Weather Critical Operations

The Right Decisions in Any Weather

e · a passion for precision · passion pour la précision · pasión por la precisión · passione per la precision

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Lufft

Weather-critical Applications

Offshore wind farms and increasingly large solar parks play an important role in global energy supply. Our mobility knows no bounds. We rely on an infrastructure that functions efficiently - on land, in water or in the air. Experienced decision-makers ensure that "outdoor" technology operates flawlessly. Environmental sensors are indispensable here as the basis for decisions.

Application Questions

Can the plane land safely, even in tropical rainfall and winter conditions? Is the travel time for my route calculated correctly as a function of the weather conditions? Are there alternatives that are not restricted by the weather?
Can I continue to operate the wind turbine under the prevailing wind conditions? Is the position of the turbine optimally aligned? Does my solar farm deliver the expected (energy) yield?

Does my plant protection strategy work and does it prevent attack by insects or fungi?

Is the air quality below the technically permissible maximum values?
What long-term trends do we observe in nitrogen oxides and particulate matter in a region or city?

Can large public buildings and industrial buildings be managed more efficiently, resulting in energy savings?

Can snow-making equipment be optimally controlled so that there is still enough snow for tourism?

Will ceilometers be able to recognize the type of cloud automatically in the future?

Will a Smart Home be able to operate autonomously and energy efficiently in the future, according to the user's individual needs?

Smart sensor technology for better solutions.

Metrology

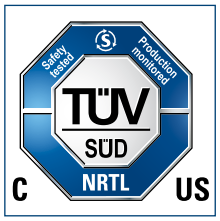
Sustainability

Your systems are complex and must have a long service life. We also specified these requirements for our environmental sensors:

> High long-term stability of the sensor
> Very long service life
> Extreme robustness
> Precise measurements
> Calibration capability of the sensor
> Reliable measurement even under extreme conditions
> Software upgrades

You take the decisions...

... we supply the measurement data that you need for this purpose. We deal with the measurement of all environmental data. Smart sensors allow not only reliable measurement with state-of-the-art technology, but also computing and diagnostic functions. In addition, via the serial interfaces of the smart sensor, the information can also be forwarded for subsequent processing in various languages (protocols). Whether cloud, datalogger or "smart communicator". Smart sensors facilitate streamlined hardware architecture in the entire measurement setup.



Applications

> Proactive runway management
Safe winter roads with optimal salt application
> Automatic spreading
> Environmentally friendly agricultural applications
> Efficient plant control for renewable energies
> Production of artificial snow
> Energy efficient buildings

System Concept

Individual sensors or modular-designed all-in-one sensors supply data via an open interface for further processing.
Whether GPRS, LAN, WLAN or satellite transmission, the necessary infrastructure to provide real-time data for decision-making is available worldwide.

Reliable Measurement Data

Big Data provides ever increasing amounts of environmental data. Which sources can you use for decision-making? Which data can you trust? To answer these questions, in the future every measurement network needs to contain several reference stations, which measure correctly at all times. Guaranteed.

We help you to master complex weather conditions.

Our Customer is King

User First

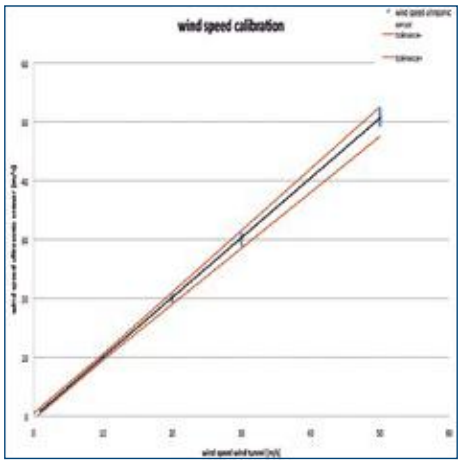
Reliable Measurement
Data Verification and Calibration

What type of maintenance do you want for your environmental sensors?
Reactive (in case of faults) with regular maintenance intervals? Or proactive with timely replacement of critical components? Predictive, taking account of probabilities of failure? Or availability-based, i.e. you expect data delivery, for example, in 99.5% of all possible cases? On this basis, verification and calibration activities can be performed on your measuring systems.

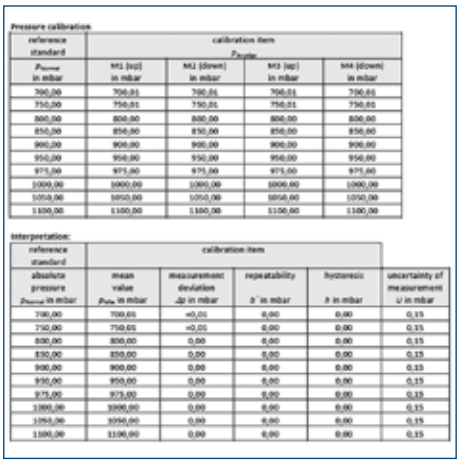
Calibration (traceability)
Environmental sensors can be laboratory tested, including traceability. In the best case, the characteristic curve of the sensor can also be corrected (adjustment). And the date of the next verification can then be set.

Verification
The measurement point is compared with a reference. Ideally, not only at a given time, but over a period of about one hour. A decision can then be taken regarding adjustment or replacement.

Reference Sensor WS3000
> Exchangeable sensors
> Redundant air pressure sensor
> Excellent ventilation
> Metal housing



Characteristic Curve of a Wind Sensor
> Target / actual comparison over the entire measuring range
> Optimization of measurement accuracy by storing the characteristic curve in the sensor
> Secondary calibration by the user during use



Meteorology and Metrology:
> Verification of accuracy, e.g. air pressure, traceable to primary standards (NIST, DAkkS, etc.).

Trust the measurement data whose origin you know.

WCO Sensors

Matrix

As well as measuring typical weather parameters such as air temperature, relative humidity, air pressure, wind and precipitation, weather-critical applications require additional sensors to provide further information.

> Road and runway conditions
> Wetness measurement for speed adjustment
> Fog detection
> Snow depth measurement
> Cloud height measurement for safe landing of aircraft and helicopters
> Redundant sensor technology for maximum reliability

Cloud height

	CHM15k	CHM8k
Measuring range up to 15 km	■	
Measuring range up to 8 km		■

Snow depth

	SHM30	SHM31
UMB protocol		■
ASCII protocol	■	

Visibility

	VS2k	VS20k
Measuring range up to 2 km	■	
Measuring range up to 20 km		■

Road / Runway Conditions





	IRS31 pro	ARS31 pro	NIRS31	StaRWIS	MARWIS
Mobile					■
Stationary	■	■	■	■	
Installed in asphalt	■	■			
Non-contact measurement			■	■	■
Freezing temperature	■	■	■	■	
Surface temperature	■	■	■	■	■
Depth temperature sensor(s)	■				
Condition	■		■	■	■
Water film	■		■	■	■
Friction	■		■	■	■
Air temperature / humidity				■	■

Temperature / Relative Humidity / Air Pressure


	WS3000	WS3100
Redundant air pressure (opt.)	■	■
Calibration certificate	■	■
Metal housing	■	■
Radiation measurement		■

Traffic Weather
Safe Arrival

Black-ice early warning systems help you to operate a proactive winter service and keep critical microclimates such as bridges constantly in view.
Mobile and stationary measuring technology gives you information at any time - not only about individual measuring points, but also about the road conditions throughout your entire road network.

Traffic Management Systems (TMS) require real-time information, not only about road conditions but also about wind conditions (on bridges) as well as visibility, in order to display the optimum speed in each case via variable warning signs.

Water film height is measured in micrometers. From as little as 10 micrometers, a road is no longer dry. With more than 700 micrometers (0.7 mm), there is a risk of aquaplaning.

The grip depends on the tire, the asphalt and the water / snow / ice layer. This weather-related intermediate layer is the key factor as far as friction is concerned.

A single measurement point is often not representative of the actual road condition. Optical, non-contact methods sample a representative surface area instead of a point. They also measure up to 100 times per second, while the measuring vehicle is in motion.

Snow Depth Laser-Technology

Clearing and spreading or just spreading?
What is the cost to the municipality for the subcontractor to carry out winter maintenance?
It is important to know the precise snow depths.
Due to climate changes, weather experts no longer expect snowfalls to be regular, but rather heavier.

Despite long-term warming, snowfall intensity is actually increasing. Snow depth measurements are an integral part of meteorological measuring networks.

Winter services and ski regions need precise information on snow depth, whether for slope preparation or proactive clearing.

In most cases, the point measurement with a single laser is sufficient. Independent of temperature, wind and relative humidity, the measurement result is highly accurate in all conditions.

The measurement method of the SHM31 is based on a combination of phase comparison and time of flight. The platform-independent UMB-Config tool enables the parameterization of the sensor according to the individual requirements.

The point or surface area measurement for a winter without surprises.

Airport Weather
Safe Landing

With regard to landing safety, pilots and technical airport management communicate via the so-called RCC (runway condition code). This RCC must be known over the entire length of the runway. Today's experience-based process can be supported by modern measurement technology. In this way, the exchanged information is clearly documented and traceable.

> MARWIS does not record the conditions at a single point, but over the entire length of the runway
> Built-in sensors measure the current runway conditions
> Atmospheric sensors are used to permanently adjust the short-term forecast
> Active built-in sensors determine the actual freezing temperature for each de-icing agent. This means that you remain on the safe side and can act in good time.
> All measurement data are automatically transferred to the RCC messages (runway condition code)

"The ultimate secret is the friction on the runway," an experienced airport manager told us. With a combination of mobile and stationary sensors, the secret can be revealed.

It is ideal to record the conditions on the entire runway, in terms of both length and width. Mobile sensors such as MARWIS can do this by installing several sensors on a unit behind the measuring vehicle.

"I'm only interested in the weather inside my airport fence".
The use of de-icing agents is expensive. For optimum proactive application, real-time data is required in conjunction with an accurate short-term prediction (Nowcast).

Most accidents occur during landing and takeoff. The main reason for this is critical weather.

Trust your experience in conjunction with state-of-the-art measuring technology.

Visibility

VS2k/VS20k

> Measuring range up to 20 km
> Active defense against spiders
> Contamination detection
> Anodized housing

Saturated air, fine dust and sand cloud the atmosphere and lead to reduced visibility. Meteorological networks and airport applications require a large measuring range. If the VS20k returns the maximum measurement value, the visibility can be identified as clear.

Fog is caused by large temperature differences between day and night and is a micro-climatic event.

Verification in the field is carried out using a calibration disc. As a further control point, the zero point is checked ("in the dark").

The degree of contamination of the sensor is transmitted together with the measured values and serves to alert proactive maintenance.

In future, spiders will have to find another place for their webs.

Cloud Height

Cumulus, Stratus or Cirrus?

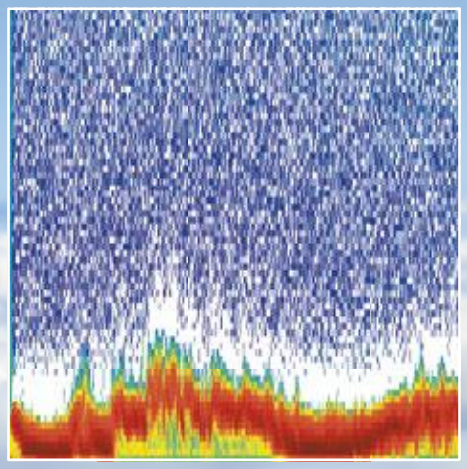
> Measuring range: Up to 15,000 meters
> Extremely high sensitivity of the measurement signal with excellent reproducibility under identical conditions
> Detection of up to 9 cloud layers with simultaneous thickness measurement
> Degree of coverage (Sky Condition Index)
> Cloud penetration depth
> Height of the aerosol layer and boundary layers
> Vertical visibility (VOR)
> Aerosol backscatter profile
> In preparation: Differentiated aerosol detection, depolarization
> Fine dust, sand, volcanic ash, "chemical weather"
> Verification with cloud height simulator

Ceilometers help to investigate the impact of climate change.
These findings are incorporated into future forecasting models.

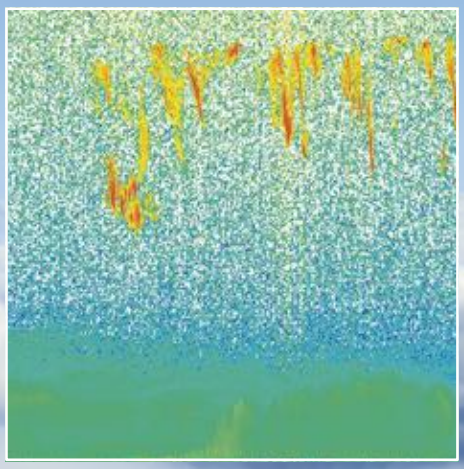
Equipment is required on location to check the functionality. The Lufft cloud height simulator allows ceilometers to be tested, even under a cloudless sky.

Ceilometers are often of dual use – for airport weather information and meteorology.

The building of international monitoring networks for cloud and aerosol observation has begun. Currently, there are significant gaps worldwide. Through the complete automation of the observation networks, ceilometers will take on a very important role in the future, and the intention is also to automatically detect the cloud type.



Ceilometers that are used for both airports and meteorology / climate research must provide precise measurement of all air layers.
Very high cirrus clouds, e.g. over the equator, are over 10 km high.



The extremely stable laser sensor produces raw data for all heights, which are converted into the different results. Signal processing by means of microprocessors is critical to the quality of the output. Cooperation with climate and meteorology researchers worldwide allows constant improvement of the data output and ensures application-specific use.

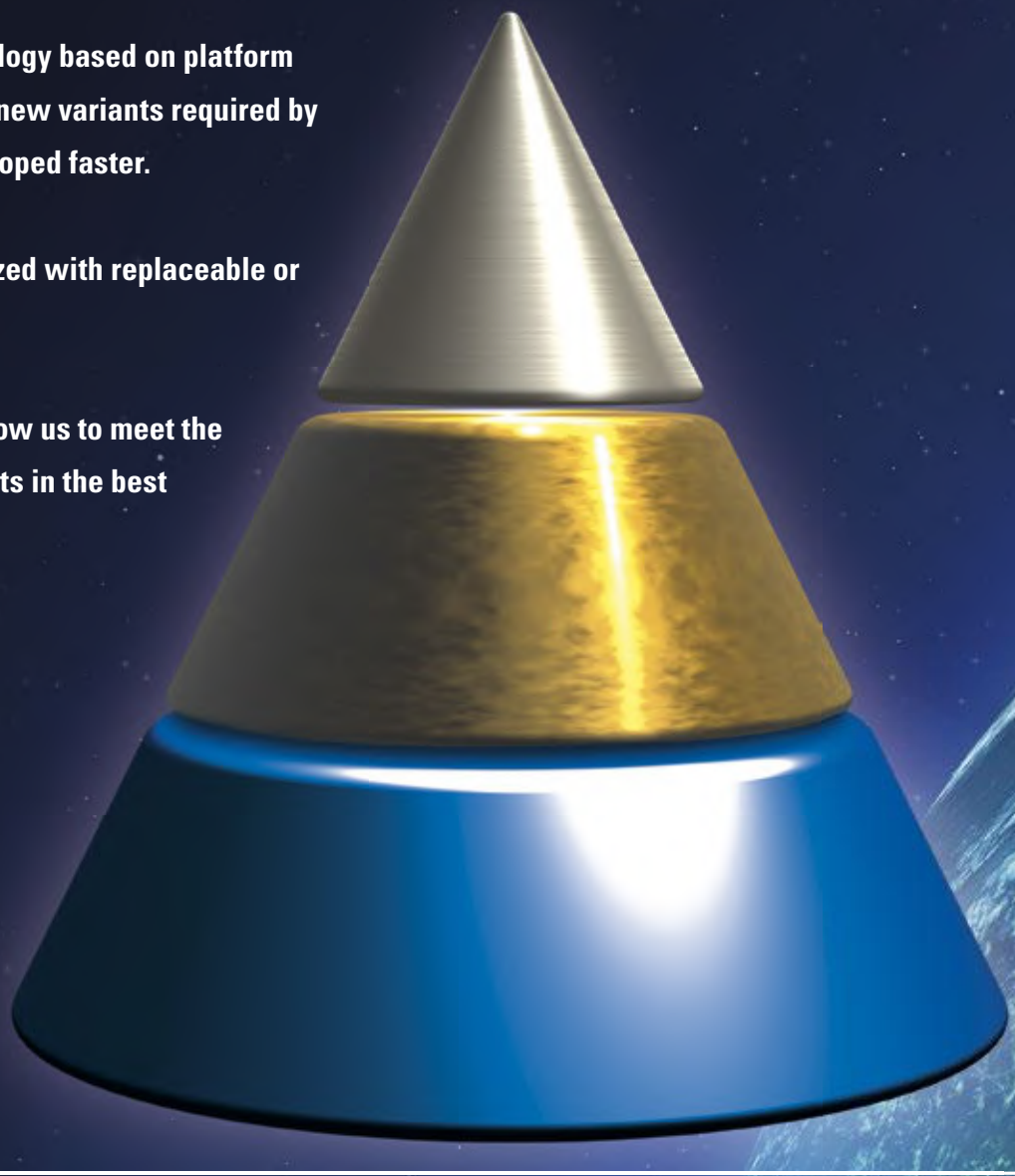
Cloud and aerosol measurement for precise forecasting of air pollution.

Platforms and Variants

Modern sensor technology based on platform concepts. As a result, new variants required by our users can be developed faster.

Platforms can be realized with replaceable or hardwired sensors.

Different platforms allow us to meet the respective requirements in the best possible way.



THE REFERENCE
WMO-STANDARD
METEO-SMART

The WMO (World Meteorological Organization) places high demands on the sensors to be used. The reference class must not only meet these requirements, but exceed them. The WMO standard sensor is intended to ensure that weather observation takes place worldwide on the basis of identical principles. And though WMO accuracies are not always required, a professional environmental sensor is still needed. That's why we developed the "Meteo-Smart" series.

Cloud height	Snow depth	Current weather	Visibility

The Reference

			
CHM 15k		Parsivel	

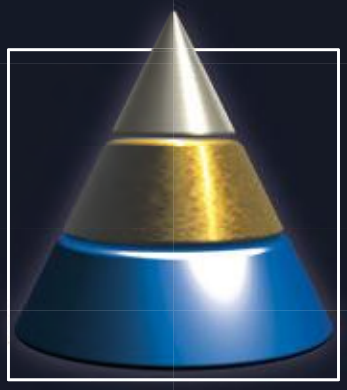
WMO-Standard

			
CHM 8k	SHM 31	WS100	V20k

Meteo-Smart

			
	SHM 30	R2S	V2k

Matrix Overview
WS Series



Wind	Temperature Relative humidity Air pressure	Temperature Relative humidity Air pressure Precipitation	Temperature Relative humidity Air pressure Radiation

Lufft WS Sensors: The Reference

Ventus

WS3000

WS3100

Lufft WS Sensors: WMO-Standard

WS200

V200

WS300

WS400

WS310

WS301/303

Lufft WS Sensors: Meteo-Smart

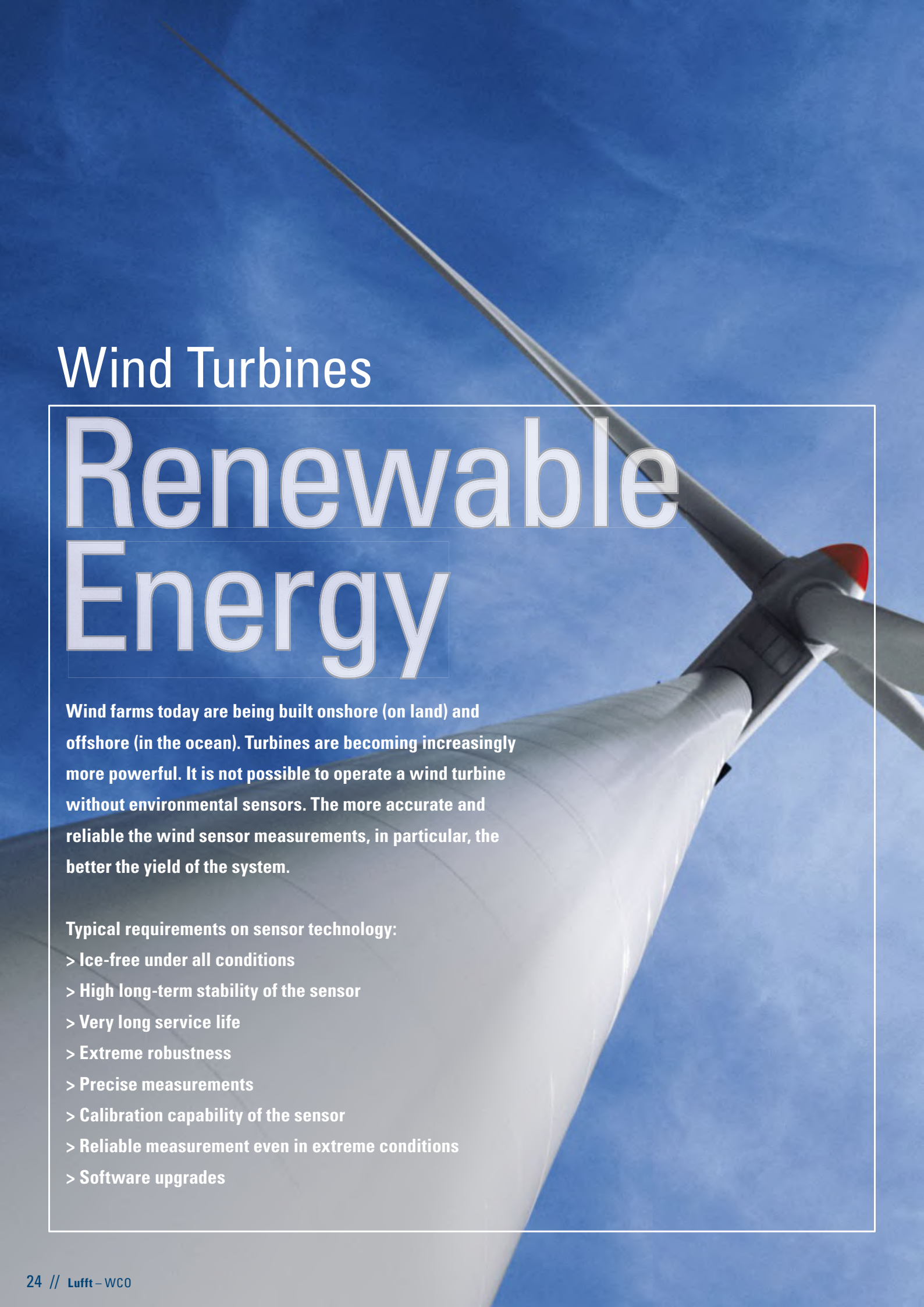
WS401

WS302

WS304

THE REFERENCE
WMO-STANDARD
METEO-SMART

	Temperature Relative humidity Wind speed and direction	Temperature Relative humidity Air pressure Wind speed Wind direction Radiation			Temperature Relative humidity Wind speed Wind direction Precipitation		Temperature Relative humidity Wind speed Wind direction Precipitation Radiation
				WS510			WS800
	WS500	WS501	WS503			WS600	WS700
		WS502	WS504		WS601		



Wind Turbines

Renewable Energy

Wind farms today are being built onshore (on land) and offshore (in the ocean). Turbines are becoming increasingly more powerful. It is not possible to operate a wind turbine without environmental sensors. The more accurate and reliable the wind sensor measurements, in particular, the better the yield of the system.

Typical requirements on sensor technology:

> Ice-free under all conditions
> High long-term stability of the sensor
> Very long service life
> Extreme robustness
> Precise measurements
> Calibration capability of the sensor
> Reliable measurement even in extreme conditions
> Software upgrades

The following verifications must be performed on the wind sensor before installation on wind turbines:

> Corrosion test
> Vibration test
> MTBF (Meantime between failure)
> Measurement certificate
> Optional: traceable calibration certificate

Interfaces to the controller:

> Modbus
> ASCII
> UMB
> SDI12
> Customer-specific protocols

Accuracy:

- Initial calibration in the factory
- Secondary calibration without returning to factory, performed by qualified partner on site
- High long-term stability
- Designed for optimal protection of ultrasonic sensor

Our technology is designed to bring you benefits.

Solar Energy

> Modular design for various pyranometer classes
> Project-specific combination of sensors can be networked via Modbus
> Traceability and highest accuracy for best possible efficiency and plant safety

Since PV systems are becoming ever larger, the accuracy of the irradiation measurement is increasingly important for the efficiency of the system. The "secondary standard" variants – the highest accuracy class in the field - are provided for this purpose.

Wind cools the temperature of the module and must therefore be included in the efficiency calculation. Precipitation leads to contamination or covering (snow).

With increasing temperature, the performance of the solar module decreases. Therefore, it is important to measure the temperature of the solar module in addition to the air temperature.

Many photovoltaic system providers throughout the world use our sensors. In general, MODBUS interfaces are used to transfer measurements to the PV controller.
On request, we integrate manufacturer-specific protocols as a plug & play interface.

Secondary standard for safe

Why is the WMO standard required in such applications?
Because the large measuring range is necessary for irradiation, in order to measure the actual efficiency of the PV system. And because the service life of the system is intended to be more than 10 years. This requirement also applies to the sensor technology.

Which alternative sensor technologies are useful?
GHI: Global irradiation on the horizontal surface
GTI: Global irradiation, tilted. And thus aligned to the irradiation angle of the sun
DHI: Diffuse Horizontal Irradiation
Together with the WS600, these sensors are transmitted via a Modbus interface to the data acquisition unit / controller of the PV system.

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MARWIS won the Industry Award 2015 and is thus regarded as one of the greatest innovations in the SME sector.

The Prism Awards are also known as the Oscars of Photonics. An eminent panel of experts distinguished MARWIS as a finalist.

MARWIS helped us to win the 2015 Innovation Award of the State of Baden-Württemberg – also known as the Dr. Rudolf Eberle Award.

In the Anniversary Edition of the Brand Lexicon, Lufft was proclaimed "Brand of the Century".

**G. Lufft belongs to the TOP 100 innovators.
By winning this coveted prize awarded by the TOP 100 mentor Ranga Yogeshwar, we once again successfully demonstrated our innovative strength in a scientific selection process. This encourages us to continue on our chosen path of innovation and quality.**

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Subject to change_WCO_03_2019