



YOUR WIND • YOUR POWER • YOUR WAY

Wind Turbine

# FREEN-20



# Contents

---

<b>1. About Freen OÜ</b>	<b>3</b>
<b>2. Why Choose Freen-20</b>	<b>4</b>
<b>3. How Freen-20 Stands Out</b>	<b>5</b>
<b>4. Technical Data</b>	<b>7</b>
<b>5. Smart Design, High Performance</b>	<b>8</b>
Blades	8
Grid Connection	9
Control System	9
Generator	10
Brake System	10
Lightning Protection	10
Sensor System	10
Storm	11
Safety System	11
<b>6. See Freen-20 at Work</b>	<b>12</b>
<b>7. Contact Us</b>	<b>13</b>

---





# About Freen OÜ



Small wind turbines represent a critical component in the global shift towards sustainable energy. They offer the versatility needed for installation in varied environments including residential areas, businesses, and remote locations.

They are particularly suited for decentralized energy generation, a vital aspect for creating resilient and self-sustaining energy grids. By harnessing wind power at a local level, small wind turbines reduce transmission losses and infrastructure costs, making renewable energy more accessible and affordable.

Among the various designs of small wind turbines, the Darrieus type stands out for its distinctive vertical axis. Named after its French inventor, Georges Darrieus, this type of turbine is particularly noted for its ability to capture wind from any direction, eliminating the need for a yaw mechanism. This feature makes **Darrieus turbines exceptionally well-suited for areas where wind patterns are variable and unpredictable.**

Freen OÜ stands at the forefront of the renewable energy revolution, specializing in the innovative design and manufacturing of small wind turbines that cater to the diverse needs of modern energy systems. Founded in

Estonia, a hub for technological advancement and environmental sustainability, **Freen OÜ combines engineering excellence with a commitment to renewable energy solutions.** Our portfolio, centered on vertical axis wind turbines, exemplifies our dedication to providing reliable, efficient, and environmentally friendly energy alternatives.

At Freen OÜ, we embrace the principles of European manufacturing standards, ensuring each turbine meets the highest quality assurance criteria. Our commitment extends beyond just production — every aspect of design, supply chain management, and customer service is held to rigorous standards to guarantee that our clients receive the best in both product and support.

This dedication to quality and sustainability makes Freen OÜ a trusted name in the renewable energy sector, poised to help our clients achieve their green energy goals with confidence and reliability.

# Why Choose Freen-20

Freem-20 is designed to maximize the return on investment in the renewable energy sector by offering superior operational efficiency and minimal maintenance. Its innovative vertical axis design eliminates the need for wind orientation mechanisms, reducing mechanical complexities and enhancing reliability. With all components produced in-house within the European Union, investors benefit from the high standards of quality and sustainability that Freem OÜ upholds.

## Key Features of Freem-20

### ✓ In-house Production of Components:

All critical components of the Freem-20 are manufactured in-house, ensuring strict quality control and supply chain reliability. This vertical integration allows Freem OÜ to maintain high standards of craftsmanship and material quality.

### ✓ No Wind Orientation Mechanism:

The Freem-20's vertical axis design allows it to harness wind from any direction without the need for mechanical adjustments to orient towards the wind.

### ✓ Dynamic Diameter and Shape during Rotation:

The unique geometry of the Freem-20 allows for slight changes in diameter and shape under rotational forces. This dynamic inflation aids in capturing more wind energy and improving overall efficiency.

### ✓ Resilience to Strong Gusts:

Unlike conventional turbines, the Freem-20's lightweight blade construction can withstand hurricane-level winds. Its aerodynamic design allows it to flex and adjust to intense gusts, mitigating the risk of structural failure.

### ✓ Certified Inverter Control:

The Freem-20 is equipped with a state-of-the-art certified inverter that manages power output efficiently, ensuring optimal compatibility with various grid specifications.

### ✓ Direct Torque Transmission Drive:

By employing a direct drive system, the Freem-20 eliminates the need for a gearbox. This results in fewer energy losses between the generator and rotor, reduced noise levels, and lower mechanical wear, enhancing the turbine's longevity and performance.

### ✓ Operates at Low Speeds:

Designed to operate effectively at a rotational speed of just 108 rpm, the Freem-20 enhances safety for wildlife.

# How Freen-20 Stands Out

The design and technological advancements of the Freen-20 address many common challenges associated with small wind turbines, including:

## Reduced Maintenance Costs:

The durability of metal construction and fewer moving parts (such as the lack of a gearbox) decrease the frequency and cost of maintenance. The direct drive system further minimizes frictional components that typically wear down over time.

## Quiet Operation:

Thanks to its vertical-axis design and the absence of a gearbox, the Freen-20 operates more quietly than horizontal turbines, reducing the potential for noise complaints from nearby communities.

## Designed for Harsh Climates:

The Freen-20's ability to endure extreme weather conditions without significant wear and tear makes it exceptionally reliable, ensuring continuous energy production even in challenging climates.

## Optimized for Low Wind Conditions:

The Freen-20 is specifically engineered to maximize energy production in areas with low to moderate wind speeds, making it highly suitable for a wide range of geographic locations.

## Wildlife-Friendly:

The turbine's slower rotational speed and robust design pose less risk to birds and bats, making it a conscientious choice for installation in diverse environments.

## Addressing Wind Power Limitations

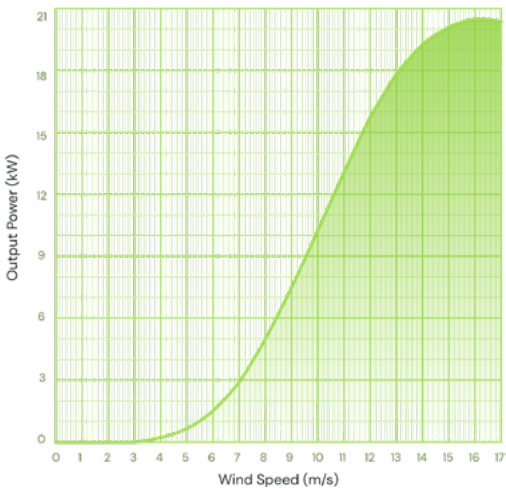
Choosing the right renewable energy solution often involves navigating a complex landscape of environmental, logistical, and technical challenges. For investors and developers weighing options between solar and wind energy, factors like space constraints and population density can significantly influence their decision. **Small wind turbines, such as the Freen-20, emerge as an ideal solution** in scenarios where space is limited or areas are densely populated. Unlike horizontal turbines or other renewable energy sources, the Freen-20 is designed to operate effectively in varied settings, mitigating common issues such as noise, wear and tear, and wildlife impact.

Freen-20 leverages advanced technology to enhance durability, reduce maintenance needs, and ensure consistent performance even in low wind conditions. Here, we explore how the Freen-20 addresses specific challenges faced by renewable energy investments, providing a robust and adaptable alternative for generating sustainable power.

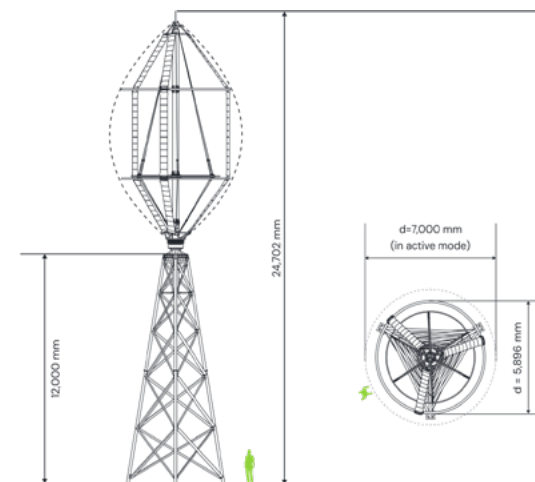
Challenge	Reason	How Freen-20 solves that
Low Energy Output	Inconsistent or insufficient wind speeds	Optimized for low wind conditions
Noise Complaints	Horizontal-axis turbines blade movement and vibrations	Quiet vertical-axis design
Maintenance Costs	Frequent wear and tear	Durable metal construction, less friction components
Wildlife Concerns	Risk to birds or bats	Safe and wildlife-friendly design and slower rotation
Weather Vulnerability	Damage from extreme conditions	Engineered for harsh climates
Installation Complexity	Complicated assembly and installation processes	Simplified installation with prefabricated foundation and modular components
Seasonal Variations	Limited installation space in urban and industrial environments	Less affected by seasonal variations, providing consistent year-round energy production in areas with adequate wind.
Spatial Constraints, Limited Roof Space for Solar Panels	Limited installation space in urban and industrial environments	Compact vertical-axis design maximizes energy generation in small footprints

# Technical Data

## Power Output



## Drawing



## Technical Specifications

Rated power, (kW)	20
Cut-out wind speed, (m/s)	3.5
Cut-in wind speed, (m/s)	17
Wind class	IEC III, IV
Swept area, (m <sup>2</sup> )	52
Noise level at 100 m distance, (dB)	45
Height, (m)	24.7
Weight, (kg)	5000
Footprint area, (m <sup>2</sup> )	35
Lifetime, (years)	20
Standard	IEC 61400-2:2013 Small wind turbines
Operating temperatures, (C°)	-25 to +40
Survival wind speed, (m/s)	36
Remote monitoring	FREEN SCADA
Installation time	1-2 days

## Equipment Set

- ✓ Wind Turbine
- ✓ Inverter ON-GRID\*
- ✓ Controller
- ✓ FREEN SCADA
- ✓ Tower

**!** The product specifications are provisional and subject to change at any time due to improvements or other reasons.

\*We offer customized off-grid solution per request

## AEP based on a Rayleigh wind speed distribution, K=2, t=15°C, P=1013 mbar, ρ=1.225

Wind speed (m/s)	AEP (MWh)*	Wind speed (m/s)	AEP (MWh)*
4	7.9	11	69.6
5	17.6	12	69.6
6	30.2	13	68.1
7	43.2	14	65.7
8	54.5	15	62.7
9	62.6	16	59.5
10	67.5	17	56.2

# Smart Design, High Performance

## Blades

The blades of the Freen-20 wind turbine are made of separate sections. The material of manufacture is rigid polyurethane foam without foaming agent in a PET shell. The shape and profile of the blades have been designed according to the following criteria:

- high  $C_p$  parameter (0.365) among Darrieus turbines;
- long service life (20 years);

### The blades have a number of technical advantages:



Resistance to frost due to low water absorption (hygroscopic material) and the absence of repetitive cycles of freezing and defrosting.



UV resistance: sheath with PET material that uses additives to increase UV resistance.



Resistance to sand corrosion due to the use of a protective film.



One of the key elements in the design is the flexibility of the prefabricated blade based on steel cables. This innovative turbine design provides tensile stresses in the blades and eliminates bending stresses, resulting in a longer material life cycle. The blades compensate for changes in rotor speed at high and low rotational speeds, arising from versatile gusts of wind at low altitudes from the ground. Unlike the classic wind turbine design (gondola and blades with angle adjustment), the Freen-20 design catches maximum airflow, regardless of changes in wind direction.



## Grid Connection

To control the synchronous generator, as well as to connect the wind turbine with the external power grid, a control box with a **Cleanverter TL** series recuperative frequency converter is used.

To achieve a high overall efficiency of the generator system, a fully digital power conversion system is used, which fully compensates for the inductance of the electric generator, minimizes harmonic current distortion, and guarantees silent operation. **Cleanverter TL** transmitters are CEI O-21 and G59/3 certified.

The transducer is equipped with an LCD display and keypad that display real operating information and alarms with a history of 50 events. A standard RS 232 interface and an optional remote control system are available and can be interacted with a PC. An RS 485 interface is also available.

Cooling fans are controlled by a temperature sensor to minimize self-consumption and maximize lifespan. Their operation is constantly monitored to prevent damage due to failures.



## Control System

The Freen-20 is controlled by a microprocessor system and SCADA software developed by Freen. Sensors poll all turbine components, environmental data, and the turbine algorithm is built accordingly.

Turbine acceleration is basically implemented in automatic mode, which is activated when certain wind parameters are reached. When the rotation speed reaches 30 rpm, automatic acceleration is turned off and the turbine spins on its own.

When the maximum operating values of the wind speed are reached, the system starts the turbine shutdown program.

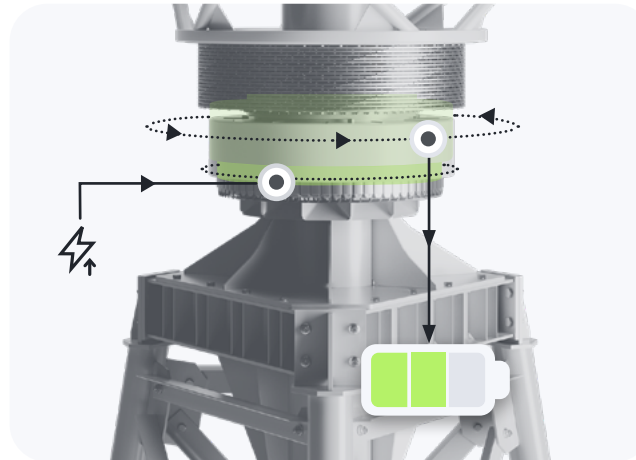
If the turbine is running and the rotor speed drops too low due to the lack of wind, the turbine is put into standby mode, in which the control system constantly processes wind and temperature sensors.

When there is a wind of 3.5 m/s, the control program switches on the turbine according to the power curve.



## Generator

The air flow on the wind turbine blades drives the generator rotor, without the use of an overdrive gearbox. The permanent magnet synchronous generator is designed to avoid high heat under load.

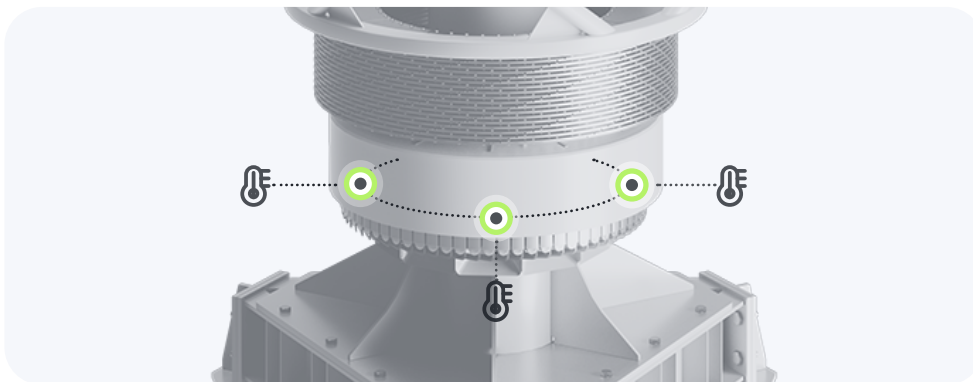


## Brake System

The Freen-20 control system provides an effective non-volatile electromagnetic brake. The system works on the principle of shorting the generator windings, that does not require connected electricity.

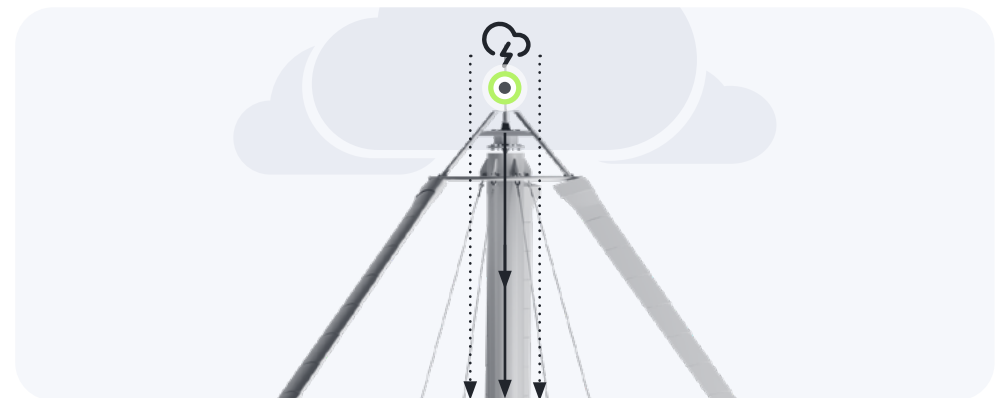
## Sensor System

A comprehensive monitoring system ensures the safety of equipment operation. Turbine rotation speed, generator temperature, loads, and other sensor parameters are controlled by electronic monitoring tools. When anomalous information is received, the turbine stops.



## Lightning Protection

The lightning protection system in the Freen-20 involves the removal of lightning strikes by connecting the lightning arrester with a copper cable to a protective grounding loop around the foundation.



## Storm

When in idle mode in strong gusts of wind (storm), the turbine does not start to prevent breakdowns.

The turbine retains automatic control, and as soon as the wind speed drops below the maximum production speed for 30 consecutive seconds, an auto-start occurs.

The components of the Freen-20 are designed to withstand significantly higher wind speeds. The maximum survival speed for the Freen-20 is 36 m/s.

## Safety System

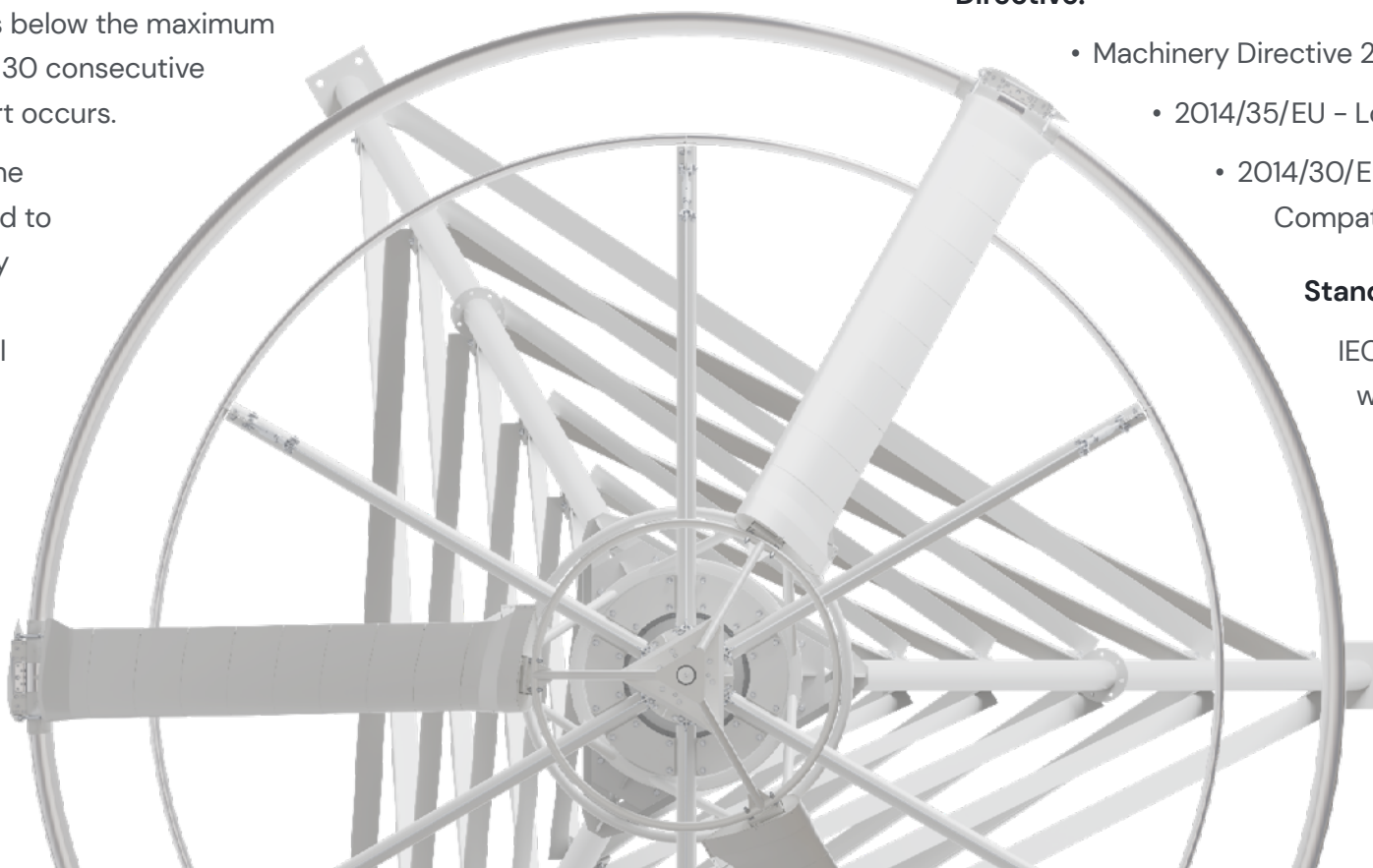
The safety system guarantees the safe operation of the turbine in accordance with international standards.

### Directive:

- Machinery Directive 2006/42/EC
- 2014/35/EU – Low Voltage Directive
- 2014/30/EU – Electromagnetic Compatibility Directive

### Standards:

IEC 61400-2:2013 – Small wind turbines



! The manufacturer reserves the right to change any technical parameters of the wind turbine due to design improvements or other reasons



# See Freen-20 at Work





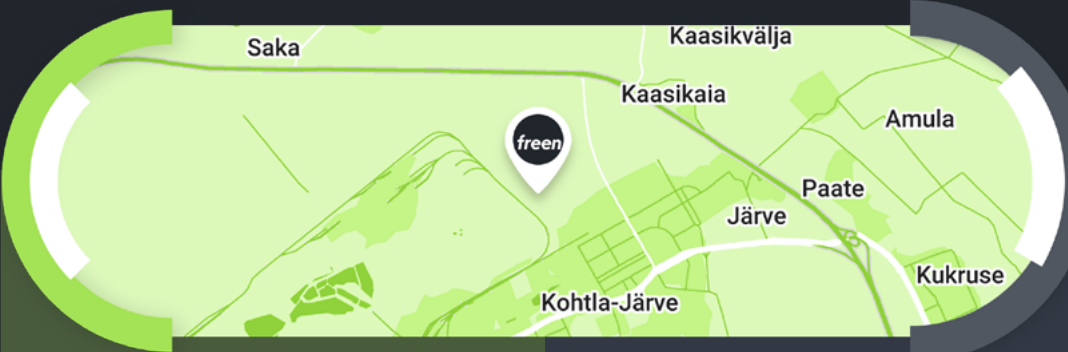


YOUR WIND • YOUR POWER • YOUR WAY


Contact Us


# Transform Your Energy Setup — Order the Freen-20 Today!


<https://freen.com/>




**Freen OÜ**

 Arenduse tn 6,  
Kohtla-Järve, 30328  
Ida-Viru maakond, Estonia

 **Phone**  
+372 5374 1754

 **Registration number**  
14541774

 **Email**  
contact@freen.com