of electrical and mechanical equipment will be removed immediately under the responsibility of the maintenance technicians.

ESW codes of the MSW expected to be generated during the operational phase of the project

ECA code	Category of waste
20 01	**Separately collected fractions of household waste**

ECA code	Category of waste
20 01 01	papers and cardboard
20 01 02	glasses
20 01 08	biodegradable kitchen and leisure waste
20 01 39	plastics
20 01 40	metals
15 01	**Waste from packaging**
15 01 01	Paper and paperboard packaging
15 01 02	Plastic packaging
15 01 06	Mixed packing
15 01 07	Glass packaging

Source: European Waste List (EWC) according to the Annex to Decision 2000/532/EC, as amended by Commission Decisions 2001/118/EC, 2001/119/EC and 2001/573/EC.

For the safe management of any hazardous waste, the project operator must deliver it to a licensed collector-transporter for disposal in an appropriate facility for further treatment, recovery or disposal, or to approved alternative waste management systems for such waste under the conditions laid down in the relevant provisions. The delivery and legal possession of the hazardous waste shall be evidenced by the Identification Form which shall accompany the hazardous waste. Upon transfer of the identification form, the responsibility of the previous holder (of the hazardous waste) ceases and the new holder becomes responsible. The final holder (management body or alternative management system) is responsible for the various procedures for the proper management of the waste, including regeneration, re-refining, recycling, decontamination, burial, etc.

For the temporary storage of hazardous waste on the project site until collection, either UN-compliant packaging (for solid waste) or tanks enclosed by a leakage collection system (for liquid waste) should be used. The collection containers must be in an area with appropriate signage and adequate ventilation and lighting. They must also be located in such a place and in such a way that they do not interfere with other activities of the installation.

Liquid Waste Outputs

During operation of the project, municipal wastewater is generated by workers during maintenance, repairs and monitoring of the plant's operation. The quantities of wastewater are very small and fully manageable by installing chemical toilets. Wastewater from the chemical toilets will be collected by a licensed company.

Emissions of Air Pollutants

The development of wind farms for electricity generation (replacing conventional power plants) is in line with the modern model of sustainable development of the power sector which requires the zeroing, where possible, of emissions of pollutants into the environment while maximising the conservation of natural energy resources. By its very nature, the project will not emit any gaseous pollutants into the atmosphere during its operation, but will instead contribute to their reduction, since the production of energy from fossil resources would be accompanied by emissions of gaseous pollutants. Based on the project design, it is expected to operate approximately 2500 hours per year at its nominal capacity. This implies an energy production of about 102 GWh per year. The operation of the proposed project would therefore avoid the release of greenhouse pollutants into the atmosphere, which annually for the same energy produced would reach the following values:

	CO_2	CH_4	$N O_2$
	sound	sound	sound
Lignite	34.000	3,81	0,57
Natural gas	42.089	0,34	0,03

Noise emissions and Vibration emissions

General

The power of the emitted noise is a function of the rotational speed of the rotor and therefore the wind speed. The proposed project includes 11 wind turbines of indicative type VESTAS V-150, rated at 4.0 MW each, and with sound power level as a function of wind speed as shown below, according to the technical specifications of the wind turbine manufacturer.

Wind speed [m/s]	3	4	5	6	7	8	9	10	11	12	Up to cut-out
AM-1	92.0	92.0	94.5	98.4	101.8	104.7	106.0	106.0	106.0	106.0	106.0

Table 1: Acoustic emission, L_{WA} [dB(A) re 1 pW] (10 Hz to 10 kHz)

The methodology applied to estimate the noise levels from the operation of the studied wind turbine is based on the Danish model for calculating noise from wind turbines (Danish 2007). The model is based on the hemispherical propagation of sound over a flat reflecting surface. The model also takes atmospheric absorption into account, but does not take into account the morphology of the area. Thus the calculated noise levels refer to a flat surface at a height of 1.50 m above the reference plane. The noise level Lp at a distance R from the source, which in this case is the rotor of the WTG, is given by

$$L_p = L_W - 10\log_{10}\left(2\pi R^2\right) - \alpha R$$

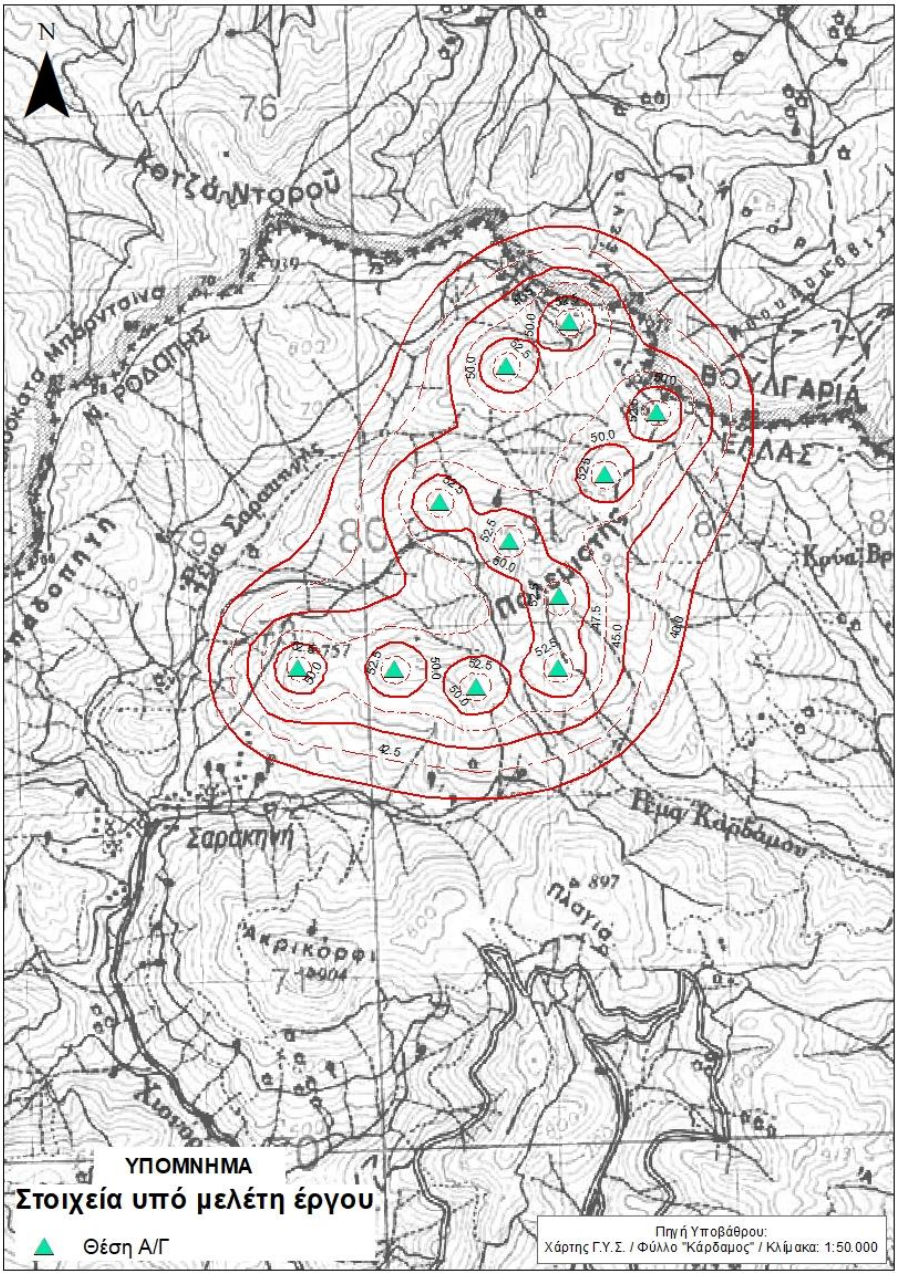
where α is the attenuation factor of the sound wave due to atmospheric absorption with a value α = 0,005 dB/m when the "Danish Method" is applied to compensate for the fact that the attenuation of

noise from the ground is not taken into account and Lw is the sound power level emitted by the wind turbine.

Noise Curves

In the context of the environmental licensing of the Wind Farm and in order to assess the potential noise impacts in the immediate area of the above Wind Farm, in order to verify whether the limits of the legislation are respected, the isothermal curves from the operation of the project were calculated. The calculation is based on the methodology based on the wind turbine noise calculation model "Description of noise Propagation Model specified by Danish Statury order on noise from windmills (Nr 304, dated 14 May 1991)", using the WIND FARM RELEASE model. The result of the calculations is the generation and visualization of the isothermal curves, as well as the calculation of the noise level specifically for the nearest house to the project.

As can be seen from the simulation results, the value of the L_P index at the nearest house to the project under permit is in the range of 42 dBA, i.e. less than the 45 dBA limit. In addition, the noise levels in the surrounding settlements are also very low . No settlements are identified within the 45 dBA limit. This noise level is the maximum level, as it refers to wind speeds at rotor height greater than 9 m/s. These speeds are expected to occur less than 19% of the year based on the wind design data for the project.



Noise curves from project operation (u=9m/s).

Electromagnetic radiation emissions

The generation and transmission of electricity in the form of alternating current involves the creation of electromagnetic fields. The intensity of the magnetic field is proportional to the intensity of the current, while that of the electric field is proportional to the voltage of the current, respectively, and the intensity of both decreases rapidly as the distance from the source increases.

Based on international experience, the following equipment components are considered as potential sources of electromagnetic fields of a wind farm:

- Generators of wind turbines

- Generator transformers
- High-voltage underground conductors
- Voltage boosting substation

The only subsystems of the wind turbine that could potentially emit low-level electromagnetic radiation are the generator and the medium-voltage transformer.

The electromagnetic field of the generator is extremely weak and limited to a very small distance around its shell, which is placed at least 100 metres above the ground. For this reason there is no real issue of exposure to electromagnetic radiation even at the base of the turbine.

The medium voltage transformers are located within the fuselage at the top of the A/V support pillar and their field will be significantly limited due to the conductive material of the pillar and the installation height. Also, the fact that the generator windings are installed in a confined space (short distance between them) and surrounded by a shell made of conductive metallic material implies that the electric field formed has zero intensity.

The generated electricity will be transmitted through an underground network of pipelines to the Voltage Booster Station 'Flamburo' also through an underground transmission line. The fields generated by the conductors are mainly magnetic as the electric fields cancel each other out due to the fact that the phase conductors are adjacent to the underground facility, as opposed to the overhead facility. The field strength at the surface depends on the depth at which the conductors are installed. As the depth increases, the weaker the magnetic field generated at the surface becomes. Moreover, this is a medium voltage line, so the current intensity is lower than that of HV transmission lines, for which again the magnetic field intensity is much lower than the safety limits of the legislation, based on measurements by ADMIE and the Greek Atomic Energy Commission.

In conclusion, it is estimated that the strength of the electromagnetic fields at the site from the operation of the project will not exceed that found in a typical domestic environment and therefore the effects on workers and the surrounding population are expected to be minimal, and much lower than the reference levels (maximum permissible exposure limits) set out in No. 3060/(ΦΟΡ)/238/2002 (Government Gazette 512/B/25-04-2002) K.Y.A. "Measures to protect the public from the operation of low frequency electromagnetic field emission devices" as supplemented-corrected by Government Gazette 759/B/19-06-2002.

SUSPENSION OF OPERATION - RESTORATION

Estimation of shutdown time or conditions

The production of wind energy is subject to all the provisions of the legislation in force concerning the obligations of undertakings concerning the restoration of the site where they are installed and the management of the materials remaining after their closure. In addition, the specific energy legislation and the spatial planning framework for RES contain additional provisions to ensure these obligations. The substance of these provisions is also incorporated in the decisions approving environmental conditions for wind farms.

The imposition of such conditions is provided for in Article 26 of the Special Spatial Framework for RES (KYA 49828/2008) which stipulates that: "*The holders of permits for the operation of electricity generation installations from RES are obliged, before the installation ceases to operate in any way, to restore, at their own expense and in accordance with the approved environmental conditions, the relevant sites, ensuring in particular the dismantling and safe removal of the installations, the restoration of native vegetation and the general restoration of the site to its previous state, provided that this is technically feasible*".

Similarly, in the Law on SIAs (Article 8, para. 7 of Law 3468/2006, as amended by Article 3(2) of Law 3851/2010): '*After the end of the operation of a RES or CHP plant, the operator of the plant is obliged to dismantle the above-ground equipment and to restore, as far as possible, the interventions in accordance with the conditions laid down in the N.P.O. decision.* ....."."

According to the legislation in force, the wind farm operating licence is issued for a period of 25 years and can be renewed for an equal period of time. It should be noted that before the operating licence is granted, a temporary connection of the park for trial operation is required, upon application to the competent operator. Once a 15-day uninterrupted operation has been achieved, the manager issues a certificate of successful completion of the tests (Ministerial Decree 13310/2007, Government Gazette 1153/B/2007, Article 14). The producer then proceeds to obtain the operating licence from the authority that issued the project's installation licence. Therefore, the estimated decommissioning time of the project is not expected to be less than 20 years from the date of obtaining the operating permit.

The definitive cessation of a RES-EHP can be caused either by the expiry and non-renewal of the production licence or by the need to upgrade the generating units. After the definitive cessation of operation of the project under study, the electromechanical equipment will be removed and the site will be returned to its original condition as far as possible.

Usually, new, more modern and more productive wind turbines are installed in the same area, so that the production of clean energy can continue using the existing infrastructure (e.g. grid).

Removal of permanent structures, removal of equipment and materials and ways to dispose of them.

After the cessation of the operation of the project under study, all measures should be taken for the safe dismantling of the main and individual elements of the equipment (WTG, electrical and electrical equipment such as voltage inverters, transformers, power electronics, cables, etc.), as well as the final dismantling of the Medium Voltage Interconnection Network. The above decommissioning works shall be managed in accordance with the legal regulations in force at the time of the dismantling of the installations. The dismantling of the WTGs will be carried out in a similar way to their erection, i.e. by partial dismantling using a crane.

Dismantling of a G/G pillar (PPC renewable project)

The materials of the old wind turbines will be recycled or managed by specialised companies accredited for this purpose in accordance with current legislation.

Transport of dismantled parts of electrical/electronic equipment (PPC renewable project)

Restoration of the WTG square (PPC renewable project)

Restoration of the square and return to agricultural use (PPC renewable project)

Management of wind turbines after shutdown

In principle, WTGs now have an economic lifetime of 25 years, while there are also WTGs that reach 30 years of operation after a 20-year audit. There are already G/Gs in Evia and Thrace which continue to operate efficiently after having completed 20 years of operation.

A wind turbine consists of the foundation, the pylon, the generator and the blades. At the end of its life cycle, the wind turbine is dismantled and its individual materials are managed. The recycling rate of a wind turbine is already significant and is constantly increasing, as it is the subject of extensive research by manufacturers and other stakeholders.

Options for the management of dismantled WEEE (PPC Renewables, 2022)

EXCEPTIONAL CIRCUMSTANCES AND RISKS TO THE ENVIRONMENT

The project under study, due to its nature, is not associated with a major environmental accident with irreversible, long-term and widespread negative impacts on the natural and man-made environment, society and health. The nature of the project, its design and construction method make it robust and minimally accident-prone. However, like all construction projects and power generation facilities, it carries the risk of accidents that may result in impacts on the environment.

Potential accidents can be categorised according to their cause into three categories: human error, material failure and natural causes. They can also be categorized according to the operation phase of the project into four groups: transportation phase, installation phase, maintenance phase and operation phase (Asian S., et al. 2017). According to the analysis of accidents from the work of Asian S., et al. 2017, the following conclusions can be drawn:

- Accidents during the transport phase mainly result from human error.
- Accidents during the operation phase are mainly due to natural causes, mainly strong winds and lightning.
- The majority of accidents occur during the operational phase.
- Accidents that occur in wind farms mainly affect the farm itself and the energy transmission system, rather than the environment and people.
- Accidents during construction are mainly due to equipment and human error.
- Accidents during the maintenance phase are mainly due to human error.
- More deaths/injuries occur from accidents during construction and maintenance and mainly affect workers.

As can be seen from the above, accidents during the transportation, installation and maintenance of WTG are mainly due to human factors and can therefore be prevented by applying stricter work protocols and safety measures. Also in these phases, the effects of accidents concern the equipment and the workforce itself, with no significant impact on the wider environment.

Accidents during the operation phase are mainly caused by fire and collapse of the WTGs. The main causes are strong winds and lightning. Nowadays, the lightning protection systems of WTGs have evolved considerably, resulting in less vulnerability to lightning. Apart from this, however, a fire in a GVW is contained and limited to the GVW fuselage, with very little risk of spreading to neighbouring land. Furthermore, due to the limited fuel and height from the ground, it can extinguish itself in a few hours and the dispersion of smoke has little chance of affecting neighbouring settlements.

Accidents caused by strong winds only occur if the rotor braking system fails for some reason. Each R/V shall be equipped with a rotor braking system for the case of strong winds. Under normal conditions this system detects wind speeds above 25 m/s and intervenes to brake the rotation of the rotor. In the event of a failure of this system, the rotor rotates at very high speed, causing the rotor to oscillate and then break part of the blades or even the pylon.

The collapse of an WTG from such a cause has a low probability of occurrence, and even if it does occur, the impact on the environment is localised. Moreover, the impact is limited to property damage rather than loss of life, as in gale-force wind conditions people and animals are in sheltered areas and not in the outdoor environment.

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