Think about wind energy

Think about windfall gains

dr. stötter GmbH

We know how the wind blows...

And, where the sun shines too...

In wind energy, Germany is the largest player in the World. Today, wind energy seems to be the answer to World's power shortages and offers small and medium enterprises the opportunity of a life time, to harness windfall gains.

Think about windfall gains

World's wind energy potential…
it's windfall gain!

The winds really are blowing through. For a fast growing, energy starved country, wind energy is a viable and profitable option.

Wind energy…
global growth.

Going by trends in the World market, the demand for wind energy will grow at over 25 percent, in terms of annual installed capacity till 2010. Researchers estimate that by 2040 wind energy will produce over 3,200 GW towards meeting the World's energy needs.

Windmills…
your green investments

Once the wind farm is in place, the cost to the investor would primarily be the cost of money which is the cost of interest on capital. Over a period, investory can recover the capital along with interest, and the only other remaining cost is towards Operation and Maintenance, which is very nominal.

Some governments allow accelerated depreciation of up to 80% of the project cost in the first year. Investment in Wind Power Projects is therefore most attractive in the long-term where, the returns on investment would be around 25% to 35% annually.

Dr. Stötter GmbH
Harnessing wind

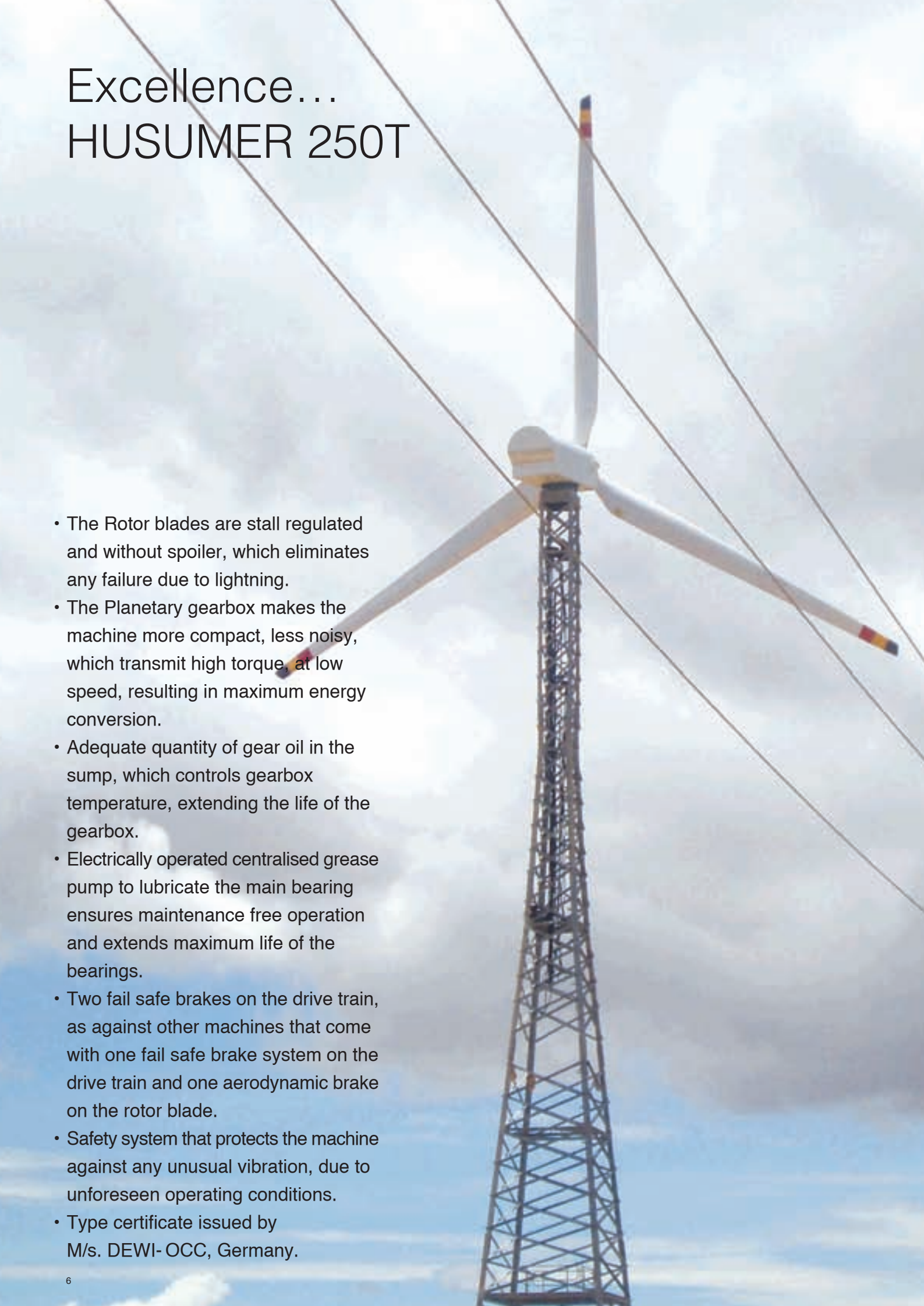
Dr. Stötter GmbH has been in the market for over 10 years; and over the recent years it has supplied more than 850 windmills of its 250 kW rated machines.

Why Invest with Dr. Stötter GmbH?

The true potential of harnessing wind energy is directly proportional to the technology of energy conversion and identification of suitable windy sites.

Dr. Stötter GmbH's windmills are built on tried and tested German technology. With its sight on being futuristic, Dr. Stötter GmbH uses cutting edge technology to offer its investors the best prospects.

Excellence…
HUSUMER 250T



- The Rotor blades are stall regulated and without spoiler, which eliminates any failure due to lightning.
- The Planetary gearbox makes the machine more compact, less noisy, which transmit high torque, at low speed, resulting in maximum energy conversion.
- Adequate quantity of gear oil in the sump, which controls gearbox temperature, extending the life of the gearbox.
- Electrically operated centralised grease pump to lubricate the main bearing ensures maintenance free operation and extends maximum life of the bearings.
- Two fail safe brakes on the drive train, as against other machines that come with one fail safe brake system on the drive train and one aerodynamic brake on the rotor blade.
- Safety system that protects the machine against any unusual vibration, due to unforeseen operating conditions.
- Type certificate issued by M/s. DEWI- OCC, Germany.

Our Strength..
Our People

Dr. Stötter GmbH provides a single point solution to engineering challenges, offering multi-disciplinary design, engineering, procurement, construction and project management services.

Human Resource

Our main strength is our human resource; in terms of knowledge and experience in process, mechanical, civil, structural, electrical engineering and process automation.

Partnerships

Dr. Stötter GmbH operates in partnership with a network of international companies. Our international partners provide access to the latest technologies in all areas of operations. Moreover, partnerships with local engineering companies permit us to extend our capabilities and provide increased value to our customers.

HUSUMER 250T

Technical Description

250 kW HUSUMER 250T Wind Electric Generator

1.0 GENERAL DESCRIPTION OF THE MACHINE

Our 250 kW Wind Electric Generator (WEG), Model HUSUMER 250T, is a third generation grid - connected Wind Electric Generator of rugged German design, incorporating the latest innovations in the design of its component assemblies. Its rated capacity is 250 kW.

The most outstanding feature of the machine is its extra large rotor of 28.5 m diameter, making it unique among all wind turbines in the 200 kW to 250 kW capacity class.

Since the power output of a wind turbine is directly proportional to the square of the rotor diameter, it follows that a larger diameter rotor will produce proportionately more power than other at any given velocity of wind. The 250T, therefore, is capable of producing around 10% or so more kWh per year than other comparable models.

Further, its dual wound, automatic pole-changing generator operating at 80 kW (again, higher capacity at lower wind speeds than that of any other machine in its class) and 250 kW, which enables the machine to produce also more power at lower wind speeds at lower rpm.

Two hydraulic brakes, one on the main, slow speed shaft and other on the high speed shaft, offer total protection against overspeeding and at any faulty conditions occuring during operations.

Further, an automatic centrifugal swich is provided on the generator end to disconnect the generator if overspeeding occours. By fitting a safety brake and a mechanical centrifugal switch on the generator side, it is possible to dispense with the tip brake. Arrangement for excess speed, thus reduce the noise emission associated with tip brakes.

An advanced aerofoil design of the Fibre Glass Reinforced Plastic (GRP) rotor blades, incorporating stall regulation, and a planetary gear box (instead of the normal spur gear box) offers the maximum fatigue resistance, contributes to maximum efficiency, effectiveness and durability of the machines.

As a consequence of the above-mentioned modular and compact design and the special adaptation of the subsystems to each other, a cost-effective and easily maintained machine has been developed to make optimum use of the varying wind pattern available at different locations all over the world.

The fact that these machines conform to the tough standarts of reliability and quality laid down by the German Schleswig-Holstein Ministry of the interior is, certified by Germanischer Lloyd, the mandated monitoring agency for Wind Electric Generators in Germany.

A brief description of the various components and sub-units are described in the following paragraphs:

2.0 BLADES

- light but of extremely strong GRP construction,
- the forces are conducted safely from the GRP structure to rotor hub, via a cast steel flange segment,
- the blade profile follows NACA/WORTMANN Standarts so that, throughout the wide range of wind speeds from 14 to 26 m/s and beyond, the rated output of 250 kW is produced by aerodynamic sef-regulation, otherwise called “stall regulation”.

3.0 ROTOR HUB

The cast steel rotor hub, together with the rotor shaft, is cast as a single, composite and compact unit for direct connection of the blades, the rotor bearing, the planetary gear and the rotor brake disc. This enables loads on the bearings and torques on the gear/transmission shaft to be kept low. This is because, passing the braking torque directly to the rotor hub ensures that the gear and transmission shaft are not subjected to excessive dynamic loads.

4.0 BEARINGS

4.1 Rotor Bearing

The rotor bearing is a three-row roller bearing. The dynamic loads affecting the rotor are absorbed and transmitted entirely by this bearing. The bearing is mounted directly on the front wall of the nacelle. To absorb and transfer the above-mentioned loads into the lower, forward area of the nacelle, the walls and platform are reinforced and stiffened by steel plates.

The main bearing is continuously lubricated by a grease pump which provides an automatic supply of fresh bearing grease from a reservoir, trough a pipeline system, in a sequential order to nine equally spaced grease nipples on the periphery of the rotor bearing.

4.2 Yaw Bearing

The ring bearing (i.e., yaw bearing) enables rotation of the nacelle in response to changes in wind direction. This ring bearing is of the pre-stressed four point type, with external ring teeth, having a diameter of 1.3 m and provides a rotating interface between the tower and nacelle.

The tower ring of the bearing is integral with the tower portion of the yaw brake disc and the inner ring is bolted to the base of nacelle.

Lubrication of the bearing is achieved through twelve equally spaced grease nipples located around the

Technical Description

periphery of the inner ring throungh the same grease lubrication system used for the main bearing. A hand access hole with a cover plate is provided for inspection and lubrication of the yaw gear ring teeth and is located on the nacelle base plate opposite to the yaw drive gear.

5.0 DRIVE SYSTEM

5.1.0 Main Drive
The main drive system comprises the blades, rotor hub and shaft with associated bearing, rotor brake (low-speed), the two-stage planetary gear box and the intermediate shaft connecting the gear box to the generator, with the associated shaft brake (high-speed) and slip clutch.

The whole system, driving the generator, works in tandem with the grid supply and is monitored and controlled by a sophisticated micro-processor control system incorporating a host of operational and safety controls.

5.1.1 Main Gear Box
The main gear box is of the two-stage planetary gear type with a reduction ratio of 1:38.2. It is connected to the rotor hub, through the drive system shaft, by a shrunk-on bushing. Two side-mounted torque supports absorb the torque loads. The gear box has a continuous rated output of 275 kW.

The Gear box is cooled by its own oil, which is circulated by a pump to the gear box, through a hose, from a tank located at the bottom of the nacelle. The oil is cooled in the tank and, when the temperature of the gear box rises to 65°C, the system computer automatically starts the circulation of the pump. Similarly, when the oil level fall below the lower mark, the system functions automatically by pumping the oil into the gear box and stops once the higher level mark is reached.

5.1.2 The Intermediate Shaft and Friction Clutch (Slip Clutch)
The gear box drives the generator through an intermediate shaft which is located between the gear box output shaft and the generator input shaft. This intermediate shaft accommodates any slight assembly misalignments. The connecting hubs for the shaft are shrunk onto the gear box and generator shafts. There are adjustable spring-packs fitted on both ends of this shaft between the flanges in each case to balance out any misalignments.

The Slip Clutch, which acts purely as a torque clutch, is part of the intermediate shaft unit fitted on the generator end. This clutch is a further safety facility, completely independent of the other safety components, and is set to 2.2 times the nominal generator output. It isolates and thereby protects the gear box and drive components from excessive torque which can, for example, occur at a faulty grid switching or a short circuit in the generator. Because the Friction Clutch cannot be considered as a rigid connection, it is located after the safety brake, on the high speed shaft.

5.1.3 Main Drive Brakes
According to the guidelines for the design, erection and operation of wind energy plants issued by the German Schleswig Holstein ministry of the Interior, in conjunction with Germanischer Lloyd, a wind energy plant must be equipped with two independent braking systems.

Accordingly, our HUSUMER 250T's braking system consists of two independent brake discs; one on the rotor shaft (slow speed) and the other on the high speed shaft, and a hydraulic circuit complete with pumps, valves and an accumulator.

The primary brake is fitted to the slow speed rotor shaft in order to avoid excessive torque being transmitted to the gear box when the generator is not running under high velocity wind regimes.

If this were to be fitted only on the driven end (ie., on the high speed shaft) alternating torques produced on the rotor shaft by changing gusts of wind, even when the unit is stationary (ie., for wind speeds in the operating range and also above the cut out level), would be transmitted through the gears onto the high speed shaft. This would put enermous stress on the gears leading to a failure of gear box.

The brake linings are pressed onto the brake disc by spring force. When the plant is operational, the brake is released by hydraulic pressure. At any operational faults, the rotor brake acts to arrest the drive shaft, ie., the slow speed shaft. Thus, even in adverse conditions, the rotor shaft brake is the First Safety Element in the FAIL SAFE SYSTEM.

The second brake system is provided for emergency. It is fitted on the high speed side of the machine and is spring actuated and hydraulically released like the rotor shaft brake. It is independent of the main brake (rotor brake) and arrests the high speed shaft if the generator overspeeds.

5.2.0 Yaw Drive
The yaw drive mechanism is fitted to the nacelle. It consists of a yaw motor, a worm reduction gear followed by a two-stage planetary reduction gear, and a pinion that engages a large, stationery, gear ring fixed to the top of the tower. The yaw motor receives its input from the micro-processor control system which, in turn, derives its signal from the wind direction sensor mounted on the nacelle.

The system ensures that the rotor blades always

Technical Description

automatically face the wind direction while in operation.

5.2.1 Yaw Gear Box
The corrective guidance of the nacelle is achieved by means of electric motor which drives a worm gear arrangement through a two-stage planetary reduction gear box and a spur and ring gear. The overall speed reduction achieved by the system is 10000:1. The motor is located on the base of the nacelle adjacent to the access opening from the tower. The spur gear on the output shaft of the reduction gear box passes through the aperture in the base of the nacelle and engages the external teeth of the yaw ring gear which is mounted on the yaw bearing between the nacelle and the upper flange of the tower.

Due to the high-ratio of the reduction gearing, a full 360° rotation of the nacelle requires about 10 minutes.

5.2.2 Yaw Brakes
The yaw drive is provided with two brakes for safety:

i) A constantly acting, spring loaded brake to ensure a steady rate or speed of slewing. The yaw motor must drive against this friction brake so that gear backlash is considerably suppressed during the corrective movement of the nacelle owing to sudden changes in wind drection.
ii) A spring actuated, hydraulically released brake caliper, acting on a stationary disk mounted on the tower top to arrest yawing automatically when so requred by the operating or any emergency conditions/faults

6.0 GENERATOR

The generator is of a 4/6 pole changing, 3 phase, asynchronous type, with a rated output of 80 kW/250 kW at rotational speeds of 1000 rpm/1500 rpm respectively. As can be seen from the power curve, at rated wind speeds of 14m/s and above, it will consistently produce more than 250 kW and is thus designed to make up for differentials in the ambient air densities between cold and warm climates, and also to account for derating with usage so that it is capable of generating not less than 250 kW at the specified wind speeds throughout its designed service life of 20 years.

The generator is built to IP55 safety standards to safeguard against corrosion of windings and shafts by cooling air of high salt content as found in coastal regions.

The generator is provided with a reinforced bearing which is lubricated and protected against overloading so that, at a continuous operation at nominal output, the generator thermal relay relay will trip only at an average output of 300 kW over a period of 15 minutes.

The generator is provided with safety sensors and associated relays to protect against overheating and overspeeding and is also designed for circulation of unimpeded cooling air.

6.0 CONTROL SYSTEM

The control system has been designed to permit automatic operation of the machine. At its heart is a programmable control unit specially developed for the HUSUMER 250T; in other words, all the switching operations are initiated and monitored by the control computer. The following control and monitoring procedures ensure effective and safe operation:

- stand-by operation at wind speed below 3.5 m/s with automatic following of wind direction;
- automatic start-up of lower power operation up to 80 kW at wind speeds above 3.5 m/s;
- automatic switch over to high power operation (up to 250 kW) if more than 58 kW is generated for 5 minutes or in the event of peak outputs exceeding 75 kW
- automatic switch-back to low power operation or stand-by operation when speed drops;
- service braking via the generator;
- monitoring of the most important operating parameters, such as generator temperature, gear oil level, gear oil temperature, brake hydraulic pressure, brake pads wear, etc., and switching-off of the machine in the event of faults by initiating the braking procedure;
- switching-off the machine by initiating the braking procedure if the maximum wind speed of 23 m/s (can be adjusted up to 26 m/s) is exceeded or the vibration switch is tripped;
- with manuel control device the rotor can be turned away from the wind by means of the ring gear drive;
- provision is also made for a possible remote transmission of all monitored and measured operating criteria to a central location.

7.0 TOWER

HUSUMER 250T WEG is normally used on a lattice tower.

The lattice tower is of bolted construction, corrosion protected and is accessible from inside up to the nacelle by a ladder. The automation system switch cabinets are located in a seperate room built outside the tower.

Technical Data

Rotor

Diameter	: 28.5 m
Area of swept circle	: 638 m^2
Speed (rated) HIGH / LOW	: 39.8 rpm / 26.5 rpm
Speed (max.)	: 46 rpm
Shaft inclination	: 6°
Alignment	: Upwind

Rotor blades

Material	: GRP
Number of blades	: 3
Weight of blade	: 750 Kg each
Gear type	: Planetary gear
Ratio	: 1 ÷ 38.16

Generator

Type	: asynchronous
Pole changing	: 6 / 4
Rated output	: 80 kW / 250 kW
Speeds	: 1000 rpm / 1500 rpm
Main voltage	: 400 V
Frequency	: 50 Hz

Yawing System

This system consists of rotating mechanism and gearing with a ratio of 1:10000; and braking and retaining with 2 brake calipers	: Wind Vane;

Braking System

Operation System regulation	: electrical by thyrosoft-

Mechanical Brakes

Brake disc (slow-speed side) brake calipers	: spring-actuated, 2 hydraulically released
Brake disc (high-speed side) brake caliper	: spring-actuated, 1 hyfraulically released

Performance Data

Rated output	: 250 kW
Rated wind speed	: 14 m/s
Cut-in wind speed	: 3.5 m/s
Cut-out wind speed	: 23 m/s
Max.Coefficient of performance	: Cp max=0.44

Tower / Lattice tower

Construction	: Bolted
Corrosion protection	: Galvanized
Height of tower	: 40 / 50 m
Hub Height	: 41.5 / 51.5 m

Accessible from inside up to the nacelle by ladder

Weights

Nacelle complete	: 11.500 kg
Tower (lattice / tubular)	: 14.500 kg / 16.500 kg
Total	: 26.500 kg / 28.000 kg

Electrical Control Cabinets

In the case of the latice tower, switch cabinets contaning the control and safety electronics are housed in a separate control room located by the side of the tower and, in the case of the tubular tower, they are housed in the base of the tower.

Regulation system

Performance regulation	: aerodynamic by stall effect

Cut-in wind regulation by thyrosoft regulator.

Yaw system	: servo motor, with reduction gearing
Designed Service Life For the complete plant	: 20 years

Safety Devices

Automatic Safety Devices

TWO independent, spring actuated and hydraulically released brakes, acting on two brake discs.

ONE Automatic Centrifugal Switch to disconnect the generator if overspeeding occours.

Manually operated Safety Devices

1. Turning the rotor away from the wind (manuel control)
2. Stopping the rotor for inspection.

Triggering Factors

Automatic braking is initiated in the following adverse circumstances:

- swich-off in storm conditions
- electrical overload
- excessive temperature (gearing, generator)
- shortage of lubrication (grease / oil shortage)
- insufficient pressure in the hydraulic system
- main failure, ie., grid supply failure
- excessive speed
- imbalances (vibration switch)
- brake-lining worm down
- overloading of motors (hydraulic, generator, lubrication pump, yaw)
- failure of thyrosoft regulartor

Salient Features of Husumer 250T WEG

1. An extra large rotor with a swep area of 639 sq.m for a machine of 250 kW capacity.This is because of the extra large diameter of our blades at 28.5 m as against 26 m, 27 m etc. of our competitor's machines. This increases the power output by a factor of 10 to 15% compared to one of the most populer competitive models in this range.

2. Further, it may also be noted that our dual-wound generator has the dual capacity of upto 80 kW and upto 250 kW in two ranges as against the 50 kW / 225 kW and 60 kW / 250 kW of our competitors machines, thus resulting in greater power being generated up to 80 kW, particularly at lower wind speeds, than in equivalent machines.

Essentially, this means a better capacity utilisation than comparable machines of the same class.

3. Provision of planetary gear box instead of a spur gear box which makes the machine more compact, less noisy and far superior in the property of fatigue resistance and optimum power transmission.

4. The provision of two brakes - instead of the normal one brake provided in other machines ensuring complete "fail - safe" capability.

5. Very high standards of German engineering and design ensuring extremely long and trouble-free life.

6. Our machines have a slip-clutch, with a pre-settable torque value, located between the main gear box and the generator. This friction clutch is a further safety facility, in addition to all the other safety arrangements provided in our machine. It protects the gear box and the drive components from excessive torques which can, for example, occur when there is a faulty grid switching or a short circuit in the generator.

7. Our machines are equipped with automatic grease lubrication which ensures their proper running and obviates the need for frequent maintenance attention. The main bearing is subjected to extreme demanding conditions and thus lubrication is of vital importance. Continuous lubrication is ensured by this automatic system.

It may be noted that this system also provides for a grease reservoir which needs to be replenished only at every scheduled inspection and maintenance interval.

8. Our machines have provision for circulating and cooling the gear box oil with the provision of an adequate sump which ensures proper functioning of the gear box and its components and also ensures that sufficient topping up quantity of oil is available at all times, obviating the necessity for frequent maintenance attention.

9. Our machines have a centrifugal switch attached to the generator shaft at the rear end ensuring absolute safety of the system even if other sequential safety systems are overridden due to unforeseen operating conditions.

Scope of Supply and Services

Supply of items and services included in our scope for EACH of our Model HUSUMER 250T Wind Electric Generator.

1. Supply of complete Model HUSUMER 250T Wind Electric Generator comprising nacelle assembly, rotor blades and sensors mounted in the nacelle assembly as per Technical Description attached.

2. Supply Power Panel and micro processor based control panel.

3. Supply of cabling and wiring upto power panel/control panel.

4. Supply of O & M Manuel.

5. Packing, forwading & delivery at side.

6. Commissioning of each WEG and handing over to Client.

7. Training of Client"s engineers at site during erection & commissioning on operation & maintenance schedule of the WEG

All other items of supply and / or work will be at additional cost to be mutually agreed upon with the customer.

Optional Supply and Services

1. Supply of lattice tower along with a separate control room suitable for housing the panels.

2. Supply of foundation parts/bolls.

3. Supply of cable from generator power panels upto transformer 400V inputs side

4. Supply of 400 V / 10-33 kV transformer and two pole structure.

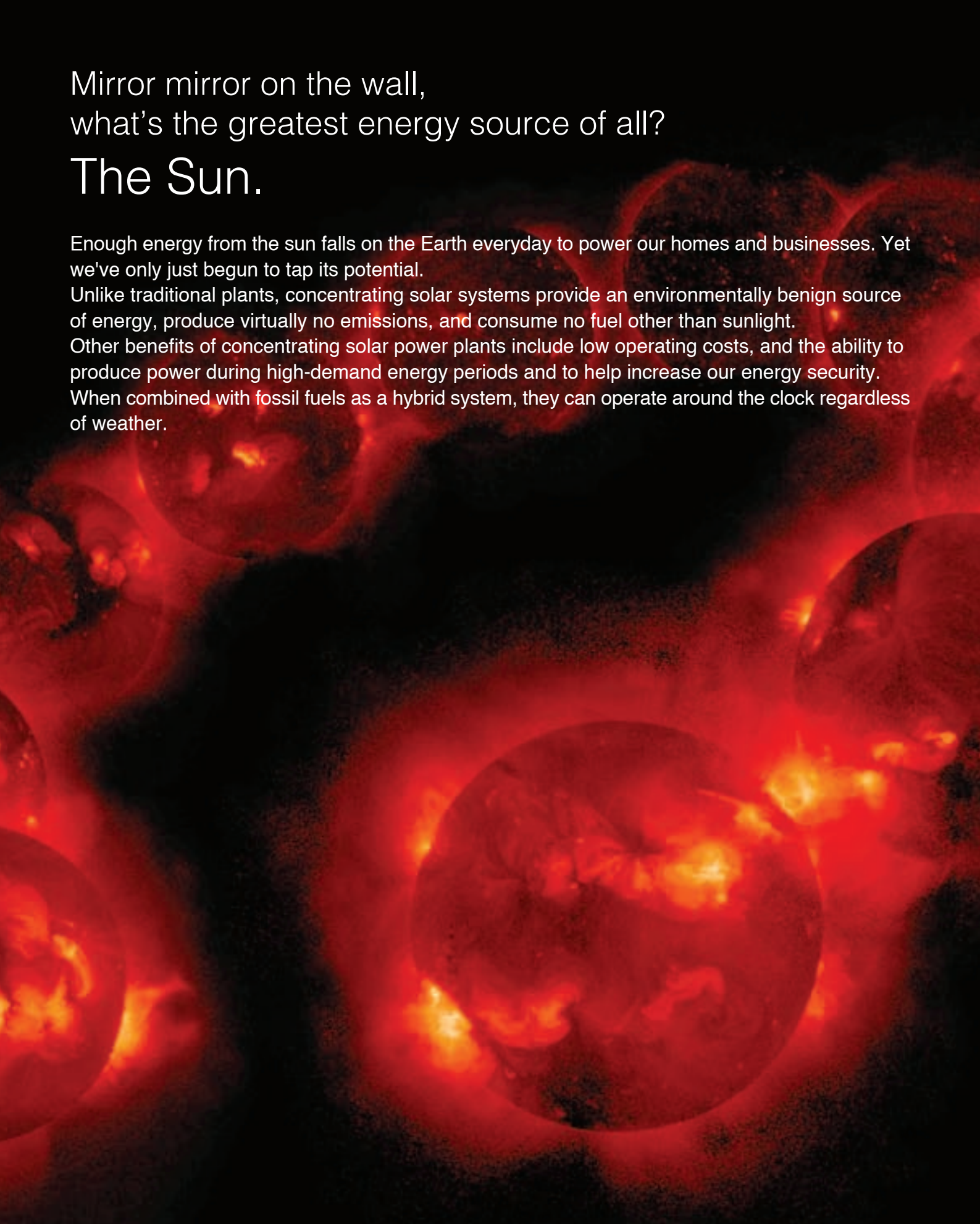
5. Erection of 2 pole structure with transformer, ABC and laying cables from power panel up to 400 V side of transformer.

6. Erection of each WEG.

Mirror mirror on the wall, what's the greatest energy source of all?

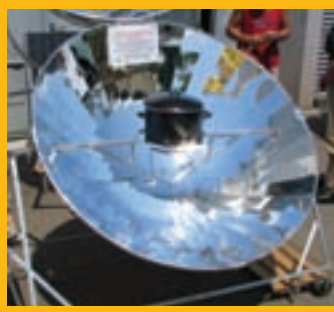
The Sun.

Enough energy from the sun falls on the Earth everyday to power our homes and businesses. Yet we've only just begun to tap its potential.
Unlike traditional plants, concentrating solar systems provide an environmentally benign source of energy, produce virtually no emissions, and consume no fuel other than sunlight.
Other benefits of concentrating solar power plants include low operating costs, and the ability to produce power during high-demand energy periods and to help increase our energy security.
When combined with fossil fuels as a hybrid system, they can operate around the clock regardless of weather.



Solar power can be used in both large-scale applications and in smaller systems for the home. Businesses and industry can diversify their energy sources, improve efficiency, and save money by choosing solar technologies for heating and cooling, industrial processes, electricity, and water heating. Homeowners can also use solar technologies for heating, cooling and water heating.

Concentrating Solar Power: Energy from Mirrors



Solar Process Heat
Commercial and industrial buildings may use the same solar technologies that are used for residential buildings. These nonresidential buildings can also use solar energy technologies that would be impractical for a home. These technologies include solar process heating, and solar cooling.

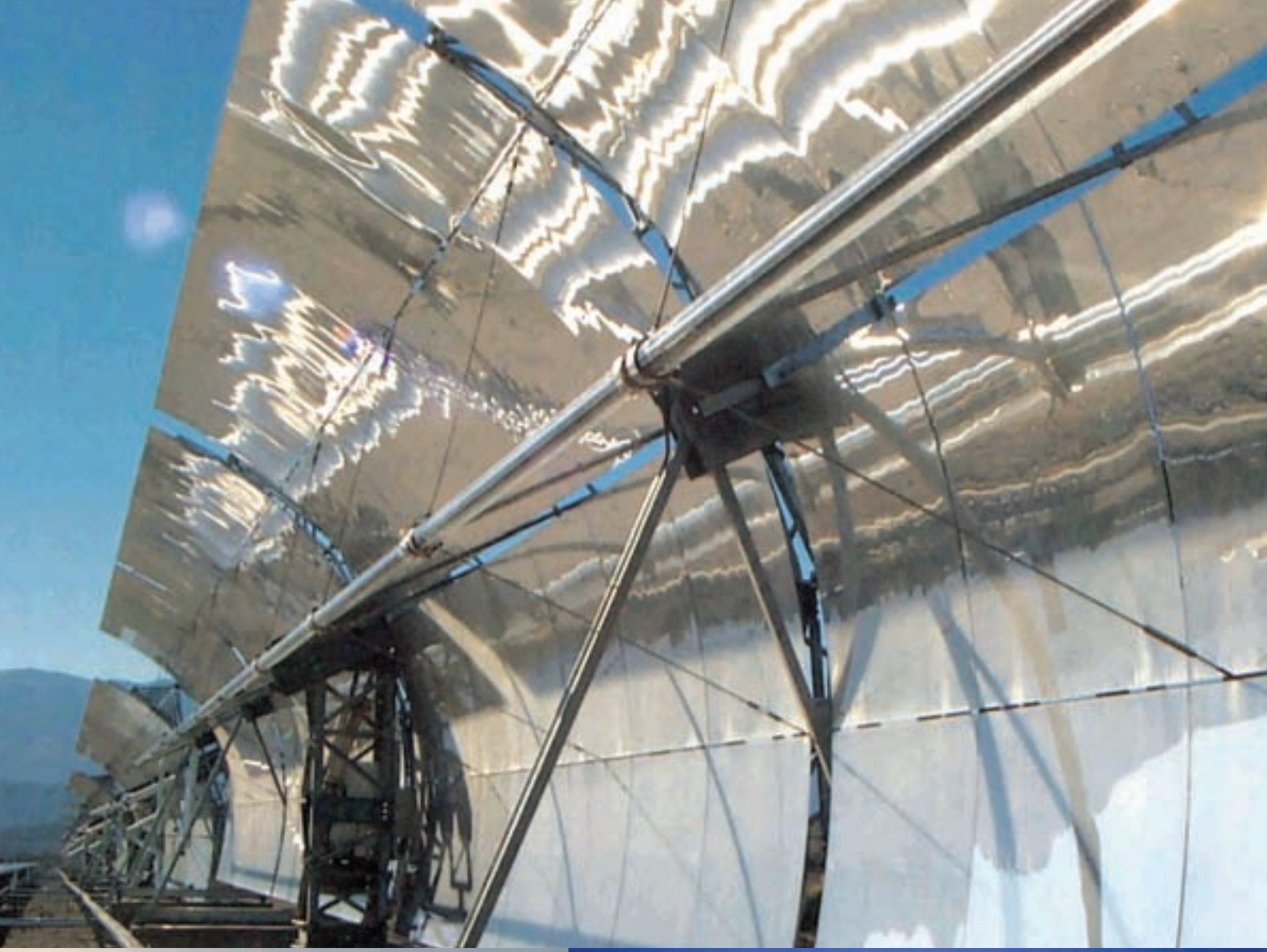
Solar process heating systems are designed to provide large quantities of hot water or space heating for nonresidential buildings. A typical system includes solar collectors that work along with a pump, a heat exchanger, and/or storage tanks.

These solar collectors use mirrored parabolic troughs to focus the sun's energy to a fluid-carrying receiver tube located at the focal point of a parabolically curved trough reflector. Many troughs placed in parallel rows are called a "collector field." The troughs in the field are all aligned along a north-south axis so they can track the sun from east to west during the day, ensuring that the sun is continuously focused on the receiver pipes.

The heat from a solar collector can also be used to cool a building. It may seem impossible to use heat to cool a building, but it makes more sense if you just think of the solar heat as an energy source. Your familiar home air conditioner uses an energy source, electricity, to create cool air. Absorption coolers use a similar approach, combined with some chemistry tricks, to create cool air from heat energy.

Beyond these localized uses of solar power, utilities and power plants are also taking advantage of the sun's abundant energy resource and offering the benefits to their customers. Concentrating solar power systems allow power plants to produce electricity from the sun on a larger scale.

Solar power technologies, from individual home systems to large-scale concentrating solar power systems, have the potential to help meet growing energy needs and provide diversity and reliability in energy supplies.



dr. stötter GmbH

Gotenweg 32 D-22453 Hamburg • Tel: + 49 40 - 55 180 53 • Fax: + 49 40 - 55 54 336 • info@dr-stoetter.com • www.dr-stoetter.com