

Russian Academy of Engineering (RAE)
International Academy of Engineering (IAE)

New Generation of Wind Power Plants

- Alexander Ovchinnikov, Inventor
 - Corresponding Member, RAE
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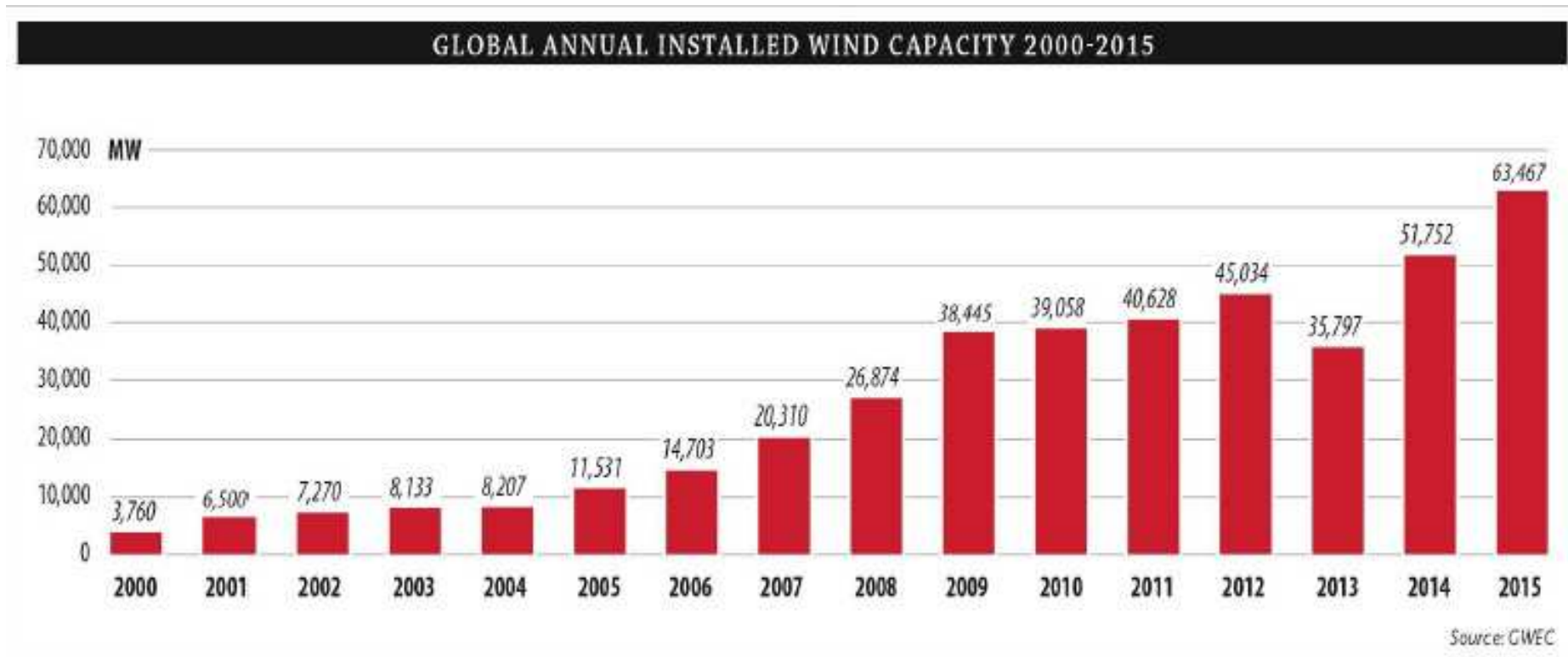
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**Presenter: Prof. Jenn-Chuan CHERN,
President, Taiwan Chapter of IAE**

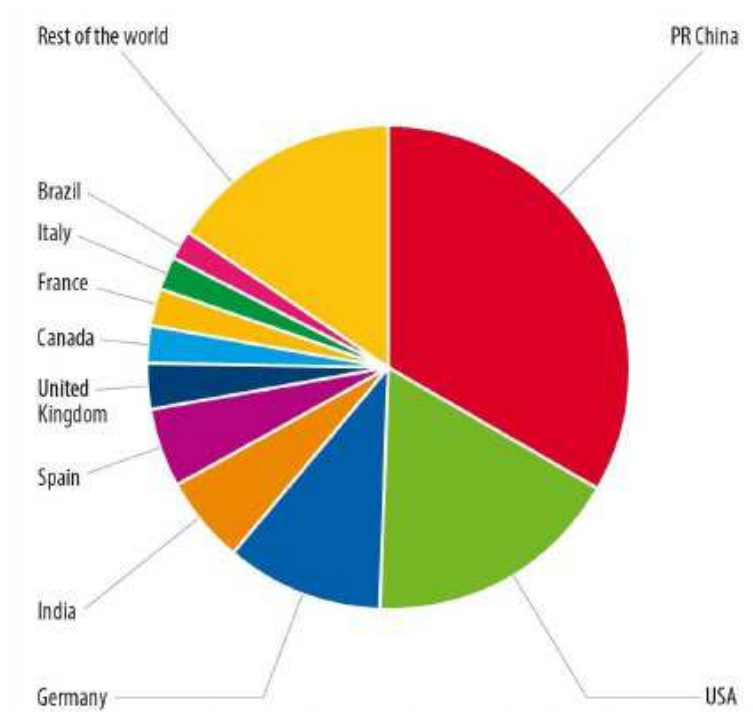


Global Wind Industry

- Annual market growth **15-20%**
- Total investments in 2015 **US \$329 bn**



Top 10 Cumulative Wind Power Capacity 2015



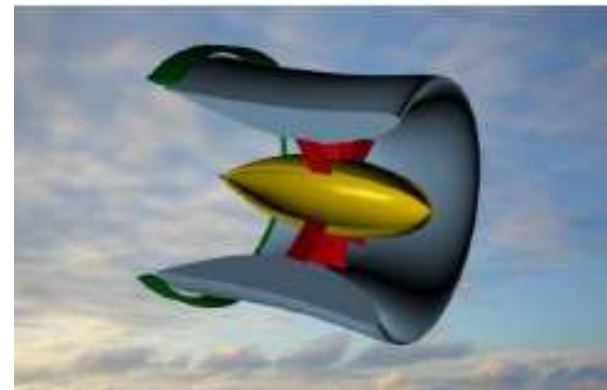
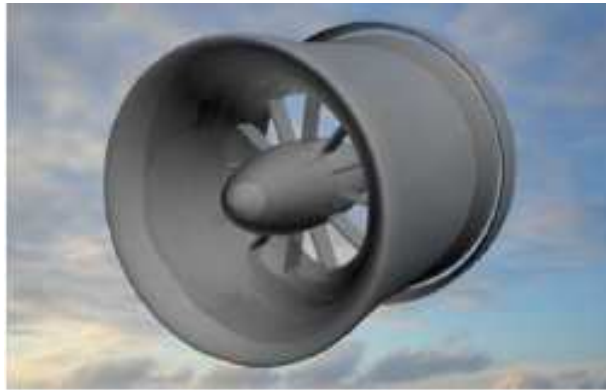
Country	MW	% Share
PR China	145,362	33.6
USA	74,471	17.2
Germany	44,947	10.4
India	25,088	5.8
Spain	23,025	5.3
United Kingdom	13,603	3.1
Canada	11,205	2.6
France	10,358	2.4
Italy	8,958	2.1
Brazil	8,715	2.0
Rest of the world	67,151	15.5
Total TOP 10	365,731	84.5
World Total	432,883	100

Source: GWEC

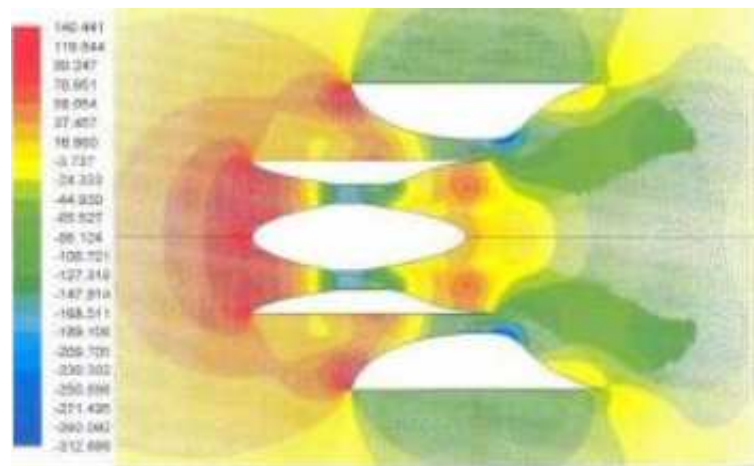
Comparative Visualization of Modules



Physical Diagrams

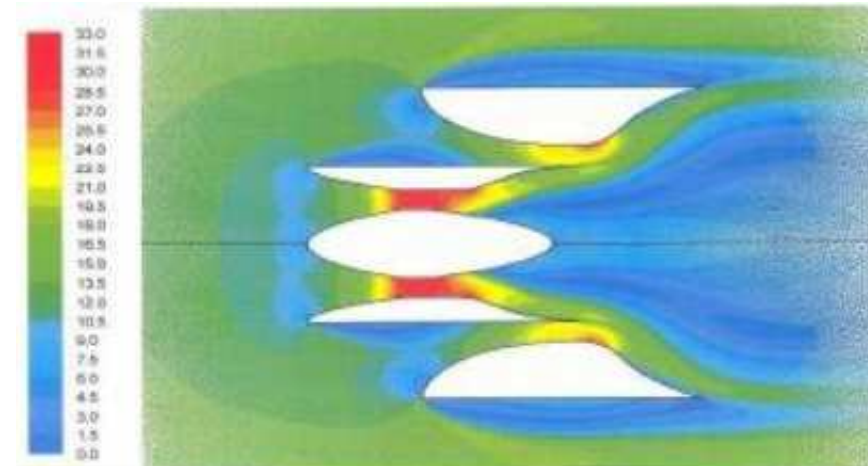


Static temperature and speed airflow and in the turbine area



Contours of Static Pressure (pascal)

Jul 11, 2006
FLUENT 6.3 (64, dbrs exp, 3-A)



Contours of Velocity Magnitude (m/s)

Jan 10, 2008
FLUENT 6.3 (64, dbrs exp, 5-A)

Competitive Landscape

	CWT	Competition (Industry Average)
Capital Cost per 1 kw set (mass production)	\$ 1000	> \$ 2000
Efficiency of a Wind Stream Usage	57%	17%
Specific Power (MWt) per 1 sq.km	56	0.6
Infrasound Impact on People	No	Exist
Alienable unit area (sq. km) (Cluster, 10 MW)	0.17	1.5

Investment Sought

- **Status**

- Design of the Wind Module and of the wind Clustering
- Mathematical modeling proved the concept.
- Technical parameters have been calculated and verified.

- **Investment**

- US \$ 0.5 million
- Building and testing pilot prototype – 5 months.
- Optimization of technical and economic characteristics.

Detailed Comparative Characteristics of Wind Power Modules

Comparative Characteristics of Wind Power Modules for Wind Farms

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Version	The Three-Blade Turbine with a Horizontal Axis	The Three-Blade Turbine with a Horizontal Axis	The Closed multi-turbine
2	Power Unit Rated Capacity	2300 Kw	2000 kW	480 kW
3	The number of power units and rated capacity is to at one mast	1/2300 kW	1/2000 kW	4x480=1920 kW
4	Minimum Possible Distance between Masts	930 m	870 m	165 m
5	Safety Zone	1.5 km	1.5 km	0.165 km
6	Diameter Maximum Power Unit	93 m	87 m	16.5 m Overall Dimensions of Model from Four Power Units 41 x 41 m
7	Axis of Rotation of Blades	Horizontally	Horizontally	Horizontally
8	Number of Blades	3	3	Multi Blade System
9	The covered Area	6800 sq. m	5942 sq. m	One Block 214 sq. m Summarized 856 sq. m Worker 1623 sq. m
10	Working Speed of Rotation of the Turbine	5-16 rev/min	8-17 rev/min	80-600 rev/min
11	Rated Speed of Rotation	15 rev/min	15.35 rev/min	120 rev/min
12	Material of Blades	Composite	No Data	Metal

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
13	Mast / the Basis Height	60 – 80 m	70 – 80 m	There are no restrictions. It is recommended 80 m
14	Mast Type	The Tubular	The Tubular	There are no restrictions. It is recommended tubular
15	Mast Material	Steel	No Data	Steel/ Concrete (there are no restrictions)
16	Anticorrosive Protection	“Sea”	No Data	“Sea”
17	Installation on a Wind	“On a wind”, by Means of the Mechanism	“On a wind”, by Means of the Mechanism	“auto-feathering” (自動順漿) Without mechanism use
18	Generator Type	Asynchronous 690 V with the Built-in Radiator	Double-fid Induction Generator 690 B	Generators of a Direct Current on Constant Magnets
19	Transmission	3-stepwise 1:91, Planetary, with Cooling through a Separate Oil Radiator Oil 400 L Volume	1:118	Straight Line without Reduction Transfer
20	Working Speed of a Wind	13-14 m/s	11.4 m/s	10.5-22 m/s
21	Moving Speed	4 m/s	3 m/s	2.5 m/s
22	Stop Speed	25 m/s	25 m/s	50 m/s
23	Tempest Speed	55 m/s	59.5 m/s	60 m/s
24	Power Unit Weight	142.0 t	123.5 t	Calculation 27 x 4 = 108 t
25	Mast Weight	It depends on an installation site	155/188 t	It depends on an installation site.

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
26	Possibility of Installation in a residential Zone	No	No	Yes
27	Possibility of use in Reserved and Park Zones	No	No	Yes
28	Possibility of Operation at a Speed of Wind more than 25 m/s	No	No	Yes
29	Infrasound Radiation	No	No	Yes
30	Creation of a Radio Noise	No	No	Yes
31	Shielding of Radio Waves	No	No	Yes
32	Considerable Dynamic Loadings	No	No	Yes
33	Existence of Open Moving Parts	No	No	Yes
34	Visual Noise	No	No	Yes
35	Electric Expenses on own Needs Current (on One Power Unit)	10 – 30 kW	10 – 30 kW	0.3 kW

Operational Costs for Wind Power Modules

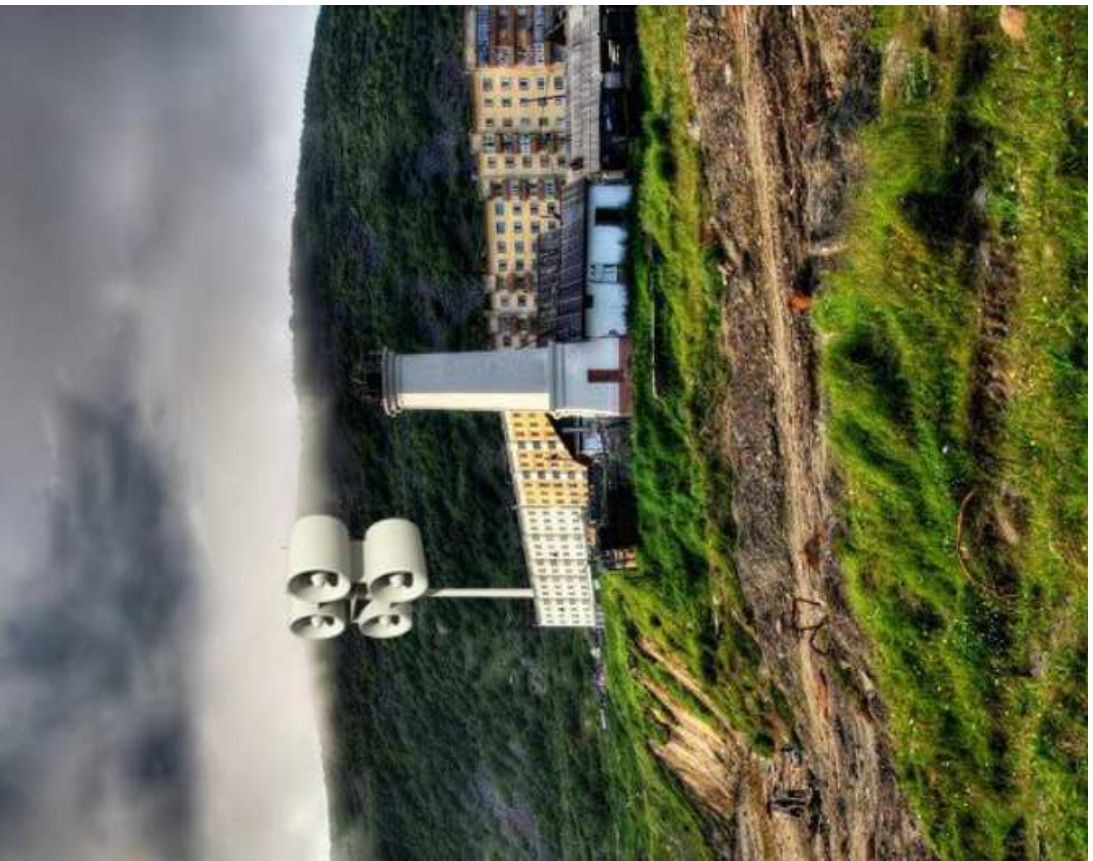
No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT - 2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Replacement of Blades	1-3 Times during Operation	1-3 Times during Operation	There is no need; renovation is possible
2	Oil Replacement in a Reducer	Each 2 Years	No Data	No
3	Oil Replacement in the Transformer	Each 2 Years	No Data	No
4	Works on Service of the Mechanism of Turn of Blades	Annual	No Data	No
5	Works on Reducer Service	Annual	No Data	No
6	Works on Transformer Service	Annual	No Data	No
7	Works on Service of the Mechanism of Turn on a Wind	Annual	No Data	No
8	Works on Service of the Main Shaft	Annual	No Data	No
9	Works on Cleaning of Blades from Dirt	Annual	Annual	No
10	Works the coverings of blades connected with abrasive wear	Time in 3 – 4 Years	Time in 3 – 4 Years	No

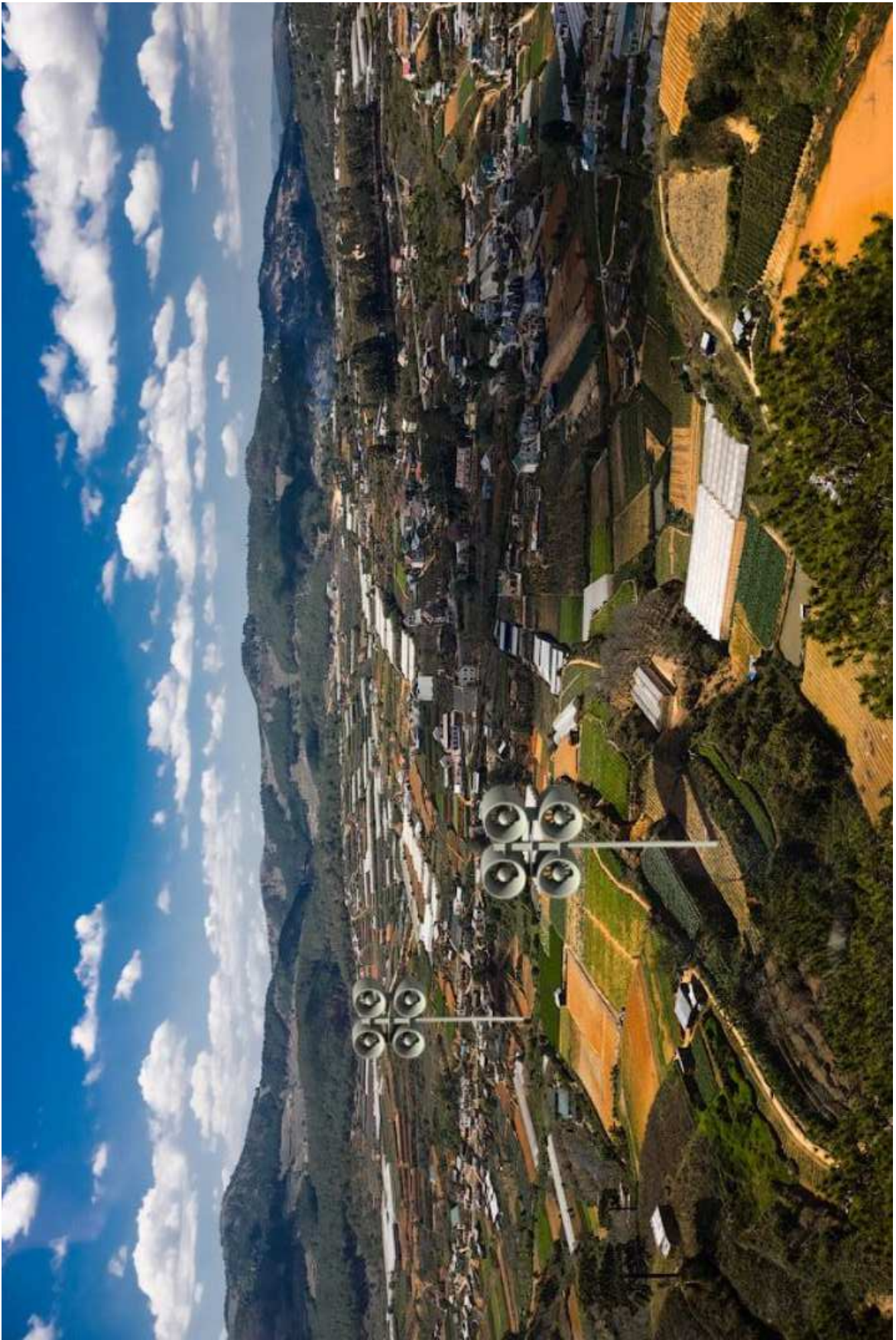
Other Comparative Data

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Utilization of the Fulfilled Blades	There is a problem.	There is a problem.	Melting as Scrap Metal
2	Possibilities of a Mimicry (masking) under a Surrounding Landscape	No	No	Yes
3	Opportunity to be an architectural dominant	No	No	Yes
4	Convertibility of Appearance	No	No	Yes
5	Possibility of Double Use	No	No	Yes
6	Flexibility of Manufacturing Techniques	5%	10%	95%
7	Flexibility in Applicability of Systems of Generation	No	No	Yes
8	Possibility of Installation and Operation in Difficult Relief Conditions	No	No	Yes
9	Possibility of Installation and Operation in Zones with the Raised Wind Loading	No	No	Yes
10	Adaptability to Climatic Zones (to Temperature Deviations from Standard)	+/- 10 Degrees Celsius	+/- 5 Degrees Celsius	+/- 20 Degrees Celsius
11	Adaptability to Air Density	+/- 10%	+/- 10%	+/- 40%
12	Adaptability to Turbulent Streams	No	No	90%

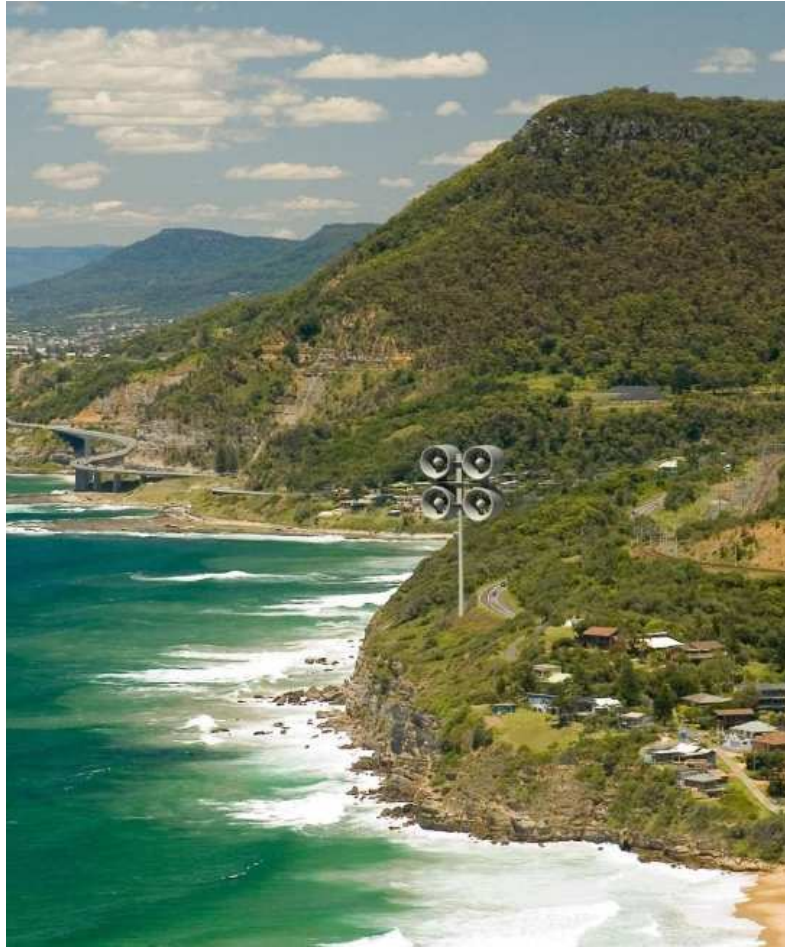
Eco-Friendly Design







Color of the Wind Power Module



Comparative Characteristics of the **10 MWt** Wind Power Parks

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Version	The Three-Blade Turbine with a Horizontal Axis	The Three-Blade Turbine with a Horizontal Axis	The Closed multi-turbine
2	Power Unit Rated Capacity	2300 Kw	2000 kW	480 kW
3	The number of power units and rated capacity is to at one mast	1/2300 kW	1/2000 kW	4x480=1920 kW
4	Quantity of Masts in the Wind Farm	5	5	5
5	Arrangement Ranks	2:1:2	2:1:2	2:1:2
6	Minimum Possible Distance between Masts	930 m	870 m	165 m
7	Area of the Main Land Allocation	1.46 sq. km	1.3 sp. km	0.046 sq. km
8	Safety Zone	1.5 km	1.5 km	0.1 km
9	Safety Zone Area	16.8 sq. km	16.3 sq. km	0.07 sq. km
10	Total Area of a Land Allocation	18.3 sq. km	17.8 sq. km	0.17 sq. km
11	General Capacity of the Wind Farm	11.5 mW	10 mW	9.6 mW
12	Specific power (MWt) is at one sq. km	0.63	0.56	56.5

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
13	Extent of Internal Power Lines	4.5 km	4.35 km	0.5 km
14	Specific Capacity on Running Kilometer of the Internal High Voltage Lines	2.55	2.3	19.2
15	Diameter Maximum Power Unit	93 m	87 m	16.5 m Overall Dimensions of Model from Four Power Units 41 x 41 m
16	Axis of Rotation of Blades	Horizontally	Horizontally	Horizontally
17	Number of Blades	3	3	Multi Blade System
18	The Covered Area	6899 sq. m	5942 sq. m	One Block 214 sq. m Summarized 856 sq. m Worker 1623 sq. m
19	Efficiency of a Wind Stream	16.5%	16%	57%
20	Working Speed of Rotation of the Turbine	5-16 rev/ min	8-17 rev/ min	80-600 rev/min
21	Rated Speed of Rotation	15 rev/ min	15.35 rev/min	120 rev/min
22	Material of Blades	Composite	No Data	Metal
23	Mast / the Basis Height	60 – 80 m	70 – 80 m	No Restrictions 80 m is recommended.
24	Mast Type	The Tubular	The Tubular	No Restrictions Tubular is recommended.
25	Mast Material	Steel	No Data	Steel/ Concrete (No Restrictions)

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
26	Anticorrosive Protection	“Sea”	No Data	“Sea”
27	Installation on a Wind	“On a Wind”, by Means of the Mechanism	“On a Wind”, by Means of the Mechanism	“Auto-feathering” (自動順漿) Without mechanism use
28	Generator Type	Asynchronous 690 V with the Built-in Radiator	Double-fid Induction Generator 690 B	Generators of a Direct Current on Constant Magnets
29	Transmission	3-stepwise 1:91, Planetary, with Cooling through a Separate Oil Radiator Oil 400L Volume	1:118	Straight Line without Reduction Transfer
30	Working Speed of a Wind	13-14 m/s	11.4 m/s	10.5-22 m/s
31	Moving Speed	4 m/s	3 m/s	2.5 m/s
32	Stop Speed	25 m/s	25 m/s	50 m/s
33	Tempest Speed	55 m/s	59.5 m/s	60 m/s
34	Power Unit Weight	142.0 t	123.5 t	Calculation 27 x 4 = 108 t
35	Mast Weight	It depends on an installation site	155/188 t	It depends on an installation site.
36	Possibility of Installation in a Residential Zone	No	No	Yes
37	Possibility of Use in Reserved and Park Zones	No	No	Yes

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
38	Possibility to Install "Package"	No	No	Yes
39	Possibility of Operation at a Speed of Wind more than 25 m/s	No	No	Yes
40	Infrasound Radiation	Yes	Yes	No
41	Creation of a Radio Noise	Yes	Yes	No
42	Shielding of Radio Waves	Yes	Yes	No
43	Considerable Dynamic Loadings	Yes	Yes	No
44	Existence of Open Moving Parts	Yes	Yes	No
45	The amount of Energy Produced in the Year	No Data	12200-18300 mW*h	16500-33000 mW*h
46	The Amount of Produced Electricity in a Year from One Square Kilometer	No Data	690-1030 mW*h/sq. km	970000-194000 mW*h/sq. km
47	Electric Expenses on Own Needs Current (on One Power Unit)	10 – 30 kW	10 – 30 kW	0.3 kW
48	Electric Expenses on Own Needs in a Year (Losses on One Power Unit)	87000 – 261000 kW/h	87000 – 261000 kW/h	2630 kW/h

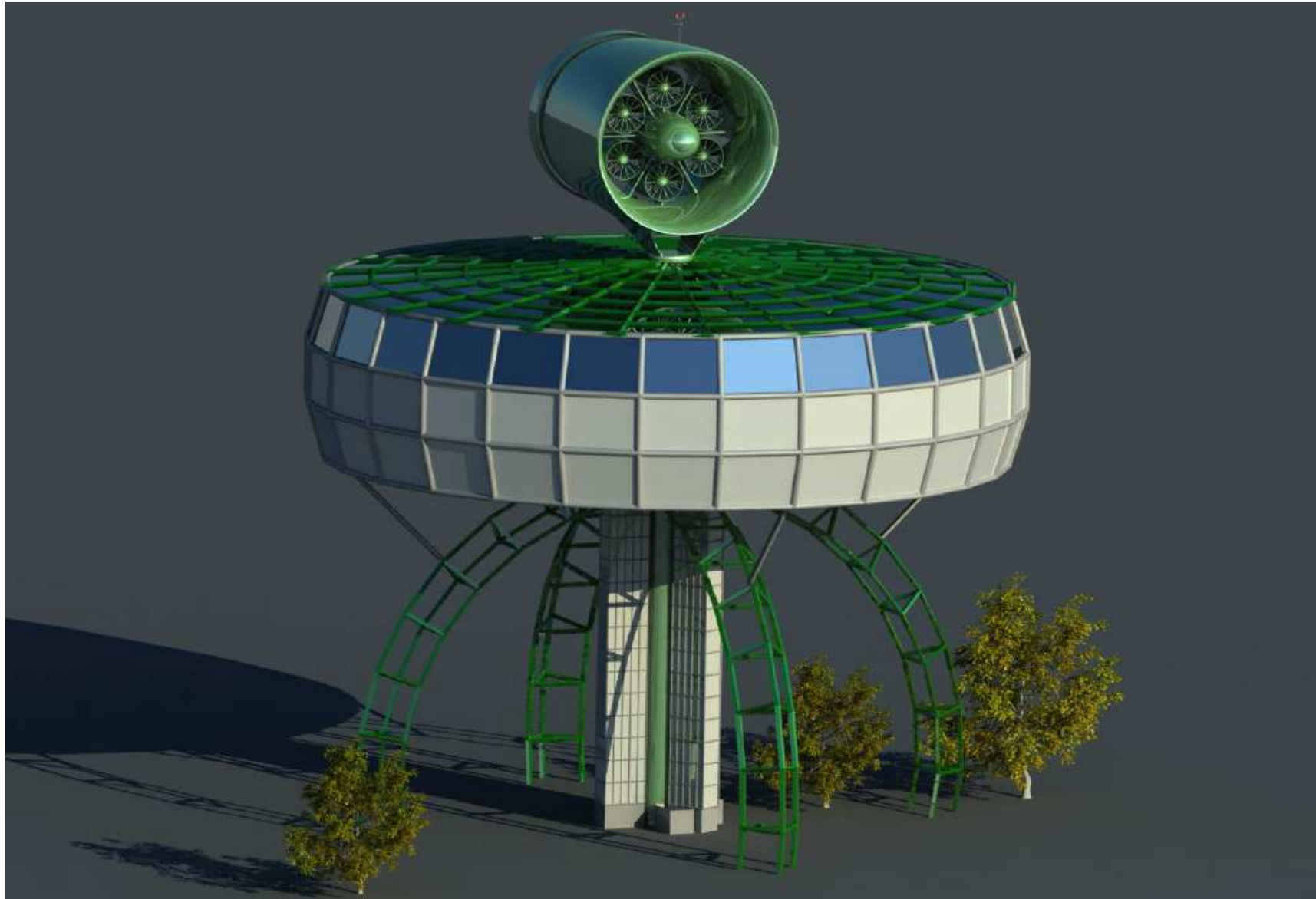
Operational Costs for the **10 MWt** Wind Power Parks

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Replacement of Blades	1-3 Times during Operation	1-3 Times during Operation	There is no need; renovation is possible
2	Oil Replacement in a Reducer	Each 2 Years	No Data	No
3	Oil Replacement in the Transformer	Each 2 Years	No Data	No
4	Works on Service of the Mechanism of Turn of Blades	Annual	No Data	No
5	Works on Reducer Service	Annual	No Data	No
6	Works on Transformer Service	Annual	No Data	No
7	Works on Service of the Mechanism of Turn on a Wind	Annual	No Data	No
8	Works on Service of the Main Shaft	Annual	No Data	No
9	Works on Cleaning of Blades from Dirt	Annual	Annual	No

Other Comparative Data

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Utilization of the Fulfilled Blades	There is a problem.	There is a problem.	Melting as Scrap Metal
2	Possibilities of Improvement and Renovation	Limit +3%	Limit +4%	Expected opportunities +30%
3	Possibilities of a Mimicry (masking) under a Surrounding Landscape	No	No	Yes
4	Opportunity to be an Architectural Dominant	No	No	Yes
5	Convertibility of Appearance	No	No	Yes
6	Possibility of Double Use	No	No	Yes
7	Possibility of Decrease in Operational Costs	10%	15%	30%
8	Flexibility of Manufacturing Techniques	5%	10%	95%
9	Flexibility in Applicability of Used Materials	5%	10%	99%
10	Flexibility of Manufacturing Techniques	No	No	Yes
11	Flexibility in Applicability of Systems of Generation	No	No	Yes
12	Possibility of Installation and Operation in Difficult Relief Conditions	No	No	Yes
13	Possibility of Installation and Operation in Zones with the Raised Wind Loading	No	No	Yes
14	Adaptability to Climatic Zones (to Temperature Deviations from Standard)	+/- 10 Degrees Celsius	+/- 5 Degrees Celsius	+/- 20 Degrees Celsius
15	Adaptability to Air Density	No	No	90%
16	Limit Predicted Capacity on one Mast	7000 kWt	6000 kWt	20000 kWt

Wind Power Module as Architectural Functional Component



Ecological Use



Comparative Characteristics of the **50 MWt** Wind Power Parks

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Version	The Three-Blade Turbine with a Horizontal Axis	The Three-Blade Turbine with a Horizontal Axis	The Closed multi-turbine
2	Power Unit Rated Capacity	2300 Kw	2000 kW	480 kW
3	The number of power units and rated capacity is to at one mast	1/2300 kW	1/2000 kW	4x480=1920 kW
4	Quantity of Masts in the Wind Farm	22	25	26
5	Arrangement Ranks	4:5:4:5:4	5:5:5:5:5	5:5:6:5:5
6	Minimum Possible Distance between Masts	930 m	870 m	165 m
7	Area of the Main Land Allocation	13.84 sq. km	12.11 sp. km	0.7 sq. km
8	Safety Zone	1.5 km	1.5 km	0.1 km
9	Safety Zone Area	31.3 sq. km	29.9 sq. km	0.4 sq. km
10	Total Area of a Land Allocation	45.14 sq. km	42.01 sq. km	1.3 sq. km
11	General Capacity of the Wind Farm	50.6 mW	50 mW	49.92 mW
12	Specific power (MWt) is at one sq. km	1.12	1.19	38.4

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
13	Extent of Internal Power Lines	19.53 km	17.4 km	4.2 km
14	Specific Capacity on Running Kilometer of the Internal High Voltage Lines	2.59	2.87	11.9
15	Diameter Maximum Power Unit	93 m	87 m	16.5 m Overall Dimensions of Model from Four Power Units 41 x 41 m
16	Axis of Rotation of Blades	Horizontally	Horizontally	Horizontally
17	Number of Blades	3	3	Multi Blade System
18	The Covered Area	6899 sq. m	5942 sq. m	One Block 214 sq. m Summarized 856 sq. m Worker 1623 sq. m
19	Efficiency of a Wind Stream	16.5%	16%	57%
20	Working Speed of Rotation of the Turbine	5-16 rev/ min	8-17 rev/ min	50-300 rev/min
21	Rated Speed of Rotation	15 rev/ min	15.35 rev/min	120 rev/min
22	Material of Blades	Composite	No Data	Metal
23	Mast / the Basis Height	60 – 80 m	70 – 80 m	No Restrictions 80 m is recommended.
24	Mast Type	The Tubular	The Tubular	No Restrictions Tubular is recommended.
25	Mast Material	Steel	No Data	Steel/ Concrete (No Restrictions)

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
26	Anticorrosive Protection	“Sea”	No Data	“Sea”
27	Installation on a Wind	“On a Wind”, by Means of the Mechanism	“On a Wind”, by Means of the Mechanism	“Auto-feathering” (自動順漿) Without mechanism use
28	Generator Type	Asynchronous 690 V with the Built-in Radiator	Double-fid Induction Generator 690 B	Multi-generating System
29	Transmission	3-stepwise 1:91, Planetary, with Cooling through a Separate Oil Radiator Oil 400L Volume	1:118	Direct Transfer of a Torque without Reducer Use
30	Working Speed of a Wind	13-14 m/s	11.4 m/s	10.5-22 m/s
31	Moving Speed	4 m/s	3 m/s	2.5 m/s
32	Stop Speed	25 m/s	25 m/s	50 m/s
33	Tempest Speed	55 m/s	59.5 m/s	60 m/s
34	Power Unit Weight	142.0 t	123.5 t	Calculation 27 x 4 = 108 t
35	Mast Weight	It depends on an installation site	155/188 t	It depends on an installation site.
36	Possibility of Installation in a Residential Zone	No	No	Yes
37	Possibility of Use in Reserved and Park Zones	No	No	Yes

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
38	Possibility to Install “Package”	No	No	Yes
39	Possibility of Operation at a Speed of Wind more than 25 m/s	No	No	Yes
40	Infrasound Radiation	Yes	Yes	No
41	Creation of a Radio Noise	Yes	Yes	No
42	Shielding of Radio Waves	Yes	Yes	No
43	Considerable Dynamic Loadings	Yes	Yes	No
44	Existence of Open Moving Parts	Yes	Yes	No
45	The Amount of Energy Produced in the Year	No Data	60900-91350 mW*h	85800-171000 mW*h
46	The Amount of Produced Electricity in a Year from One Square Kilometer	No Data	1450-2175 mW*h/sq. km	66000-130000 mW*h/sq. km
47	Electric Expenses on Own Needs Current (on One Power Unit)	10 – 30 kW	10 – 30 kW	0.3 kW
48	Electric Expenses on Own Needs in a Year (Losses on One Power Unit)	87000 – 261000 kW/h	87000 – 261000 kW/h	2600 kW/h
49	% of the Losses on Self Consumption	No Data	6-12	0.003-0.006

Operational Costs for the **50 MWt** Wind Power Parks

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Replacement of Blades	1-3 Times during Operation	1-3 Times during Operation	There is no need; renovation is possible
2	Oil Replacement in a Reducer	Each 2 Years	No Data	No
3	Oil Replacement in the Transformer	Each 2 Years	No Data	No
4	Works on Service of the Mechanism of Turn of Blades	Annual	No Data	No
5	Works on Reducer Service	Annual	No Data	No
6	Works on Transformer Service	Annual	No Data	No
7	Works on Service of the Mechanism of Turn on a Wind	Annual	No Data	No
8	Works on Service of the Main Shaft	Annual	No Data	No
9	Works on Cleaning of Blades from Dirt	Annual	Annual	No
10	Works the Coverings of Blades Connected with Abrasive Wear	Time in 3-4 Years	Time in 3-4 Years	No

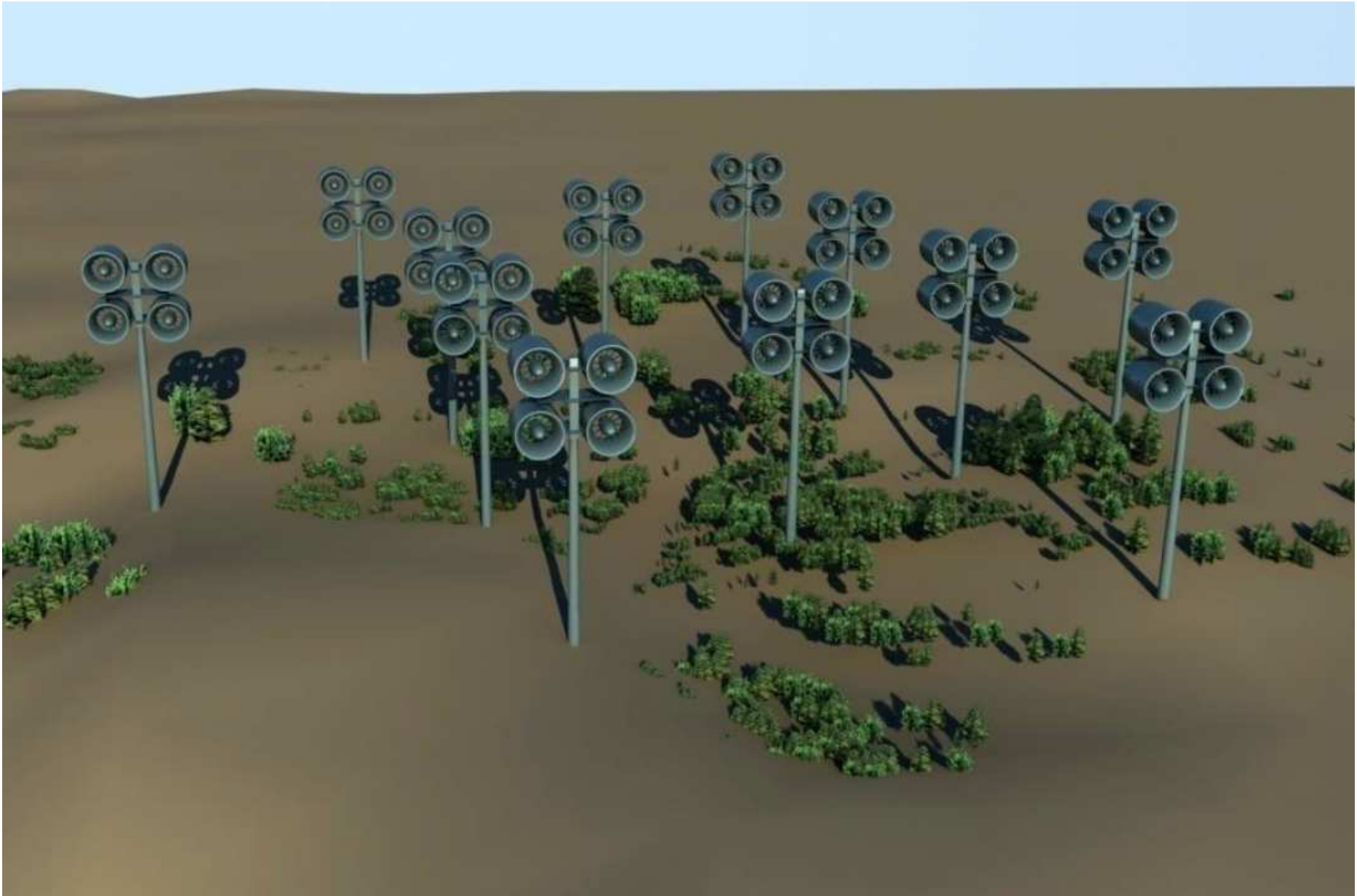
Other Comparative Data

No.	Name of Parameter of Wind Power Installation	Name of Basic Wind Power Installation		
		SIEMENS SWT -2.3-93	SEWIND W2000	CWT 480x4 =1920
1	Utilization of the Fulfilled Blades	There is a problem.	There is a problem.	Melting as Scrap Metal
2	Possibilities of Improvement and Renovation	Limit +3%	Limit +4%	Expected opportunities +30%
3	Possibilities of a Mimicry (masking) under a Surrounding Landscape	No	No	Yes
4	Opportunity to be an Architectural Dominant	No	No	Yes
5	Convertibility of Appearance	No	No	Yes
6	Possibility of Double Use	No	No	Yes
7	Possibility of Decrease in Operational Costs	10%	15%	30%
8	Flexibility of Manufacturing Techniques	5%	10%	95%
9	Flexibility in Applicability of Used Materials	5%	10%	99%
10	Flexibility of Manufacturing Techniques	No	No	Yes
11	Flexibility in Applicability of Systems of Generation	No	No	Yes
12	Possibility of Installation and Operation in Difficult Relief Conditions	No	No	Yes
13	Possibility of Installation and Operation in Zones with the Raised Wind Loading	No	No	Yes
14	Adaptability to Climatic Zones (to Temperature Deviations from Standard)	+/- 10 Degrees Celsius	+/- 5 Degrees Celsius	+/- 20 Degrees Celsius
15	Adaptability to Air Density	No	No	90%
16	Limit Predicted Capacity on one Mast	7000 kWt	6000 kWt	20000 kWt

Wind Power Modules CWT 1920



Wind Farm Development



Contacts

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