SUNVENTION
SOLAR ENERGY

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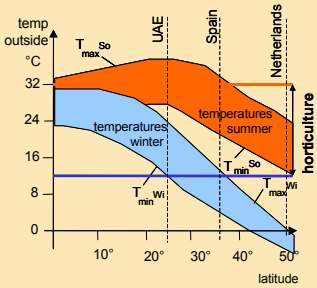
Energy Generating Greenhouse

Sunflower: A solar energy system for greenhouses

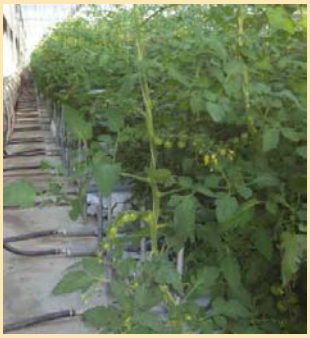
Plant growth in greenhouses can be greatly increased by optimizing the factors for plant growth such as temperature, humidity, irradiation or CO_2-content.

In northern regions greenhouses are heated to extend the growing season, whereas they have to be cooled in hot climates to safeguard good plant growth. Greenhouses are widely spread in Mediterranean as well as in East-Asian countries and are gaining increasing importance in arid climates for the cultivation of local agricultural produce. A case in point are the United Arab Emirates with 1,450 ha greenhouses.

To maintain required temperatures at night about 300-500 kWh thermal energy is needed per square meter which causes the emission of about 3 kg carbon dioxide per kilogram of tomatoes. The conventional cooling employed today uses up to 20 times the amount of water needed for irrigation greatly contributing to the scarcity of water in southern regions.



The solar energy systems of Sunvention aim at converting greenhouses from energy users to net producers of renewable energy. One of these systems, Sunflower, installed in the roof structure of the greenhouse converts the direct solar radiation into electricity and useful thermal energy. Only the diffuse solar radiation, sufficient for photosynthesis, i.e., plant growth, enters the interior of the greenhouse thus protecting the greenhouse from overheating. As a consequence much less cooling energy is needed during the day and in cold nights the thermal energy captured during the day heats up the greenhouse.



The Vision

Sunvention´s solar greenhouse technology is to convert the 1,5 million ha industry into the largest producer of solar energy and is the core component of the "Solar Power Village".

The Solar Power Village is to harness solar radiation to supply energy, water and food to the rural areas of developing countries. The cultivation of agricultural products in the solar greenhouse provides first of all food (1); in addition, it generates thermal energy which is stored for day and night cooking (2), for round-the-clock electricity generation via a Stirling engine (3) and to provide mechanical energy to drive mills or water pumps (4).

The Company

Sunvention was established in 2004 as a joint venture of Solar Dynamics GmbH (Lörrach) which has been in the R&D business of solar technologies for over 30 years and EBF GmbH (Heppenheim) .

Sunvention pursues a business policy of developing and marketing sustainable, economic and ecological products to save energy and to generate renewable energies. Working with international partners active in the greenhouse and solar market, Sunvention plans to equip 20 hectares of greenhouses in the USA and in Spain with its solar energy systems within the next 5 years. This corresponds to a 40 GWh installed performance and to a 20,000 tons CO_2 reduction per year..

Sunvention will use part of its profits to build "Solar Power Villages" in disadvantaged regions to supply sustainable and economical energy, water and food.

EBF BSR Solar Technologies

SOLAR POWER VILLAGE Energy

SOLAR POWER VILLAGE Food

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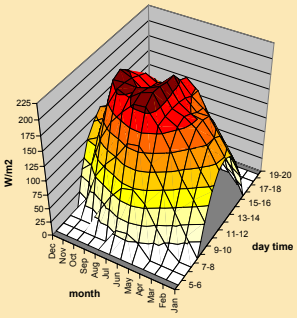
A Multifunctional System

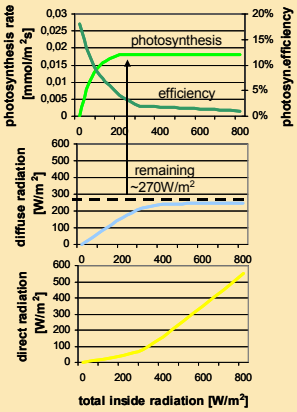
Sunflower: A concentrating solar technology

The optical system of Sunflower concentrates the direct sun light, converts it into useful energy and thus protects the greenhouse from overheating. The solar energy system can be integrated also in other architectural structures such as in buildings or can be employed as large-scale solar power plants. Depending on what type of energy is to be generated the system is equipped as follows:



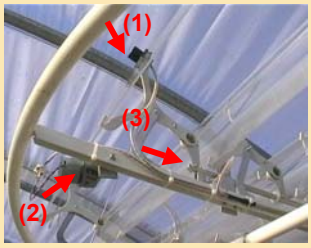
• **Concentrator PV-Modules**
Concentrator solar cells which are cooled on both sides generating electricity with a high efficiency due to a low cell temperature in spite of being exposed to concentrated solar radiation. The cooling medium absorbs thermal energy which is stored for heating up the greenhouse during cold nights.

• **Thermal Absorber**
High-vacuum collector tubes generating thermal energy at temperatures up to 400^{0}C+. The heat can be used as industrial process heat, for water desalination or for powering thermodynamic converter for the generation of electricity.



• **Maximizing Photosynthetic Active Radiation**
Plants require a certain part of the solar spectrum for photosynthesis. Employing a specific pigment solar radiation which is not active photosynthetically is shifted into the photosynthetically active spectrum thus increasing plant growth.

The lenses of the Sunflower are always perpendicular to the sun. A sensor (1) controls two motors, one for the elevation tracking (2) and one for the azimuth. A guide rod (3) keeps all lenses are parallel to each other.

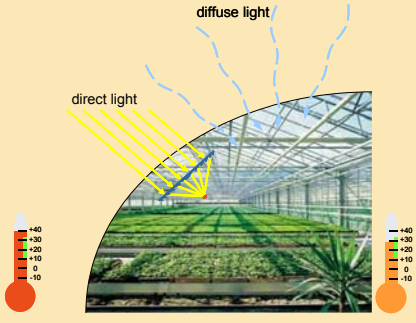


The light penetrating the greenhouse interior is about 300W/m^2 and diffuse thus ideal for plant growth.

Concentrating Photovoltaic

For the generation of electricity from solar radiation there are attractive alternatives to flat-plate photovoltaic modules, for instance, solar thermal power plants. Large solar-thermal projects are planned in Spain in regions with high irradiation (kWh/a) and , at the same time, with a high density of greenhouses (30'000 ha).

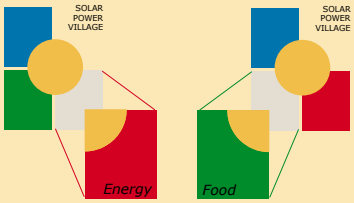
Another alternative are concentrator photovoltaic systems which require less cell material for the same electrical output. The use of triple junction cells in concentrating systems is especially attractive since they have an efficiency of up to 35% thus achieving when employed in large volume electricity generating cost of below 10 €-cent per kWh.



Envelope Technology

Concentrator system require accurate tracking. When operating outside and exposed to wind and weather they require extensive and heavy structures. These systems are expensive and thus diminish the economics of solar power plants.

The Sunvention envelope technology protects the solar systems from wind and weather with a thin and highly transparent fluorpolymer cover. This light weight construction reduces investment cost significantly. The fluorpolymer foil transmits UV-radiation important for plant growth especially for color and flavor.



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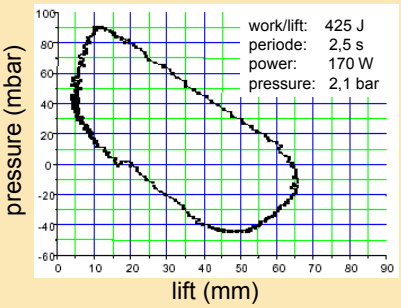
Solar-Powered Water Pumps

Sunpulse: The solar-thermal water pump

In sunny developing countries, the majority of the population depends on home-grown agricultural products. For this, high productivity of small plots of land and the cultivation of new agrarian land is essential – and both need irrigation.

Efforts to expand the irrigation potential lead to the conclusion that large dam projects are less efficient and cost more than smaller solutions. Since investment-intensive channel systems often result in distribution conflicts, small farmers prefer small-scale irrigation systems with clear property rights and no large-scale intrusion into the environment.



The solar-powered water pump Sunpulse, a low-temperature Stirling engine powered by unconcentrated solar radiation, is a small-scale pumping system ideally suited for decentralized irrigation systems. Sunpulse pumps surface water or ground water from up to 60 meter depth. The performance meets the water needs for a family. The sun powers the pump, an environmentally friendly and cost-efficient solution.

The pump can also be employed to provide drinking water. Today, water pumping in agrarian countries with conventional pumping systems requires a large share of the electricity production. The solar-thermal water pump greatly contributes towards securing the growing energy demand in sun-belt countries.

Starting Serial Production

Unlike water pumps powered by photovoltaic modules, the solar-thermal pump can be produced with the simple facilities available in sun-belt countries. This strengthens the rural economy and production costs in line with the local spending capacity are realized.

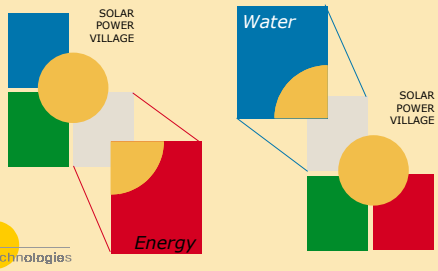
After years of development, this unique technology is about to enter serial production. Today, Sunvention is looking for partners qualified by their technical know-how, profound marketing knowledge and solid financial means who will engage in the start of production in their respective country.

Stirling Technology

Stirling engines were invented by the Scottish minister Stirling around 1800. In a closed container air is heated up and cooled down cyclically, generating pressure fluctuations which in turn are converted by way of a working piston into mechanical energy.

Stirling engines can be powered by various heat sources and be operated at different temperature levels. Usually, high temperatures are used by burning fossil fuels, biomass or by using the energy from concentrated solar radiation.

This pumping system is a low-temperature (operating at 120^{0}C to 200^{0}C) Stirling engine powered by unconcentrated solar radiation. Slow movement and a robust construction promise long life and low maintenance.



EBF BSR Solar Technologies

UVitt Wasserentkeimungs-Systeme

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Germ-Free Drinking Water

UVitt: Efficient water purification

The UVitt water purification system has been developed and is being manufactured and locally distributed in cooperation with the Indian Partner Integral Technologies Pvt. Ltd. in Pune, India.

Among other installations, 80 UVitt InstaFLO units have been installed in 80 Indian schools. The UV disinfection is equipped with a filtering system to clean dirty water priot to the purification process. Various installations have been also realized in Africa and Asia in cooperation with GTZ Eschborn, a technical aid association sponsored by the German government.

Germ-free water is vitally important in developing countries saving human lives. Worldwide 1,2 Billion people have no access to clean drinking water and sanitary facilities. Each year, about 250 Million people get ill due to polluted water, 5 Million die of it.

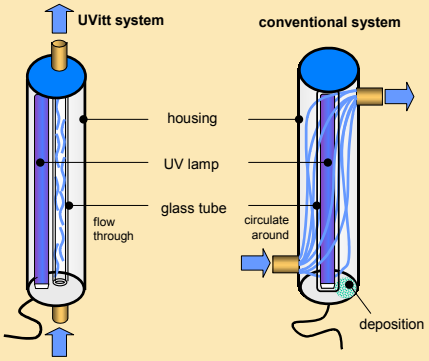
The UV purification requires no chemical additives and leaves no harmful residues. Energy needed for the 16 Watt UV-lamp can be supplied by a photovoltaic module.

Applications in Europe

Apart from drinking water treatment, UV disinfection is applied in industry and in special fields: Process water, cooling water and waste water is kept free of micro-organisms. Swimming pools, fountains and ponds are further applications.

UV disinfection gains in importance to keep air-conditioning systems clean. The residues of the common biocides in the air constitute a sanitary long term problem.

UVitt systems can efficiently fight legionaries' disease. The air space between the UV radiator and the glass tube through which the water flows allows the purification of warm water without impairment of UV-lamp efficiency. The patented arrangement enables a rapid turbulent flow, which prevent the formation microbiological films and deposits.



UV Purification and Ozone

UV light of 254 nm is highly effective in killing germs. The energy intensive radiation damages the DNS and therewith inactivates the micro-organisms in the water. Harmful bacteria die within seconds.

Ther water treatment systems adds ozone generated outside the system, which oxidizes and neutralizes organic compounds. The UVitt system generates automatically O_3 inside the UV chamber which is sucked into the water flow by a Venturi injector.

The UVitt system is an economic, simple and efficient water treatment system ideally suited to improve hygienic conditions worldwide.

EBF UVitt

Water
SOLAR POWER VILLAGE

Mobile with Plant Oil

Jatropha: Promising Fuel Source from India

Jatropha

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Bio-Diesel has become competitive to fossil fuels. However, for one source of bio-diesel, the rape-plant, the ecological impact is disputed since the cultivation and processing require a significant amount of energy. But there is an interesting alternative to rape-methyl-ester (RME). Although many vegetable oils may qualify to satisfy the growing demand for fuel the Jatropha plant has very promising aspects:

• **Resistant, toxic, high yield:** The toxic nut is widespread in the tropics, it is resistant but cannot be used for other purposes than fuel. Compared to the rape-plant, it generates three times more oil per hectare.

• **Waste land turned productive:** Due to the modest demand in respect to soil quality and water Jatropha is a good pioneer plant. Cultivation on waste land prevents erosion and agriculture can be conducted in the shadow of the Jatropha scrubs.

• **Employment and earnings:** New agrarian land is developed and rural jobs are created thus migration to the slums of the cities can be prevented.

Jatropha cultivation is already promoted in several states of India. Even a well-known car manufacturer supports the research of Jatropha-biofuel. Instead of being constrained by rising crude oil prices, the Indian economy could cover its growing energy needs internally with renewable sources, enabling its important agricultural sector a promising future.

Links:

Jatropha
www.jatrophaworld.org
www.jatropha.de
www.uni-hohenheim.de
www.daimlerchrysler.com

Alternation plant oil motors
www.biocar.de
www.pflanzenoel-motor.de
www.elsbett.de

Supply of plant oil fuel
www.biotanke.de
www.rerorust.de
www.biodiesel.de

Vegetable Oil in the Tank

Depending on car fuel-efficiency one hectare of Jatropha cultivation supplies fuel for about 50,000 km. The vegetable oil fuel can be produced locally.

Diesel engine with a small alteration can be powered with pure vegetable oil. Due to high viscosity the fuel has to be preheated. Some people are already today driving their cars with recycled frying oil. Others mix the vegetable oil with diesel and have driven thousands of kilometers without any alterations.

Alterations of diesel motors for using plant oil are offered by several garages. Plant oil can be bought in the super market, from oil mills or at bio petrol stations. In Germany, it is considerably cheaper than diesel.

Jatropha with EBF

The alteration of our company car to be powered by vegetable oil is only the start of our commitment to renewable fuels.

We aim to enhance the publicity of plant oil as renewable fuel and contribute to a user friendly distribution in Germany.

In addition our interest is to promote the ecological and economically promising business of Jatropha cultivation using our connections in India. Do you want to be a partner in this?

SOLAR POWER VILLAGE

Energy

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Agri-culture