

VATIS UPDATE

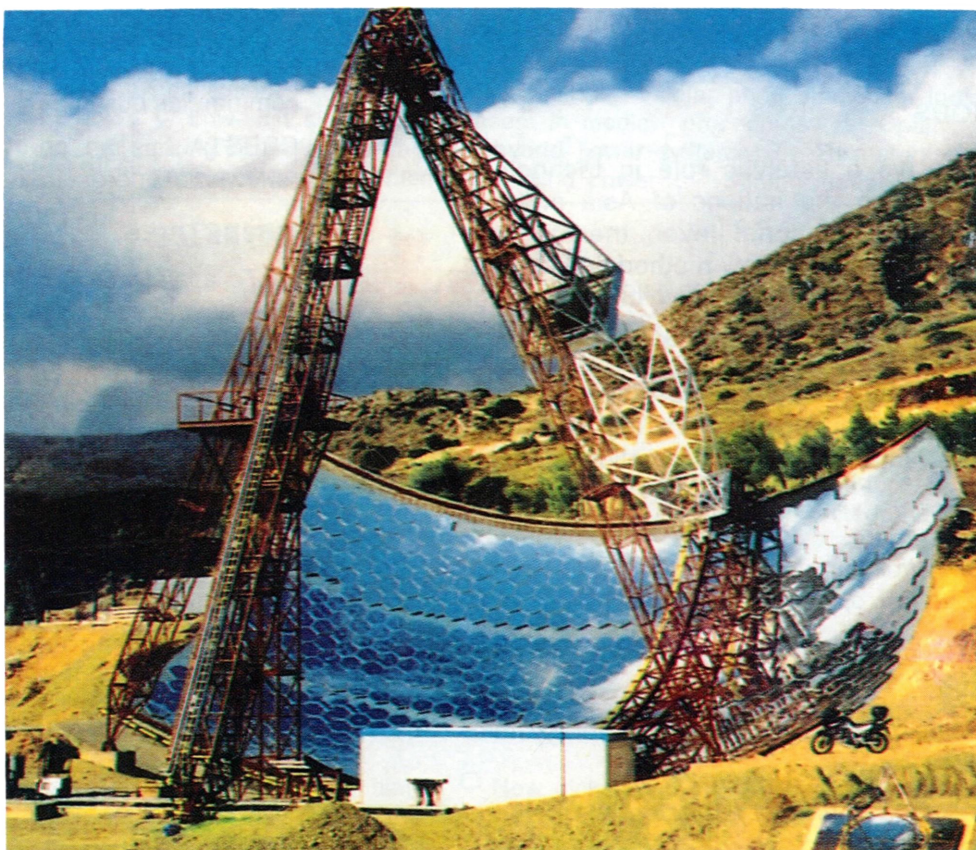
Non-conventional Energy

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Highlights

- Consultancy and advisory services
- Solar energy from coal mines
- New tool for wind energy projects
- Nickel alloys in geothermal plants
- Solar pond studies in India
- Affordable solar power generator



APCTT



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CRESTA

A P C T T

The Asian and Pacific Centre for Transfer of Technology (APCTT), established in 1977, is a UN regional institution under the aegis of the Economic and Social Commission for Asia and the Pacific (ESCAP). The Centre receives overall policy directions from the annual ESCAP sessions, and specific guidelines from the yearly meetings of its Governing Board and Technical Advisory Committee.

OBJECTIVES

- *The statute of the Asian and Pacific Centre for Transfer of Technology defines the organization's objectives as: to assist member and associate member countries of ESCAP, through strengthening their capabilities to develop, transfer, adapt and apply technology; improve the terms of transfer of technology; identify and promote the transfer of environmentally sound technologies relevant to the region.*

METHODS

APCTT plays a catalytic role in technology transfer among the nations of Asia and the Pacific. At the national level, the Centre's approach is to evolve new methodologies, and pilot tests to demonstrate their usefulness for eventual adoption by member countries. At the enterprise level, the main emphasis is to assist small and medium enterprises in technology acquisition, adoption and upgrading through its technology information and promotion services.

SERVICES

- *Information on technology, business and investment opportunities.*
- *Matching of business partners, and search for technology worldwide.*
- *Training, consultancy and technology evaluation.*
- *Assistance in project financing and contract negotiation.*
- *Market studies and marketing assistance.*

C R E S T A

The Centre for Renewable Energy Systems Technology Australia (CRESTA) is a University Research Centre within the School of Electrical and Computer Engineering at Curtin University of Technology, in Perth, Western Australia.

The Centre is active in pure and applied research and development in the general area of renewable energy systems technology. Innovative developments are rapidly turned into technologies that are used in a wide range of national and international industry-based projects. The Centre has long and strong collaboration with a number of key industry partners in Australia and overseas.

CRESTA is a founder and a major node of the Australian Co-operative Research Centre (CRC) on Renewable Energy, and responsible for the power conditioning programme, which is aimed at developing improved power electronics converters for interconnection of renewable energy sources with conventional power generators, rural distribution lines, battery storage and power in commercial buildings.

CRESTA has an on-going industry-sponsored renewable energy training programme.

OBJECTIVES

- *To assist the industry with R&D projects in renewable system technologies.*
- *To provide advice to governments and industry on matters related to renewable energy technology.*
- *To provide opportunities for education and training through courses for technicians, engineers and managers.*
- *To participate in major demonstration projects in Australia and overseas.*
- *To involve in technology transfer and commercialization.*

SERVICES

- *Research, Development and Commercialization*
- *Technology Transfer*
- *Consulting*
- *Education and Training*
- *Information Services*

Cover Photo
Demonstration of a solar energy generator that can
power 100 households.
(Source: British Commercial News, Sep/Oct 99)

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Nov - Dec 1999

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Non-conventional Energy
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relevant and latest technological
developments and events in the field of
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tailored to policy-makers, industries and
technology transfer intermediaries.

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ASIAN AND PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY

Adjoining Technology Bhawan

Qutab Institutional Area

Post Box No. 4575

New Delhi 110 016, India

Tel: (91) (11) 6966509

Fax: (91) (11) 6856274

Tlx: 31 73271 APCT IN

E-mail: postmaster@apctt.org

Internet: http://www.apctt.org

CENTRE FOR RENEWABLE ENERGY SYSTEMS TECHNOLOGY AUSTRALIA

School for Electrical and

Computer Engineering

Curtin University of Technology

Perth, W.A., Australia

Tel: (61) (8) 9266 2960

Fax: (61) (8) 9266 3107

E-mail: cresta@cc.curtin.edu.au

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IEC standard for the use of renewable energies

The International Electrotechnical Commission (IEC) has formulated a standard that describes specifications for using renewable energies in rural decentralized electrification. IEC/PAS 62111 (1999-07), a publicly available specification, states the functional parameters on which the design, implementation and exploitation of the constituent parts of rural electrification systems should be based. It tries to establish a common standard for use as a reference to assess the quality of such systems.

IEC/PAS62111 was submitted by Electricite de France (EDF) through the French National Committee of IEC and has been processed by IEC Technical Committee 82 (Solar PV energy systems). PAS62111 is also relevant to the activities of TC 21 (Secondary cells and batteries) and TC 88 (Wind turbine systems). It is presently available in downloadable PDF format.

*JP-Just Published,
Vol. 1, Issue 8, August 1999*

Market-oriented renewable energy project in India

India-Canada Environment Facility has awarded a grant of US\$655,000 to the Tata Energy Research Institute (TERI), India, to implement renewable energy technologies (RETs) in rural parts of the country through non-governmental organizations (NGOs). The aim is to develop sustainable alternative approaches for implementing rural energy programmes by focusing on a community-based implementation and financing strategy. The projects will be implemented in the districts of Jabhua, Dehra Dun and Bikaner. Barriers identified

in dissemination of RETs will be eliminated by various measures like training, capability building, soft loans and integration with other development priorities.

*TERI Newswire,
1-15 September 1999*

ORMAT plans to develop geothermal energy in China

ORMAT Holding Corp. and Yunnan Province Geothermal Development Co. Ltd., China, have entered into a joint venture agreement for exclusive electric power development of geothermal sources in China's Teng Chong County, western Yunnan province. Under phase-I of this project, a power plant will be constructed with a capacity of at least 12 MW. Related exploration and development will be carried out at the Rejai geothermal field. Total power potential of the steam field has been estimated at over 200 MW. ORMAT will own 85 per cent of stake in this joint venture and plans to sign a power purchase agreement with Yunnan Province Electric Power Corp.

*Geothermal Bulletin,
June 1999*

Upcoming EU directives for renewable energy

Two directives under preparation in the European Union (EU) will have a significant impact on the development of renewable energy in the Union. The most advanced is a revision of the EU Directive of State Aid, regulating the kind of subsidies and other measures EU nations can have to support – for example, renewable energy and energy-efficiency solutions. The text of this directive is presently being negotiated in the European Commission (EC).

The other directive is for regulating renewable energy in the open electricity market. A working paper has already been published and views elicited. Nine NGOs (Greenpeace, Climate Network Europe, COGEN, Friend of the Earth, European Wind Energy Association, Fodergesellschaft Windenergie, WWF, Bundesverband Wind Energie and the Business Council for Sustainable Future) proposed ten principles for the new directive, including national minimum targets of 8 per cent renewable energy in the electricity mix by 2005 and 16 per cent by 2010, with a minimum increase of, respectively, 4 per cent and 8 per cent.

*Sustainable Energy News,
No. 26, August 1999*

Solar projects start to meet financial goals

There is great financial news in the solar power industry. Long dependent on subsidies and grants, solar power is now starting to sell and stand on its own! PVs are an extremely small part of the electricity industry. Mr. Clay Aldrich of Siemens Solar, predicts about 150 MW of solar production worldwide this year – not an impressive amount considering that a large utility generator supplies about 1,200 MW. However, solar growth has averaged 20-25 per cent yearly over the last decade. Costs have declined from US\$100/W installed in the 1980s to less than US\$10/W today. In addition, there are several new applications that propel development and increased efficiency, resulting in more sales.

But solar power doesn't sell itself, so marketing and distribution had to be tackled. Siemens concentrated on markets where products sell without a subsidy. A shortlist includes phone repeater stations in remote areas, message boards along highways, farm products and importantly,

householders or commercial developers who want a bit of energy independence. Siemens and the World Bank have done studies on various potential projects involving PVs. Results show that solar is handy where utility connections are too costly. In developing countries, for instance, small solar systems can provide light and communications inexpensively – often cheaper than candles or kerosene lighting in the long run. As a consequence, sales have grown.

Today, the large players are building factories and operating three shifts a day. AstroPower, headquartered in northern Delaware, is one of solar's success stories. Started in 1983, it recently allied with General Public Utilities to sell 1 to 4 kW units. More than 100 of its units have been delivered, including hardware to interconnect with a power grid and storage battery bank, and are viable anywhere. AstroPower says that system costs have declined about 8 per cent a year, a trend expected to continue. The company last year reported US\$23 million in sales, an increase of more than 39 per cent from 1997's US\$16.6 million.

Sarah Howell, spokeswoman for Solarex, another big player in the PV business, agreed that the business is competitive right now. About 75 per cent of domestic PV production is exported, she said. Japan and Germany are big markets with environmentally conscious governments that support solar power. But both countries offer more than lip service. Japan provides a 50 per cent subsidy for PVs. That will decline over the next few years on the expectation that PV costs will decrease enough to be an attractive purchase. On the other hand, Germany offers a rebate to householders who generate their own power.

Trends in Renewable Energies,
#95, 30 August 1999

Quest for cleaner electricity

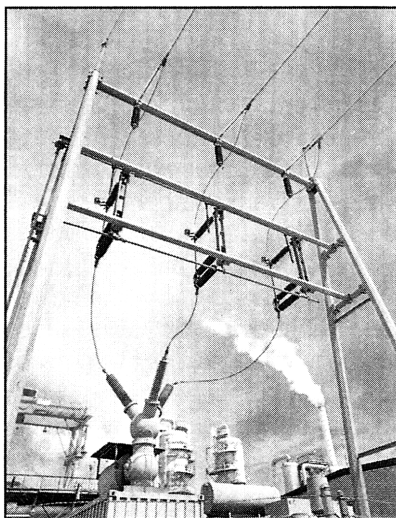
Depleting oil and gas reserves, combined with growing concerns of global warming, have made it inevitable to seek alternative eco-friendly energy sources. Utilizing hot fluids generated naturally in the earth's crust to produce electricity is one such sustainable energy resource. This technology is being developed in nearly 22 countries around the globe where hot, corrosive geothermal brines are being tapped. Several difficult tasks are being faced by engineers in designing systems to bring brines to the surface, flash them to steam and turn turbines to generate electricity. Nickel-containing materials have been found to offer a reasonable and cost-effective solution to many of these challenges. However, at 8,240 MW, the global installed capacity of geothermal plants, this source alone cannot fulfil the world's energy requirement. At present, geothermal energy accounts for just one per cent of global energy consumption.

Another novel renewable source of energy is incineration of municipal solid waste in waste-to-energy facilities. On average, 80 per cent of the

dry weight of municipal solid waste is combustible organic material, a part of which is composed of plastics – including polyvinyl chloride (PVC). Incineration of chlorine compounds such as these and others results in the creation of hazardous substances, notably dioxins. Fortunately, dioxin emissions can be effectively minimized to conform with even the most stringent air pollution control legislations by maintaining optimal combustion conditions and by rapid cool-down of flue gases through the 250°-400°C range.

In Japan, an 8-year private/public sector project to develop a waste-fired power plant that can operate at 30 per cent efficiency is nearing completion. A key part of this project is the application of new nickel-containing, corrosion-resistant alloys that are required for high temperature superheaters. These alloys exhibit exceptionally good resistance to high-temperature chloride attack, which is a constraint to raising steam conditions in today's waste-to-energy plants. It is therefore clear that nickel-containing materials will play a commendable role in solving formidable engineering as well as environmental challenges of providing clean and sustainable sources of electricity.

Nickel, Special Issue,
August 1999



A geothermal facility

Solar home lighting systems in India

Shell Renewables India (P) Ltd., a wholly owned Shell group company, plans to launch solar lighting units in India. A survey conducted in four southern states indicated Pollachi, in Tamil Nadu, to have a high potential for the new Solar Max lighting system. Solar Max variants range between US\$150-500 depending on the lighting system, from a single point lighting to six points. Shell is presently consulting with various

financial institutions and banks for providing easy finance schemes.

*TERI Newswire,
1-15 August 1999*

Consultancy and advisory services

PV Energy Systems (PVES) of the United States offers advisory and consultancy services to the photovoltaic (PV) industry. Its services include comprehensive financial advice and services and assistance to clients with key strategic and competitive analyses. PVES can provide in-depth evaluation of PV industry's leading edge technology options including all cell materials, concentrators, crystal growth, ingot casting, sheet growth, packaging materials and processing technology. It has considerable experience in projects related to solar home systems, PV lanterns, PV-powered light emitting diode (LED) lights for many applications, PV for portable electronics, PV-powered automobiles, battery packs of nickel metal hydride, PV-powered radio-controlled gliders and others. *Contact: PV Energy Systems Inc., 4539 Old Auburn Road, Warrenton, VA 20187, the United States. Tel/Fax: +1 (540) 3494 497; E-mail: pvenergy@crosslink.net; Internet: <http://www.pvenergy.com>.*

Solar to power fuel stations in Australia

Fuel service stations in Australia will switch to PV modules at new installations built by BP Australia, a subsidiary of BP Amoco. The use of solar power will improve energy efficiency at the sites and help reduce emission of greenhouse gas. The next solar powered service station will be opened in Perth this month, and five more will be installed around Australia by the end of this year. PV modules will be installed at 200 new

service stations in 11 countries in the first phase of a two-year, US\$50 million project. Utilization of solar power will displace the emission of 3,500 tonnes of carbon dioxide each year from conventional electricity generation equipment. BP Amoco has announced a goal of increasing its sales of PV modules by ten-fold, to reach US\$1 billion worldwide.

*Trends in Renewable Energies,
#96, 6 September 1999*

Japan warms to wind energy

Twenty wind turbines have been installed in the coastal town of Tomamaecho, Hokkaido, Japan, to produce electricity under the nation's first long-term, commercial contract between a private and public electricity company. The general trading company, Tomen, will begin testing the turbines in October and then sell the power to Hokkaido Electric Power under a 17-year contract. The windfarm has a generating capacity of 20 MW. Tomen plans to construct a 60 MW windfarm in Higashidori-mura, Aomori Prefecture, which will make it the largest source of wind power in Japan. Another 30 MW facility in Tomamaecho, near the Tomen facility, will be constructed in December 2000 to capture winds from the Sea of Japan.

The government of Tachikawamachi, Yamagata Prefecture, has three small United States-made turbines, while a private company operates four Danish units. Two more turbines will be installed by March to provide some positive benefits for strong wind that damage crops and cause severe storms in winter. The turbines will generate 30 per cent of electricity by the end of the year, and the town's energy policy will increase that level to 36 per cent by next year. Tachikawamachi has a number of facilities to promote wind-generated

power, including a Windome that demonstrates electric carts powered by wind power. Also, it has become a national centre for the Japanese government and companies that are interested in renewable energy.

There were 107 turbines in Japan at the end of last year, according to government data, which received support through subsidies. Their total capacity is more than 30 MW, but most units are used for experimental or private purposes. There is a grass-roots movement in Japan to expand green energy, including an initiative by residents of Sapporo to form a non-profit organization that collects a premium of five per cent from its members, with which it will construct a wind power plant. *Contact: Internet: <http://www.yomiuri.co.jp/newse/0828so21.htm>.*

*Trends in Renewable Energies,
#96, 6 September 1999*

Solar energy from coal mines

In Germany, an education and office complex is being constructed on Herne's Mont Cenis mine's 7 ha site. The main attraction of this complex is a glass-based roof that incorporates 10,000 m² of PV modules. The 3,000 modules installed here will produce 750,000 kWh/y of power, making it the largest of its kind in the world. Power from this installation will be used to fulfil electricity requirements of the 16,000 m² complex housing the Advanced Training Academy of the state of North Rhine-Westphalia's Ministry of Interior Affairs, plus lodging, restaurants, offices, a communications centre and a library. *Contact: Mr. Uwe Burghardt, Haroldstr. 4, D 40213, Dusseldorf, Germany. Tel: +49 (211) 866 42-0; Fax: +49 (211) 8664 2222; E-mail: burghardt@lus.com; Internet: <http://www.energieland.nrw.de>.*

Common Ground, 2, 1999

Solar-powered drier

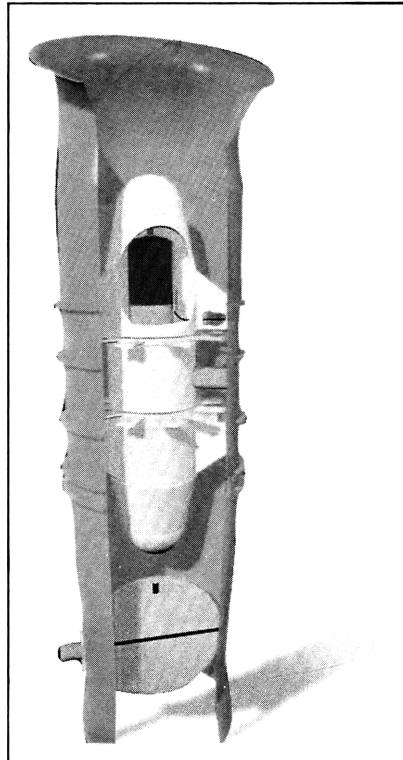
The Society for Energy, Environment and Development (SEED) in India has developed a solar-powered drier, under a UNDP project, for dehydration of fruits, vegetables, honey and forest produce. The drier maintains a temperature about 15°-30°C higher than the ambient temperature and is available in four models with capacities ranging from 2 to 50 kg.

The drying process incorporates integrated solar thermal and solar photovoltaic technologies. A maximum temperature of 70°C can be achieved in forced circulation mode. The zero-energy units conform with international cleanliness standards, have forced circulation with solar fan and are guaranteed for ten years. Electrical heaters are provided for back-up. Mango, papaya, guava, grapes, tomato, carrot, ginger, mint, curry leaves, coconut, honey, etc., can be dried in these driers.

*Processed Food Industry,
September 1999*

New systems to harness energy from oceans

Wavegen, the United Kingdom, has developed a land-installed, marine-powered energy transformer (LIMPET) to supply power to small island communities. LIMPET 500 has been designed to operate right on the shoreline, relying on an existing cliff edge for support, and can produce 0.5 MW of energy. It employs the oscillating water column (OWC) principle and uses a combination of Wells turbines and induction generators to convert the pneumatic power captured into electricity. Aerodynamic designing and the use of appropriate materials in the construction of the turbine generators has resulted in reduction/elimination of noise. Automatic shutdown and



Turbo generator

fail-safe systems ensure personnel safety, apart from protecting the device and associated power system in case of grid connection failure or extreme weather conditions. These units can also be incorporated within rubble mounds or caisson breakwaters.

The company has also developed an ocean swell powered renewable energy (OSPRED) wave energy unit to harness power from ocean waves. OSPRED 2000 systems, based on the OWC principle, have a power rating of 2 MW. Designed to operate in the near-shore environment at a depth of about 15 m, these systems perform optimally when driven by a long ocean swell generated over a fetch of more than 400 km. During extreme storms, the incoming power will be greater than the device capacity and the automatic control system will cap generation at the maximum rating. OSPRED systems also offer the same noise and safety features available in LIMPET 500. It is ideal

for supplying energy to an existing grid or as a prime source for remote island communities. The addition of a marineized wind turbine to an OSPRED system creates a wind and ocean swell power (WOSP) unit. The extra structural loading from a wind turbine of up to 1.5 MW is low compared to the wave loading for which the OSPRED structure is designed.

Some novel features of the aforesaid systems include:

- Modular composite steel/concrete construction;
- Minimal environmental impact;
- Rapid system build and installation; and
- 60-year structural design life with 20-year M&E plant upgrades.

LIMPET 500 and OSPRED 2000 have been designed as components for incorporation in coastal defence, breakwater, land reclamation, harbour wall construction or as stand-alone units. *Contact: Wavegen, 50 Seaford Road, Longman Industrial Estate, Inverness IV1 1LZ, the United Kingdom. Tel: +44 (1463) 238 094; Fax: +44 (1463) 238 096; E-mail: enquiries@wavegen.co.uk; Internet: http://www.wavegen.co.uk.*

Micro-cogeneration system developed in Switzerland

In Switzerland, Ecopower Energy Solutions AG has developed technology for micro-cogeneration. The various parts of the ready-to-install unit include a control panel, exhaust heat exchanger with catalytic converter, engine, generator, muffler, heat exchanger, electrical connections, gas supply, air intake/exhaust and heating connections.

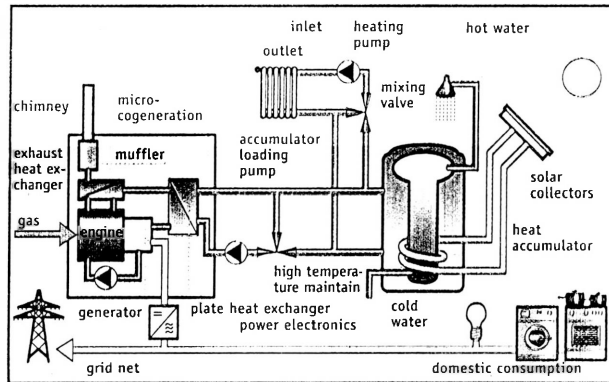
The modulating output micro-cogeneration unit is especially suitable for single-family house application. In

larger buildings (e.g. small industries, office units, etc.), its bivalent application is used to cover the base energy load, completed by an additional system for heating. For an optimum utilization rate of fossil energy, co-generation along with a heat pump brings the global efficiency to more than 160 per cent.

A newly developed operation interface with a turning press button provides the user with the opportunity to adjust, at any time, the units for personal requirements of heat and power production. This menu-led programming tool is user-friendly and does not necessitate an in-depth study. For maximization of system readiness, the micro-cogeneration maintenance interval are spaced out as approximately every 4,000 running hours. Maintenance/service procedures would be limited to an oil change, filters and spark plug change, exhaust measurement as well as a general inspection. Security standards of the unit are in accordance with the European C.E security regulations.

The robust single-cylinder engine and its 3-way catalyst achieves low NO_x emission values similar to a gas heater. These values are well below the Swiss Clean Air Act for stationary engines. Apart from environmental benefits, depending on local power tariffs, micro-cogeneration also offers economic returns. Cost-effectiveness of this unit is based mainly on electricity produced in place of the public grid power net. This advantage guarantees the user short-term and middle-term productive investment.

Contact: Ekopower Energy Solutions AG, Bozingenstrasse 39, CH 2500, Biel-Bienne 4, Switzerland. Tel: +41



Principles of micro-cogeneration

(32) 3442 009; Fax: +41 (32) 3416 563; E-mail: ekopower@spectraweb.ch.

New tool for wind energy projects

Ekopower, the Netherlands, has developed a low-cost windlogger to provide accurate and reliable wind data. It is an essential tool to carry out feasibility studies, meteorological studies, evaluation of wind energy projects and wind turbine testing. Data thus obtained can be used to calculate the energy production for any wind turbine with known power curve. EKO 20B can measure average wind speeds with an accuracy of 0.2 m/s (or 0.1 m/s with special calibration certificate) instead of the normal 0.5 m/s (according to the World Meteorological Organization/ American Wind Energy Association standards).

EKO 20B has a non-volatile memory card, with memory capacity up to 80 MB and is expandable up to 128 channels (analogue, counters, etc.). It also offers additional communication options (telephone, satellite, GSM). It can even be used to form the core part of a whole wind test facility, with optional channels for air temperature, atmospheric pressure, power, turbine status, rainfall, rotor speed, etc. The energy storage capacity of a stand-alone system can also be estimated by comparing the wind

energy production with the energy consumption pattern, which can be determined by the EKO 20B. The channel specifications of this research-quality windlogger are:

- Wind speed recording (range 0-51.40 m/s) - average, standard deviation, maximum gust. Resolution 0.01 m/s (average wind speed and standard deviation), 0.05 m/s (instantaneous wind speed and gust speed); and
- Wind direction recording - polar average values, resolution 0.5°.

The innovative SODDAR system is intended for vertical profiling of wind speed and wind direction. The small flat array antenna is designed for mobile installation (32 kg). The 64 speakers can produce nine beams in ten frequencies between 1,650-2,750 Hz. Wind measurements in layers of 15 m; vertical range 15-500 m.

Dataloggers are also available for solar energy, energy management, environment, meteorology and other general purposes. *Contact: Ekopower, P.O. Box 4904, 5604 CC Eindhoven, the Netherlands. Tel: +31 (40) 2814 119; Internet: <http://www.IAEhv.nl/users/ekopower>. Or Mr. J.W. Pronk, Ekopower/Wittich and Visser BV, P.O. Box 1111, 2280 CC Rijswijk, Holland, the Netherlands. Tel: +31 (70) 3070 706; Fax: +31 (70) 3070 938; E-mail: info@ekopower.nl; Internet: <http://www.ekopower.nl>.*

Cyclist Promotes Renewables

A 43-year-old Illinois man intends to cycle across the frozen Bering Strait to call attention to research on solar and wind energy. Mr. Robert Kennedy has cycled 5,800 miles from Florida to Alaska and wants to be the first person to cycle the 700 mile frozen Bering Strait to Russia in March.

(Trends in Renewable Energies, No. 95)

Nickel alloys in geothermal plants



Highly corrosive geothermal brines from inside the earth are brought to the surface and flashed to steam to run turbines at this plant in Heber, the United States

In the United States, steam from deep below California's Imperial Valley is used to generate electricity with the help of nickel alloys. These alloys are used in the surface facilities where electricity is generated from highly corrosive steam tapped from depths of up to 3,000 m. Unocal, the world's leading producer of electricity from geothermal sources, conducted a six-year programme to test various nickel alloys in geothermal brines containing dissolved solids ranging from 13-30 per cent and with a pH of 5.1-4.6. Corrosion data were collected to identify alloys capable of withstanding the corrosiveness of hot brines. *Contact: Internet: <http://www.geothermal.org> Or <http://www.unocal.com>.*

Nickel, Special Issue, August 1999

Solar-powered water purification

In Japan, NTT has developed and tested solar-powered water purification systems at two locations – one at Shin-Mitsuke moat and the other at Mitsugi Park pond. The disk-shaped system has a diameter of

about 10 m and has a unique floating structure. It uses electric power generated by solar cells installed on the roof and electric power stored in the power storage equipment for telecommunications in case of exigencies. Under normal conditions, energy is used for charging the power storage equipment and water puri-

fication. The system consists of the following units:

- An aeration unit that ejects water including air to supply oxygen into the water for the purpose of improving the oxygen content in water and restricting the generation of hydrogen sulphide that causes an unpleasant smell;
- A filtering unit to remove suspended solid matter;
- A phosphorus adsorption unit designed to separate phosphorus in water to reduce the speed of algal growth; and
- A pressure unit designed to add pressure to the surface water, which contains phytoplankton, and reduce the proliferating ability of plankton.

The maximum water capacity processed by each unit is 216 t, 144 t, 36 t and 20 t per day for aeration, filtering, phosphorous absorption and pressurizing, respectively.

In the energy system, single crystal silicon solar cells were employed because of their excellent power generation efficiency. The 62 solar battery panels can generate 5 kW at peak performance. Annual power generated is estimated to be about 6,000 kWh. Satisfactory results from the two experimental sites could result in more systems being installed at other lakes and marshes around the country.

Journal of Scientific and Industrial Research, Vol. 58, September 1999

Wafer-thin solar cells

At the University of Florida, the United States, researchers have developed solar cells that are thinner than a human hair and can be moulded to fit on any surface. Such cells can be produced easily and more cheaply than existing solar panels, which have to be made from wafers of ex-

pensive semiconducting material. The new panels are produced by placing an extremely thin film of a new material called copper-indium diselenide on to a base surface such as plastic or glass.

*TERI Newswire,
1-15 August 1999*

Solar pond studied in India

The Tata Energy Research Institute, Delhi, India, constructed a 6,000 m² solar pond at a milk processing plant, in Bhuj, to supply process heat. An inexpensive lining scheme comprising alternating layers of clay and low-density polyethylene combination was used for lining the pond. A maximum temperature of 99.8°C was recorded in May 1991. The lining scheme had to be later redesigned as a result of leakage caused by high stagnation temperature and large air pockets below the liner. The new lining scheme was completed in June 1993 and hot water was supplied to the dairy from September 1993. *Contact: Tata Energy Research Institute, Darbari Seth Block, Habitat Place, Lodhi Road, New Delhi 110 003, India. E-mail: akumar@teri.res.in.*

*TERI Information Digest on Energy,
Vol. 9, No. 2, June 1999*

Low-cost alternative to lasers in medical procedures

Researchers at Ben-Gurion University of the Negev, Israel, have developed a novel technique wherein concentrated sunlight can be used to replace lasers in medical treatment. In this process, sunlight is concentrated in two stages – with a paraboloidal dish primary mirror and a secondary dielectric concentrator – and then fed through a low attenuation silica fibre to the operating room.

Laser light has a high power density, is monochromatic and highly collimated. Concentrated sunlight can compete with laser in terms of power density, but cannot match its other two properties. As a result, cutting tissue with sunlight, for example, is not possible. However, for several other medical treatments only a high power absorption in the tissue is needed. Such treatments include tissue coagulation and welding, knee and shoulder surgery, hyperthermia treatment of tumours and angioplasty. One limitation of using concentrated solar light is that clear and sunny weather is necessary and so can be used only for non-emergency treatment. It was also observed that a solar surgical unit is about 10 per cent cheaper than current surgical laser with fibre-optic coupling.

Journal of Scientific and Industrial Research, Vol. 58, July 1999

Optimal sizing of battery storage for hybrid power systems

Researchers at King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia, have tried to determine the optimum size of battery storage capacity required for hybrid energy conversion systems (wind and diesel). Hourly mean wind speed data for the period 1986-97 were recorded at the solar radiation and meteorological monitoring station located at Dhahran in Saudi Arabia. The monthly average wind speeds for Dhahran range from 4.12-6.12 m/s. The hybrid system used in this study comprised two wind energy conversion systems (WECS), along with a battery storage system and a diesel back-up. The study investigated the impact of variation of battery storage capacity on hybrid power generation.

Results indicate that for economic considerations, for maximum use

of battery storage and for optimum operation of the diesel system, a storage capacity equivalent to 1-3 days of maximum monthly average daily demand needs to be used. Also, use of one day of battery storage reduces diesel energy generation by about 35 per cent and the number of hours of operation is reduced by nearly 52 per cent. *Contact: Energy Resources Division, Research Institute, King Fahd University of Petroleum and Minerals, Dhahran 31261, Saudi Arabia. E-mail: elhadidy@kfupm.edu.sa.*

*TERI Information Digest on Energy,
Vol. 9, No. 2, June 1999*

Research papers examine problems with wind power

The Centre for International Climate and Environmental Research, Oslo, Norway, has published three recent working papers on wind energy. *Institutional dynamics and barriers in wind energy development* notes that Tamil Nadu in India has about 719 MW of windfarm capacity, out of the nation's total of 992 MW, while Andhra Pradesh has 58 MW. A boom in 1995-96 saw 282 MW and 39 MW installed, respectively, after which there was a steady decline in windfarm development. The paper traces the reasons for the boom and the slump, and the role of institutions in disseminating wind energy. It concludes that rapid growth of wind energy development in these two states would require the creation of a "wind fund", establishment of co-operative windfarms, setting up of wind estates, linking generation to incentives for optimum production, promotion of reliable water pumping windmills and wind battery chargers for small-scale applications. *Institutional barriers to commercialization of wind power in India* examines government support for renewable

energy technologies in India, and the "disappointing" performance of wind power projects in the region. It examines the factors that constrain commercialization of wind power in India, which it argues are primarily institutional in character.

Wind energy technology development and diffusion provides an overview of the diffusion of small household wind generators and development of windfarms in Inner Mongolia, with emphasis on policy and institutional perspectives. It analyzes wind technology diffusion within social, economic and environmental contexts, which it links to institutional framework building, and identifies the major constraints of wind technology development. Contact: Internet: <http://www.cicero.uio.no/cgi-bin/order/publications>.

Trends in Renewable Energies,
#95, 30 August 1999

Stirling ideas

In the middle of the last century, the Stirling engine was one of the front runners in the race to provide power to an industrializing world. The first devices operating on the principles

of the Stirling engine, known as 'air engines', are believed to have been demonstrated as early as 1699. In the year 1816, Rev. Dr. Robert Stirling demonstrated an engine that gracefully combined the laws of thermodynamics in a balanced and viable mechanism. However, it lost out to its more powerful opponent – the steam engine. But interest is returning to the Stirling engine as it is safer, quieter and more efficient.

A Stirling engine is a closed-cycle, regenerative heat engine that uses an external combustion process. It operates on a closed, regenerative, thermodynamic cycle with cyclic compression and expansion of a working gas – e.g. helium or air. In its most simple form, a gas is heated in a hot chamber to expand and push a piston to do useful work. It is then cooled and allowed to contract, pulling on another piston before returning to be heated and start the cycle again. The Stirling engine can be constructed in two types, the two-piston type and the displacer type.

In the two-piston type engine, heat is delivered to the heat exchanger (hot piston). Gas pressure increases owing to the rise in temperature in a

closed volume. Increase in pressure pushes the hot piston, expanding the volume and causing work to be done. The movement of the pistons move the gas through the 'regenerator', where heat from the gas is stored. It then flows into the cooler section above the 'cool piston'. The gas contracts because of cooling, thereby lowering the pressure and effectively pulling the cool piston up. This drive mechanism continues through the cycle, moving the pistons in such a way as to move the cooled gas back to the hot end through the regenerator (where it picks up the stored heat) and the gas is heated again. The displacer type Stirling engine works in a manner similar to the two-piston engine, except that the displacer piston is not sealed within its chamber and it simply moves hot air from below, up to the cooler area above.

Alternative engines are being built and sold using the Stirling design to pump water, generate electricity and provide power to processing applications. It is attractive because of its superior performance over other heat engines, its simplicity of design and it can be adapted to run on almost any type of fuel. In the United States, Stirling Technology has developed a 5 hp motor called ST-5, which can be operated by anything that burns. When coupled to an electrical generator, ST-5 provides a power output of 3.5 kW.

In New Zealand, a Stirling generator has been developed to supply heat and electricity. The WhisperGen unit can supply sufficient hot water for a household, while simultaneously producing electricity for lighting, cooking and operating appliances. Any excess power from this unit can be supplied to the grid or, at times of deficiency power, can be drawn from the grid.

Australian Energy News,
June 1999

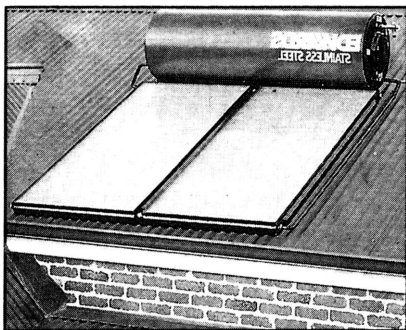


Hi-tech Stirling engine produced in Australia

Solar water heaters

Edwards Energy Systems Pty. Ltd., an ISO 9001 certified Australian company has been awarded the prestigious Australian Design Award. A leading player in solar technology, the company's solar heating systems offer maximum energy output, durability and reliable performance. They are maintenance-free, corrosion-free and environment-friendly.

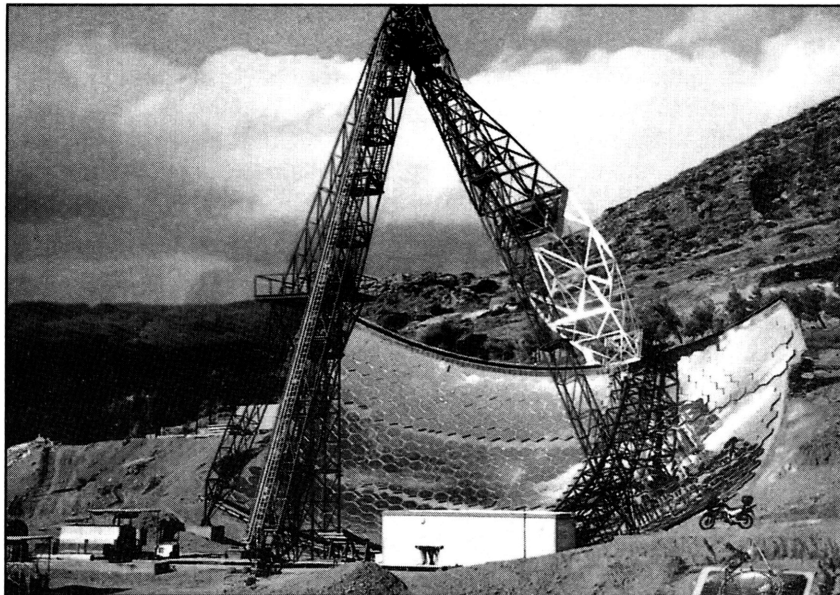
Storage cylinders of Solar Edwards' heating system is manufactured from marine grade 316 stainless steel. This facilitates storage of water at a higher temperature than feasible in the more common mild steel vitreous enamel cylinders. CFC-free compressed polyurethane, with a thickness of 65 mm at the top and 25 mm at the bottom of the tank, is used for insulation. The outer casing has been fabricated from BHP corrosion-free Colorbond™, with a variety of colour options available. The panels are made from copper and aluminium with a black Colorbond™ casing to enhance efficiency. Hot water units from 50-5,000 l storage capacity –



Solar heater

using a variety of energy sources such as electric, solar, oil and reject heat – can also be designed to suit individual requirements. *Contact: Edwards Energy Systems Pty. Ltd., 109 Vulcan Road, Canning Vale, Perth 6155, Australia. Tel: +61 (8) 9334 4222; Fax: +61 (8) 9334 4200; E-mail: edenergy@edwards.com.au; Internet: <http://www.edwards.com.au>.*

Affordable solar power generator



The solar energy generator at Crete that can power 100 households

Solargen, based in Cambridge, the United Kingdom, has developed a cost-effective solar system that incorporates some features of the most advanced solar systems but is cheaper. It is ideal for the remotest village in developing countries. In this system, concave mirrors are used to trap and concentrate solar radiation. The heated air, whose temperature can reach up to 1,000°C, is sucked into the system to drive a conventional gas turbine to generate electricity. The gas turbine can be used to produce energy even on cloudy days and during the night. The cost per kWh is estimated to be US\$0.11.

A prototype of the system has been built, on the Mediterranean island of Crete. It focuses sunrays with 800 m² of mirrors, fixed at ground level, to produce 35 kW of electricity. This system can also be used to desalinate water and in air-conditioning. *Contact: Solargen Europe Ltd., Bartholomews, Foxton, Cambridge CB2 6SU, the United Kingdom. Tel: +44 (1223) 208 544; Fax: +44 (1223) 208 545; E-mail: gen@solargen.com. Or World Energy Council, 34, St. James's Street, London SW1 1HD, the United Kingdom. Tel: +44 (171) 9303 966; Fax: +44 (171) 9250 452.*

British Commercial News, September-October 1999

Millennia photovoltaic modules

Millennia™ photovoltaic modules from Solarex, represent a major development in efficiency and stability, use advanced tandem junction thin-film technology to harness energy from sunrays. Thin-film solar cells are manufactured by depositing semiconductor alloys in thin layers on

glass. The resulting tandem-junction structure layers two solar cells vertically with each cell tuned for maximum conversion of different segments of the light spectrum.

Solarex's patented laser-scribing technique forms the individual solar cells and all inter-cell electrical links are internal to the module. Compared with conventional PV modules, the millennia modules require far less

silicon and substantially lower energy to manufacture. Up to 25 per cent saving is achieved as the millennia modules do not require protection for bypass diodes. Also, this monolithic structure uses only two solder points instead of the 400 or more solder points seen in other modules.

Millennia MST-43LV modules are fabricated with a strong, corrosion-resistant aluminium frame and has double thick glass for strength as well as maximum protection against humidity and moisture. These units offer superior performance in tropical or hot climates with less power loss than comparable modules. Systems with universal framing are provided with an optional charge controller, factory-installed in the junction box, to simplify on-site installation. *Contact: Solarex, 630 Solarex Court, Frederick, MD 21703, the United States. Tel: +1 (301) 6984 200; Fax: +1 (301) 6984 201; E-mail: info@solarex.com; Internet: http://www.solarex.com.*

Largest PV rooftop plant

The world's largest and most technically advanced rooftop photovoltaic plant has been installed on the roof of the New Munich Trade Fair Centre in Germany. It has a peak output of 1 MW and will feed the grid with one million kilowatt hours of solar power, thereby enabling the Centre meet its own power requirements. A total of 7,812 solar modules have been mounted over an area of 7,916 m².

The key to this speedy installation can be attributed to the use of a new installation system with shockproof connectors. For this project, a special solar module was developed with a peak output of 130 W. It is frameless and comprises 84 monocrystalline silicon solar cells. It is currently the only module on the market that is suitable for use in large photovoltaic

plants with only a single inverter. A three-unit 1,000 kVA power inverter switches the plant on and off depending on the power provided by the sun. This achieves technical and economic benefits, namely:

- Utilization of the system is optimized; and
- Lifetime of the inverter is increased by around 60 per cent.

TERI Information Digest on Energy, Vol. 9, No. 2, June 1999

Sun tracking system

Equipment-Gesellschaft fur Intern. Elektronik Systeme (EGIS) GmbH, Germany, has developed a novel sun tracking system for automatic positioning of photovoltaic panels, light deflection mirrors (flat/concave mirrors), parabolic/spherical collecting and spot reflectors, optical lenses and prisms, sun collectors and heliostats. The system can be divided into two parts: outdoor and indoor units.

The outdoor unit contains a swing/tilt rotor with facility for mounting a big mirror/reflector/panel. The rotor is driven by two electric motors and can turn the rotor-head with solar/reflector panel horizontally by 180° and has a vertical lift range up to 65°. The indoor unit comprises a computer and rotor power supply. These systems are established in a metal casing with front-sided operating elements and a 40 digit LC display. Connection clamps for the cable serving the rotor and the connectors for RS 232C interface and analog input are found at the rear.

Usage of the positioning system can be divided into two functional areas:

- Direct and synchronous sun tracking and path following: The rotor and thereby the rotor head mounted object (solar collectors, PV panels, etc.) is directly faced into the sun. The spherical utilization cone covers 90°-270° in azimuth at an elevation

span of 65°. The EL-span location can be determined by the user at the site.

- Sunlight deflection with a flat mirror on to any target: The mirror mounted on the rotor head is automatically driven into a position between the sun and target point, thereby directing sunlight on to the target throughout the day. On indirect tracking, the rotor can deflect at any time all sun positions between 90° east to 270° west.

Contact: Equipment-Gesellschaft fur Intern. Elektronik Systeme (EGIS) GmbH, Flutstr. 34-36, D 63071 Offenbach, Main, Germany. Tel: +49 (69) 858 327; Fax: +49 (69) 857 863; E-mail: EGISrotor@AOL.com; Internet: http://www.members.AOL.com/EGISrotor.

New range of PV modules suitable for diverse applications

Helios Technology, an Italian company, has released a new range of photovoltaic modules – H12, H50, H200, H500/H600, H800 and H900 series. In all these series, four holes are provided in the metal frame to facilitate easy installation and also ensure strong support. They can all withstand winds greater than 200 km/h. Monocrystalline silicon cells are utilized, which are connected in series and assembled by lamination.

All Helios PV modules have a life-span of over 30 years. Generated current is proportional to the solar radiation. Storage and operating temperatures are in the range of -40°C to 95°C. Apart from the H900 series, which has an output value of ±5 per cent, all the other series have an output value of about ±10 per cent. All the units are covered by a Helios Technology warranty for 20 years. A waterproof junction box houses the bypass diodes and the connecting terminals.

The H12 PV module consists of 36 cells and has a peak power output of 12 W. H50 series contain 39 cells measuring 135x67 mm and has a peak output of 50 W. A H200 module comprises 36 cells that measure 67x67 mm and a peak output of 20 watts. In the H500/H600 series, the H500A module and H600 module contain 36 cells measuring 110 mm lengthways and have a peak output of 55 W and 60 W, respectively. The H800 series has 36 silicon cells that together measure 135 mm in length and have a peak output of 80 watts (H800A), 75 W (H800X) and 70 W (H800B). H900 has 36 monocrystalline cells measuring 135 mm in length and a peak power output of 90 W.

The PV systems are ideal to power various applications including;

- Rural electrification: Remote houses, mountain shelters, holiday resorts, etc.
- Village power: Remote villages, islands, social centres and schools.
- Telecommunication: Radio and TV repeaters, radio telephones, satellite receivers, radar stations, educational TV and mobile radio station.
- Water pumping: Drinkable water for villages, irrigation systems, purification and desalination of water.
- Refrigeration: Domestic uses, food stuffs and vaccine conservation.
- Medical: Hospitals, medical equipment, health care centres and mobile medical units.
- Lighting: Streetlights, illumination of remote cross roads, rural villages and military zones.
- Cathodic protection: Oil, gas and water pipelines.
- Data recording: Meteorological stations, pollution recording units, water level metering, earthquake and fire alarm system.
- Signalling and warning: Off-shore platforms, lighthouses, sea buoys, railroad traffic, highway call boxes, fire alarm system and heliport traffic lights.

Helios is also offering a range of HR charge controllers – HR5, HR12, HR8, HR20 and HR30 – for PV units of all power classes. The software of the built-in microprocessor has been designed to allow the charge controller to fit all types of batteries and operate in all environmental conditions. Some of its features include: automatic voltage adaptation to the system's voltage (12/24 V); very long durability; maintenance-free service; ease of installation and system trouble-shooting; battery charge optimization; built-in blocking diode, thus eliminating external diodes; and a large connection terminal section.

The main functions of the HR charge controllers are:

- Automatic voltage selection (12/24 V dc)
- Overcharge protection;
- Overload protection;
- Over-temperature protection;
- Monthly equalizing charge of the battery;
- Overdischarge protection;
- "Low-battery" warning;
- Temperature compensation;
- Protection against installation errors;
- Night light function (for streetlights); and
- Selection of battery type (lead acid/gel type).

Contact: Helios Technology S.r.l, I-35010 Carmignano di Brenta/PD, Via Postumia 11, Italy. Tel: +39 (49) 9430 288; Fax: +39 (49) 9430 323.

California solar power plant is a success

The world's most advanced solar system has been declared a success by the United States government. Solar Two is a 10 MW demonstration project that uses molten salt to store solar energy. The California facility captured international attention three years ago when it produced solar electricity at night. Solar Two finished its test run earlier this year. It generated 8,500 MWh of green energy since June 1996. The facility's storage system allowed power to be delivered to the grid for 153 straight hours, achieving an efficiency level of 97 per cent. It can dispatch electricity by storing energy in about 1.36 million kilogram of molten salt.

The first power tower, Solar One, operated from 1982 to 1988, using a water/steam system to drive a conventional turbine, but its inability to store energy limited production of electricity. The US\$55 million cost for this project was shared by the Department of Energy (DOE), Bechtel, Southern California Edison, California Energy Commission, Arizona Public Service, Electric Power Research Institute, Idaho Power, Los Angeles Department of Water and Power, Sacramento Municipal Utility District, PacifiCorp and the Salt River Project. Some equipment from this project has been utilized in Solar Two to reduce investment costs.

Solar Two uses 2,000 sun-tracking heliostats to direct sunlight on to a receiver, a 300 foot tower, where the salt is heated to 574°C and transferred to a storage tank. According to DOE, the technology is commercially viable and could be applied to power plants as large as 200 MW in many parts of the world. *Contact: Internet: <http://www.edisonnews.com/releasesexe/99-131.htm>.*

Trends in Renewable Energies, #96, 6 September 1999

Rice husk-based power plant installed in India

India's first independent biomass power plant is situated in Raipur district of Madhya Pradesh. The rice husk-fuelled plant generates 6 MW of electricity and consumes 7 t/h of rice husk. Power generated at this plant is exported to the State Electricity Board grid. The plant, owned by Indo Lahari Bio Power Limited, uses a massive fluidized bed combustion type boiler supplied by Thermax to burn the husk. Husk is automatically fed into the boiler, which will generate high-pressure steam at 480°C to run a turbine.

The estimated capital cost per megawatt of power produced is approximately US\$833,333 compared to US\$952,380 for power from coal-based power plants. Even at a very conservative estimate, 800 MW of power can be generated from rice husk in the country. The potential states where such plants can be installed include Madhya Pradesh, Andhra Pradesh, Tamil Nadu and West Bengal.

TERI Information Digest on Energy, Vol. 9, No. 2, June 1999

Multi-fuel combustion units available in the United Kingdom

Talbott's, the United Kingdom, is offering a range of combustion units that can be fuelled by a variety of biomass fuels. The C range of combustion systems can generate 50-3,000 kW of electricity from biomass such as wood, chipboard, sawdust, dust, farm woodchips, combustion refuse, wood off-cuts, logs, paper briquettes, cardboard, shavings, pallets, paper and general briquettes. Some standard features of these units are:

- All heat exchangers, water type and warm air type, are pressure tested;
- Complies with British standard BS855;
- Manufactured to European standards; and
- Lowest emission levels.

Additional features of these units include:

- Clean combustion, preheated;
- Separate heat exchangers to combustor;
- Vertical heat exchange pipes that self clean for consistent efficiency;
- Primary and secondary ceramic combustion zones;
- Fully insulated combustion zone; and
- Thermal recycling.

These units are ideal for use in wood-working industry, forestry and farming, paper/waste industry, general manufacturing and service industry. *Contact: Talbott's Heating Limited, Drummond Road, Astonfields Industrial Estate, Stafford ST16 3HJ, the United Kingdom. Tel: +44 (1785) 213 366; Fax: +44 (1785) 256 418; E-mail: Combuster@msn.com.*

United States plans to boost energy from biomass

The United States plans to increase its consumption of energy from biomass sources, by 300 per cent, by 2010. Bioenergy and bioproducts have enormous potential to create new economic opportunities for rural America, enhance power security, and help in solving environmental challenges like global warming, and tripling biomass could add US\$20 billion in new income for farmers and rural communities. Increasing energy from crops and plants will

also reduce emissions of GHG from consumption of fossil fuels.

The government wants to generate 7.5 per cent of power from renewable energies by 2010. Last year government agencies in the country were directed to use biomass products whenever possible. Tax credits were also proposed for biomass-based electricity production.

Trends in Renewable Energies, No. 93, 16 August 1999

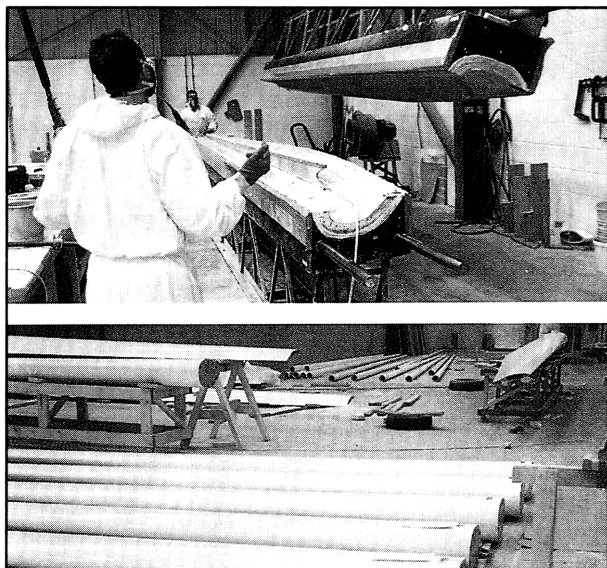
DoE Prepares Bioenergy 2020 Plan

Assistant Secretary Dan Reicher of the United States Department of Energy (DoE) gathered together a group of biomass energy stakeholders on November 18 to begin a collaborative process between the industry and DoE on an integrated vision and road map for bioenergy in 2020. Bioenergy 2020 is described as "a national partnership to develop an integrated industry to produce power, fuels, and chemicals from crops, trees, and wastes."

Mr. Reicher is hoping to bring together not only the fragmented DoE programs but also the various external biomass stakeholders to agree on a common direction and strategy. He intends to have a core stakeholder group prepare a vision statement by late February, when it will be circulated more widely for comments.

Reicher's draft plan includes: creation of an effective policy framework; expansion of biomass markets; promoting advanced technologies; improving Federal-State coordination; and maintaining an effective partnership between the industry and the government.

(Web page of American Bioenergy Association)



Wood/epoxy blades for wind turbines

New wind turbine generator developed in the United States

In the United States, Atlantic Orient Corporation has developed a wind turbine generator together with the United States Department of Energy and the National Renewable Energy Laboratory (NREL) under the Advanced Wind Turbine programme. The AOC 15/50 consists of a 15 m rotor that produces 50 kW at 11.3 m/s wind speeds. Each component of the unit was designed and tested to ensure that actual field performance meets or exceeds design specifications.

An important safety criteria in the AOC 15/50 is the ability to safely control the wind turbine in normal and extreme conditions. Some features of this unit include:

- Engineered for use in high penetration wind/diesel hybrid systems;
- Downwind passive yaw configuration;
- Single piece castings for hub, gearbox housing and tower top;
- Four independent braking sys-

tems: dynamic brakes, parking brake, tip brake and stall regulated blades;

- Absolute simplicity and minimal maintenance requirements;
- Integrated drive train provides efficient load path;
- PLC-based control system; and
- Advanced thick airfoils: Well proven wood epoxy blades, improved bug and dirt tolerance, efficient over a wide spectrum of wind speeds.

Contact: Atlantic Orient Corporation, P.O. Box 1097, Farrell Farm Road, Route 5, North Norwich, Vermont 05055, the United States. Tel: +1 (802) 6495 446; Fax: +1 (802) 6495 404; E-mail: info@aocwind.net. Or Atlantic Orient Canada, 780 Windmill Road, Suite 302, Dartmouth, Nova Scotia B3B 1T3, Canada. Tel: +1 (902) 4681 621; Fax: +1 (902) 4686 865; E-mail: aoc@seafortheng.ca.

Windfarm in Australia

A major Australian electricity supplier will purchase green energy from a windfarm that will be completed by next year. Twenty turbines are being built at the Windy Hill site in Atherton, Queensland. The first two units will be finished by the end of this year, and the remaining will be operational by next July. The 12 MW capacity will make it the largest wind project in Australia. Ergon Energy of Brisbane will buy power from nine of the 20 turbines in a five-year purchase agreement with Stanwell, a major producer of green power. Electricity generated will be SEDA accredited wind energy, and supplied to nearly 2,000 homes.

Ergon supplies power to 97 per cent of Queensland. Two per cent of its power is generated by wind turbines and solar panels on Coconut Island and Thursday Islands, in addition to major purchases of electricity produced from sugar cane and landfill gas. Electricity generated by coal, gas and oil produces 40 per cent of the nation's GHG emissions. *Contact: Internet: <http://www.ergon.com.au>.*

Trends in Renewable Energies, #96, 6 September 1999

Installed wind power capacity in India

State	Demonstration projects (MW)	Private sector projects (MW)	Total capacity (MW)
Tamil Nadu	19.355	705.705	725.060
Gujarat	17.345	149.565	166.910
Andhra Pradesh	3.050	58.740	61.790
Karnataka	2.575	17.060	19.635
Madhya Pradesh	0.590	17.855	18.445
Maharashtra	6.440	22.495	28.935
Kerala	2.025	-	2.025
Orissa	1.100	-	1.100
Others	0.465	-	0.465
Total	52.945	971.42	1,024.365

(Repso Vision, Vol. 7, April 1999)

Fuel cell power plant

Siemens AG, Germany, is developing an emission-free fuel cell power plant together with a unit of the Royal Dutch/Shell group. Shell Hydrogen and Siemens Westinghouse have announced an agreement creating a framework for the parties to develop and market a unique power generation technology, fuelled by natural gas that would essentially eliminate emissions to the atmosphere. The project combines high-temperature solid oxide fuel cell developed by Siemens with the carbon dioxide removal technology being developed by Shell.

Down to Earth,
31 August 1999

New nickel zinc line begins production

Evercel Inc., the United States, will dedicate its new corporate facilities and pilot production line to provide market samples of its rechargeable nickel zinc batteries to customers for field testing. Full-scale production facilities are nearing completion in Xiamen, China, under a joint venture involving Xiamen Three Circles ERC Battery Corp. Ltd.

Evercel intends to initially offer its batteries for sale through original equipment manufacturers. The primary applications to be targeted by the company include small electric vehicles, e.g. scooters and bikes, and battery-operated equipment like lawnmowers. Some advantages of nickel-zinc batteries over lead-acid and nickel-cadmium systems include:

- **Cycle life:** Previously a major obstacle to nickel zinc commercialization, Evercel batteries have achieved more than 500 deep discharge and recharge cycles.
- **High power density:** This deter-

mines the battery's ability to deliver large amounts of power quickly, an important consideration for electric vehicles.

- **High energy density:** A measurement of how much energy can be stored in a given weight. Nickel-zinc batteries can deliver the same amount of storage in approximately half the weight of lead-acid batteries.
- **Low environmental impact:** Evercel's nickel-zinc batteries use materials claimed safer for the environment than lead-acid and nickel-cadmium batteries. Evercel has also patented a manufacturing process that reduces contaminants hazardous to the environment.

Lead Zinc Update, Vol. 8, No. 1,
January-March 1999

Fuel cells show promise

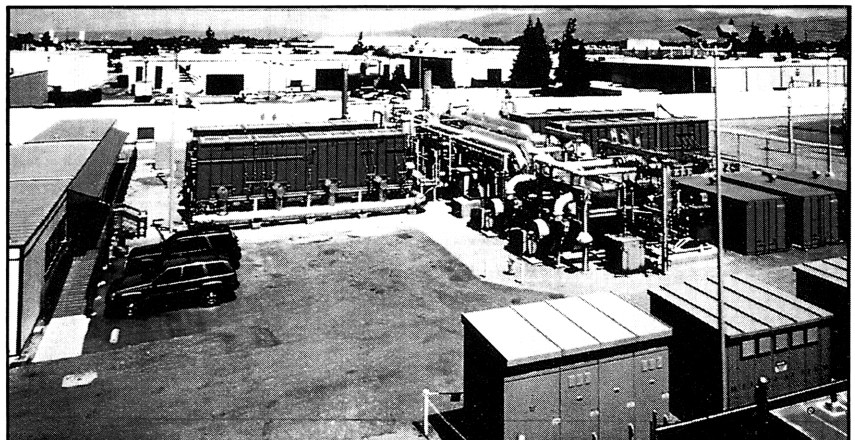
A quiet, non-polluting means of producing electricity could become an important part of the power industry in the 21st century if planned demonstration projects produce the desired results. Under a multi-million dollar project in the United States, partly funded by the United States' Department of Energy, molten carbonate fuel cell (MCFC) technology is being investigated. Positive results could result in the construction of large, stationary plants that will use oxygen

and hydrogen to generate electricity, with water and heat as the by-products.

If present design concepts hold up, the anodes and cathodes of these massive power plants will be made of porous nickel alloys. Typically, the anode is a nickel-chromium alloy while the cathode is composed of a lithiated nickel oxide. MCFCs use highly corrosive carbonate salts as an electrolyte. At 650°C, these salts melt to provide the required ionic conductivity. Hydrogen reacts with carbonate ions at the anode to produce water, carbon dioxide and electrons. Similarly, at the cathode, carbon dioxide and oxygen (recycled from the anode), react with electrons to form carbonate ions, which replenish the electrolyte and transfer current through the fuel cell.

The largest demonstration of such a fuel cell was in Santa Clara, California, in 1997. It was built by Energy Research Corp. of Danbury, Connecticut and is rated at 19 MW of alternating current. Another 250 kW unit was installed in San Diego. Though MCFCs have proved to be technically sound, concerns regarding durability and the long-term maintenance fears of potential users, in the utilities industry, have to be answered.

Nickel, Special Issue,
August 1999



Cross-section of a molten carbonate fuel cell

The World Photovoltaic Market

This publication dwells on the development of photovoltaics from 1975 to 1998. Some of the major topics covered include:

- In-depth historical data: prices, shipments, etc.;
- Manufacturing status for all key technologies;
- Detailed country status; and
- Installed systems cost for basic systems

Contact: PV Energy Systems Inc., 4539 Old Auburn Road, Warrenton, VA 20187, the United States. Tel/Fax: +1 (540) 3494 497; E-mail: pvenergy@crosslink.net; Internet: <http://www.pvenergy.com>.

Solar Air Systems Series

Active solar systems for air heating are a straightforward yet effective way of using solar energy for space heating and tempering ventilation air. This series is intended to help designers plan, analyse and construct such systems in an effective manner.

Contact: James and James (Science Publishers) Ltd., 35-37 William Road, London NW1 2ER, the United Kingdom. Tel: +44 (171) 3878 558; Fax: +44 (171) 3878 998; E-mail: orders@jxj.com; Internet: <http://www.jxj.com>.

Stand-alone Photovoltaics Applications - Lessons Learned

This book presents the views of an International Energy Agency team, from 15 different countries, who have been studying photovoltaics over the last decade. Economic, institutional, social and technical aspects of installing and using such systems have been provided.

Contact: James and James (Science Publishers) Ltd., 35-37 William Road, London NW1 2ER, the United Kingdom. Tel: +44 (171) 3878 558; Fax: +44 (171) 3878 998; E-mail: orders@jxj.com; Internet: <http://www.jxj.com>.

Biomass Energy Systems

A comprehensive coverage of all major issues concerning biomass energy, including issues related to forest management and forest science to those dealing with potential technologies have been discussed.

Contact: Outreach Cell, Tata Energy Research institute, Darbari Seth Block, Habitat Place, Lodhi Road, New Delhi 110 003, India. E-mail: outreach@teri.res.in.

20-22 Dec
Indore
India

National Renewable Energy Convention '99
Contact: Prof. R.L. Sawhney, NRSE '99, School of Energy and Environmental Studies, Khandwa Road Campus, Indore 452 017, India.
Tel: +91 (731) 460 309;
Fax: +91 (731) 470 372/523 352;
E-mail: rlsawhney@hotmail.com.

2000

24-29 Jan
Geneva
Switzerland

World Clean Energy Conference and Exhibition
Contact: WCEC 2000, B.P. 70, CH-1211, Geneva, Switzerland.
Tel: +41 (1) 4630 226;
Fax: +41 (1) 4630 252;
E-mail: wcec@cmdc.net.

18-21 April
Shanghai
China

International Exhibition on New Energy, Renewable Energy and Energy Saving
Contact: Ms. Kammy Shum, Coastal International Exhibition Co. Ltd., China Resources Building, 26 Harbour Road, Wanchai, Hong Kong.
Tel: +852 28276766;
Fax: +852 2827 5224;
E-mail: general@coastal.com.hk.

5-9 Jun
Sevilla
Spain

Biomass for Energy and Industry: 1st World Conference and Technology Exhibition
Contact: Dr. David Chiaramonti, Energia TA-Florence, Piazza Savonarola, 10 I 50132 Florence, Italy.
Tel: +39 (55) 5002 174;
Fax: +39 (55) 573 425.

2-4 Jul
Brighton
United Kingdom

Renewable Energy 2000 Congress and Exhibition
Contact: Reed Exhibition Companies Ltd., Oriel House, 26 The Quadrant, Richmond, Surrey TW9 1DL, The United Kingdom.
Tel: +44 (181) 9107 976;
Fax: +44 (181) 9107 989.

30 Jul-4 Aug
Aspen
United States

International Conference on Photochemical Conversion and Storage of Solar Energy
Contact: The Secretariat, IPS-2000 National Renewable Energy Laboratory, 1617, Cole Blvd., Golden, CO 80401-3393, The United States.
Tel: +1 (303) 3846 611.

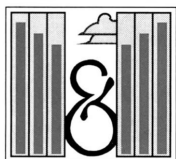


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Fax: 011-3732245, 3733712. E-Mail: iic@giadl01.vsnl.net.in Website: http://www.nic.in/iic



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