VATIS UPDATE

Non-conventional Energy

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Highlights

- Off-grid solar electricity in Asia
- Competitive photovoltaics
- New sun tracker
- Rankine cycle heat engine
- Flat plate collectors
- New tool for designing turbine blades

APCTT

curtin
University of Technology
Western Australia

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 and Sustainable Technologies 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
Solar energy efficient hot water heating system
[For details See p.13]
Courtesy: Solchrome Systems India Limited

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Non-conventional Energy
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Boost for solar power development in India

The Global Energy Facility (GEF) has allotted US$15 million to India, towards market development activities for solar photovoltaic system. This sum will be spent over the next two years. The Ministry of Non-conventional Energy Sources (MNES), India, is expected to allocate additional funds to set up more 200 kW solar power plants in the next two years.

TERI Newswire,
16-31 December 1999

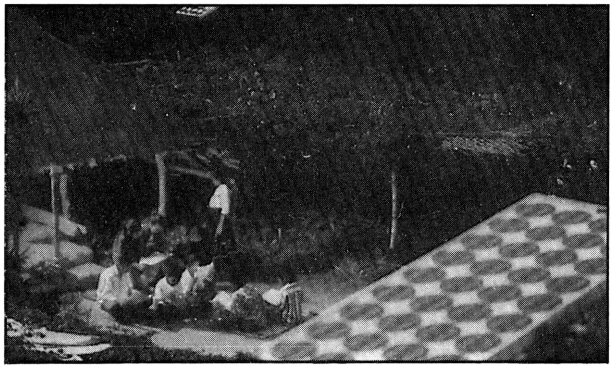
Financial aid for IREDA to promote renewable energy

The Kreditanstalt fur Wielderaufban, Germany, is offering financial assistance for the Indian Renewable Energy Development Agency (IREDA). The assistance would be utilized to reduce emission of greenhouse gas by promoting exploitation of renewable energy sources and related technology development. This is the third credit line sanction to IREDA by an international donor agency after the World Bank and Asian Development Bank.

View Point,
January-March 2000

Off-grid solar electricity in Asia

A major market where photovoltaic (PV) energy can compete with fossil fuel-based sources is in the off-grid regions of developing nations. Solar Electric Light Company (SELCO) is one of the key players in this field. A typical solar home system (SHS) provides power for lighting and for a variety of appliances – from radios and televisions to fans and juice blenders – depending on the purchasing power and requirement of the consumer.



PV water pumping and lighting system by SELCO-India

The two greatest challenges faced by solar electrification companies are consumer finance and information dissemination. Though a large portion of the customers are poor, most have a annual income not exceeding US$350. The dollar value of their income does not necessarily indicate their willingness or ability to pay for solar electricity. Nearly 55 per cent of people without access to grid electricity can afford to buy a SHS. Except for the five per cent who can pay cash upfront, the major 50 per cent need access to consumer finance to be able to pay for a SHS.

In India, a well developed network of rural development banks and financing institutions provide SELCO-India's customers with access to finance. In Viet Nam, SELCO-Viet Nam utilizes funding from the International Finance Corporation's small and medium enterprise (SME) programme to provide loan guarantees for SHS customers. The Viet Nam Women's Union (VMU) is accountable for collecting payments from the customers. The World Bank has set up a renewable energy fund in Sri Lanka to provide incentives for rural finance institutions to arrange low-interest loans in rural areas.

Each solar company has developed its own methods and approaches to marketing, relevant to the particular socio-economic profile of its target market. E.g. in Viet Nam, VMU combines SHS demonstrations and sales talks with health camps in rural areas. Gansu-PV company (GPV), a subsidiary of SELCO in China, promotes solar lighting to rural people through testimonials which are read on province-wide, government-owned radio on bi-weekly, slickly-produced, 30-minute 'infomercials'. GPV also sells portable SHSs to Tibetan nomads using radio broadcasts in Tibetan. *Contact: Ms. Kamal Kapadia, Solar Century, London, the United Kingdom. Tel: +44 (870) 7358 101; E-mail: kk@solarcentury.co.uk.*

Renewable Energy World,
November 1999

Tapping solar energy

Sunlight is available everywhere and is more predictable than wind. Also, it is less vulnerable to variations in seasonal weather patterns than e.g. hydro power. The main market for solar power is in developed countries like Germany, the United States, the Netherlands and Japan. These countries are already promoting this eco-friendly renewable energy. While Germany intends to install 100,000 solar roofs, Japan has planned for 70,000 roofs and a million has been targetted in the United States.

The second market is in developing countries. Growth in these nations is expected to be driven by large populations in remote locations with no access to electricity grids. A viable alternative to extending the utility grid, the latter may prove to be uneconomical, is rural electrification. Developing countries like India, the Philippines and China have initiated various steps to exploit solar energy.

In the Philippines, more than 680 solar power projects have been installed in about 263 remote sites during the previous year.

Researchers at the University of Florida are developing solar cells with a semiconductor layer thinner than a human hair and one-hundredth the thickness of silicon solar cells. The new thin-film cells could eventually prove to be cheaper and could be available in the next ten years. A California-based company is developing photovoltaic (PV) cells with more than 30 per cent efficiency in converting sunlight into electricity. This innovation would help reduce the number of cells and the area required to produce electricity.

Power Line, January 2000

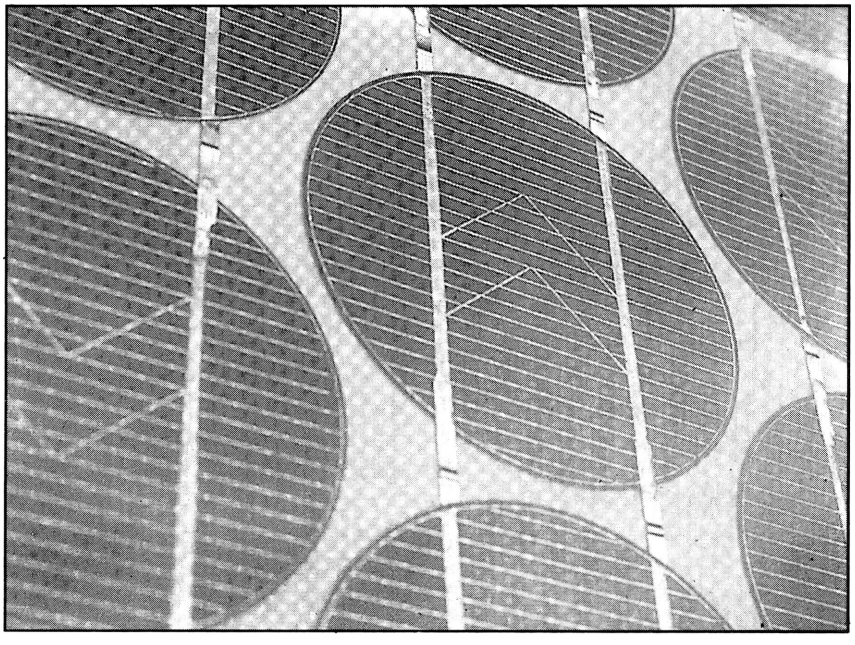
Solar cell production capacity increasing worldwide

Manufacturing capacity for photovoltaic (PV) cells of different kinds is expanding rapidly with the building of large-scale new manufacturing plants around the world. Solar of Toledo, Ohio, the United States, is building a PV facility capable of producing 100 MW/y of thin-film cadmium telluride cells. Kaneka, Japan, is reported to have completed construction of a plant for producing 20 MW/y of amorphous silicon solar cells. Mitsubishi Electric plans to expand its solar cell production to 15 MW/y. In Germany, Shell opened its latest solar cell production plant which manufactures 10-12 MW/y of crystalline silicon cells.

Renewable Energy World, January 2000

Competitive photovoltaics

A recent report commissioned by Greenpeace has revealed that solar photovoltaics (PV) could be a competitive alternative to conventional power sources even in the short term. Compiled by business consultants and accountancy firm KPMG, the report estimates that one large-scale solar PV factory producing five million solar panels per year could reduce the cost of solar energy by a factor of four. The United Kingdom market for this level of solar panel production equates to less than 0.3 per cent of the existing roof area of domestic housing and less than 40 per cent of new properties built each year. In the United States, this would be only 20 per cent of new housing and in the Netherlands, two per cent of existing housing. *Contact: Greenpeace Press Office, the United Kingdom. Tel: +44 (207) 8652 556.*



A single large-scale solar PV plant could reduce cost of solar power by four-fold

Appropriate Technology, Vol. 26, No. 3, December 1999

Australian solar expertise in India

The Solarch Group at the University of New South Wales (UNSW), Australia, will implement a new AusAid project in Himachal Pradesh, India. This is a sub-project of the long-term AusAid programme 'India-Australia Training and Capacity Building Project.' Under the sub-project, Australian know-how in solar passive architecture will be imparted by training local builders and artisans. As a result, solar efficient houses, schools and other buildings can be built in rural areas to improve the quality of life and energy efficiency of buildings. Some of the important features of this sub-project include:

- To assist in building the capacity of rural artisans (masons, carpenters and blacksmiths) to market passive solar technology and to design and construct or retrofit passive solar buildings, thereby enhancing their income generating potential; and
- To assist in building the capacity of the Technical Project Management Cell to implement the Solar House Action Plan in Himachal Pradesh.

This sub-project involves the development of training materials as

well as design and construction of 25 model low-cost solar buildings. Five people with scientific, architectural and engineering experience will also be trained in Australia in international best design practices for solar-efficient design of buildings. Three more participants with policy and administration backgrounds will be trained in building energy policy and practice in Australia.

Australian Energy News, December 1999

Indo-Namibian pact on solar technology

A manufacturing licence agreement between India and Namibia has enabled the latter to exploit India's solar photovoltaic systems technology. The Central Electronics Ltd. (CEL) is to set up a manufacturing facility for solar cells, modules and systems in the African country. India will also assist Namibia to develop infrastructure for the production and marketing of solar systems. CEL's technology would be used to generate electricity in rural areas and to power factories.

Technology Exports, October-December 1999

Fuel cells: bright future ahead

Fuel cells are expected to become a common energy technology owing to their noiseless operational ability, high fuel efficiency, fuel flexibility and very low emission levels. These power sources would be able to provide energy in places and at times when other conventional sources fail to deliver. Many of the fuel cells are also well suited for co-generation.

In Australia, an ONSI fuel cell installed at the Australian Technology Park (ATP) has completed its first year of operation and has been producing 200 kW of electricity and heat. Conversion of the DC output from the ATP fuel cell stack into AC grid voltage power is achieved by using a solid state power conditioning mechanism. About 480,000 kWh of electricity has been supplied by the ATP fuel cell plant since its installation in November 1998. It has also reduced emission of nearly 370 t of greenhouse gases. Turnkey 200 kW fuel cell plants are available from ONSI and have been installed in the United States, Europe and Japan. The plant is about the size of a shipping container, offers an electrical efficiency exceeding 40 per cent and a thermal efficiency of about 40 per cent.

In Australia, CSIRO has developed a ceramic fuel cell which uses hydrogen and natural gas as fuel. Work is underway to use liquid fuels with the help of catalysts to breakdown LPG and produce methane at relatively low temperatures of 300º-350ºC. *Contact: Mr. Brian Jay, Australian Technology Park, Sydney, Australia. Tel: +61 (2) 9209 4208.* or *Ms. Jenny Hill, NorthPower, Australia. Tel: +61 (2) 6582 8707.*

Australian Energy News, December 1999

Geothermal energy: Indian perspective

In India, the need to provide energy for a growing population of 1,000 million people may accelerate utilization of geothermal fields. India has several geothermal sites with temperature in the range of 30º-100ºC. Some of the most promising geothermal areas include: Puga-Chhumathang, Manikaran and Tapoban in New Himalayas; Konkan, Cambay and Bombay Offshore; Taptapani; Gondawanic grabens; and Volcanic areas of Andaman and Nicobar islands. The total geothermal power potential has been estimated to be in the range of 2,000-10,000 MW. At present, geothermal power plants with a capacity of 20 kW to 1 MW are being planned at a few locations.

Chemical Weekly, 4 January 2000

Energy export networks in the United Kingdom

Three renewable energy export networks have been established in the United Kingdom. The Biomass Exports Network, British Trade Winds and the Hydro Industry Export Network were all set up with assistance from the British DTI. *Contact: Mr. Peter Billins, The Biomass Exports Network, c/o. British Biogen, 7th Floor, 63-66 Hatton Garden, London EC1N 8LE, the United Kingdom. Tel: +44 (171) 8317 222; Fax: +44 (171) 8317 223; E-mail: info@britishbiogen.co.uk; Internet: http://www.britishbiogen.co.uk.*

Mr. Gaynor Hartnell, Co-ordinator, British Trade Winds, c/o. British Wind Energy Association, 26, Sprint St., London W2 1JA, the United Kingdom. Tel: +44 (171) 4027 102; Fax: +44 (171) 4027 107; E-mail: bwea@gn.apc.org.

Mr. David Bassett, Secretary, Hydro Industry Export Network, c/o. British Hydropower Association, Sovereign House, Bramhall Centre, Bramhall, Stockport, Cheshire SK7 1AW, the United Kingdom. Tel: +44 (161) 4409 196; Fax: +44 (161) 4409 273; E-mail: weal@mcmail.com.

British Commercial News, January/February 2000

Solar-powered petrol stations

In Australia, some of BP's service stations have installed photovoltaic (PV) modules to improve energy efficiency at the sites and help reduce greenhouse gas emissions. 400 PV

Shell's new solar cell facility opened

Shell's latest PV manufacturing plant in Germany

Shell has commenced operation at its new solar cell manufacturing facility in Gelsenkirchen, Germany. The facility boasts of a fully automated production line which will turn out 1,000 pieces/h of 2 W polycrystalline cells. A second production line has been planned for installation this year. Manufacturing costs at this plant is expected to decrease by 20 per cent. Solar panels manufactured here are anticipated to achieve 14 per cent cell efficiency.

Renewable Energy World, January 2000

panels and related electronic equipment will be installed at 200 new service stations in 11 countries in the first phase of the company's two-year US$50 million project. The installations will be connected to the grid so that any excess power generated is exported or power imported at times of deficiency. The installation at each petrol station will have a maximum output of 20 kWp. *Contact: Internet: http://www.bpamoco.com/pluginthesun.*

Australian Energy News, December 1999

240 MW power from renewable sources

The Haryana State Energy Development Agency, India, plans to add about 240 MW to the state's grid from renewable energy sources by 2010. About 108 MW would be generated from biomass, 95 MW from bagasse cogeneration, 20 MW from mini-hydel plants and 17 MW from municipal solid waste. While 61 MW is expected to be added by the end of next year, 179 MW is proposed to be added by 2010.

TERI Newswire, 1-15 January 2000

Solar village in India

In Tilonia, a small village in Rajasthan, India, a 6,000 m^2 college campus runs entirely on solar energy. All the roofs at Barefoot College are connected to a 400,000 l underground tank to collect rainwater. 15 kW solar panels, provide energy for 20 computers, an electronic mail system, a solar pump distributing 25,000 l, 500 domestic tube lights and an 80-line rural telephone exchange. A remarkable feature of this project is that the people responsible for installing and maintaining these systems have had no formal education beyond primary school.

Here, waste paper is recycled into papier mache puppets which are then used in puppet shows to impart knowledge. Over 150 schools spread over 1,300 km^2, which teach shepherd boys and girls during the night, are now using solar lanterns fabricated by the students. The Barefoot College has also solar-electrified remote villages and houses in Ladakh where temperatures reach -50ºC in winter. *Contact: Mr. Bunker Roy, Barefoot College, Tilonia, Rajasthan, India. E-mail: bunker@slt1.unv.ernet.in.*

Renewable Energy World, January 2000

Biomass energy in China

At present, about 61 per cent of rural household energy in China is supplied by biomass. The government's rural energy policy aims at minimizing commercial fuel use by focusing on efficiency improvement and developing renewable energy technology, mainly biomass. Some of the related project carried out nationwide include:

- Plantation and reforestation: A pilot project on integrated rural energy development was carried out in Guangdong province. In 14 years, the size of plantation reached 170,600 ha and the forest coverage rate increased from 31.5 per cent to 49.4 per cent.
- Improved stoves: From 1983 to 1996, stoves have been distributed to 177 million households, representing 76 per cent of the total rural households. Efficiency of the improved wood-fuel stoves is in the range of 20-30 per cent and saves nearly 13.62 million t/y of wood.
- Development and increased

utilization of renewable energy: from 1991 to 1997, available agricultural residues increased by 1.8 per cent annually, and amounted to about 590 million tonnes. Only 35 per cent was used in direct combustion while a major part of the remainder was burnt directly in the fields. A new regulation was promulgated in April 1999 under which 60 per cent of the crop residues must be utilized by the year 2002.

Wood Energy News, Vol. 14, No. 3, December 1999

Non-conventional energy in India

India has increased its power generating capacity, over the past five decades, by nearly five-fold. About 250,000 MW will have to be added by 2015 for catering to power requirements. An estimated 1,300 MW of power, about 1.5 per cent of total grid-connected capacity, was generated from renewable sources as of December 1998. The Ministry of Non-conventional Energy Sources (MNES) is preparing a comprehensive plan under which 10 per cent of the total power generated by the year 2007 will come from renewable sources.

Some aspects of renewable energy sources in the country are as follows:

- Wind: As of March 1999, the installed capacity of grid-connected wind power generation crossed 1,022 MW. Nearly 4.5 billion units of electricity has been fed into the grid till date. Private investors and developers have been setting up commercial wind power projects in Tamil Nadu, Gujarat, Maharashtra and Andhra Pradesh.
- Biomass: At present, biomass gasifiers produce up to 500 kW and are manufactured using indigenous technology.
- Solar: Tremendous potential exists for solar thermal systems for solar heating, space heating, desalination, crop drying, refrigeration and power generation. Solar systems with capacities up to 240,000 l/d of hot water have been installed in many industries and about 25,000 homes have installed systems with 50-100 l/d capacities.
- Solar photovoltaics (SPV): have two distinct market segments. The first is government sector and the second is commercial in nature (for meeting essential load requirements for data logging, telecommunications, transmissions and for applications in the railways, etc.) In the area of SPV, India today is the world's second largest manufacturer of SPV panels based on crystalline solar cells.

Contact: Mr. Rakesh Bakshi, Chairman, RRB Consultants and Engineers Pvt. Ltd., 161, Sukhdev Vihar, New Delhi 110 025, India. Tel: +91 (11) 6848 226/6838 365; Fax: +91 (11) 6836 160.

German News, December 1999-January 2000

Harnessing renewable energy in the United Kingdom

In the United Kingdom, a new project has been scheduled to exploit wave and wind energy off the Scottish coasts. About 53 projects – including wind, wave, hydro, waste-to-energy and biomass – have been contracted to provide almost 150 MW of renewable electricity capacity.

Two 'Whiplash' units are to be installed at Machir Bay over the next three years. Whiplash is a jointed steel tube, 100 m long and 3.4 m wide. Its pumps, when the moored tube is undulated by the waves, force oil down a pipe to a hydraulic motor which drives an electric-powered generator. About 750 kW of electricity is thus generated. Wavegen's Limpet machine uses wave power to force air up a coastal gully to spin a turbine which reverses its spin, sucking air down when the waves subside, thus providing electricity.

The largest wood-to-power plant in the United Kingdom will be built close to an Inverness timber mill. The 12.9 MW facility will burn wood waste and provide heat and electricity to nearly 12,000 homes. *Contact: Scottish Office, St. Andrew's House, Edinburgh EH1 1DG, the United Kingdom. Tel: +44 (131) 2442 702; Fax: +44 (131) 2442 918; Internet: http://www.scotland.gov.uk.*

Spectrum, September-October 1999

Solar medical refrigerator

Since its development more than 12 years ago, Dulas VC 150F solar medical refrigerators have been exported to Africa, South America and India. The refrigerators offer highly reliable storage space for vaccine or blood products. This reliable and cost-effective system is ideal for use in remote areas. *Contact: Mr. Dilwyn Jenkins, Dulas Ltd., Dyfi Eco Parc, Machynnlleth, Powys, the United Kingdom. Tel: +44 (1654) 70500; Fax: +44 (1654) 703 000; E-mail: dulas@gn.apc.org; Internet: http://www.gn.apc.org/dulas.*

British Commercial News, January/February 2000

RENEWABLE ENERGY WEBSITES

Office of Government Information Technology – www.ogit.gov.au.

Source Guides Renewable Energy – www.sourceguides.com/energy/index.html.

Australian Energy News, June 1999

New sun tracker

Solar Energy System P/L, Australia, is offering a sun tracker which can increase solar array performance by more than 40 per cent. Available in four models, the Sun Tracer can hold 3-16 m^2 of solar panels. A microprocessor control system keeps the array directly facing the sun. A 30-second delay has been programmed into the controller to help prevent the tracker from following bright spots in the sky caused by moving clouds on overcast days.

Moreover, the tracker will stay in a neutral position during storms, thereby preventing any damage to the array. The tracker has been tested for wind speeds up to 198 km/h. *Contact: Solar Energy System P/L, 3/61 Guthrie Street, Osborne Park, WA 6017, Australia. Tel: +61 (8) 9204 1521; Fax: +61 (8) 9204 1519; E-mail: info@sespl.com.au; Internet: http://www.sespl.com.au.*

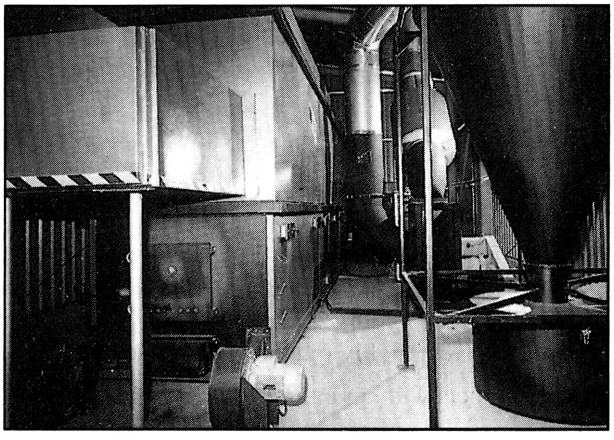
Renew, Issue 70, January-March 2000

Portable solar power

Energy Stream P/L, Australia, has developed the Pure Power range of portable solar generators. Three models are presently available, all of which use Selectronic sinewave inverters having high surge and intermittent capacities. The Ex1 and Ex2 have a 50 W solar panel, while Ex3 comes with an 80 W panel. All units incorporate a Plasmatronics PL20 intelligent regulator and a sealed gel battery for zero-maintenance. Some potential applications of the portable generators include remote buildings, holiday houses, camping, standby power source, etc. *Contact: Energy Stream P/L, P.O. Box 476, Eltham, VIC 3095, Australia. Tel/Fax: +61 (3) 9439 1582; E-mail: estream@enternet.com.au.*

Renew, Issue 70, January-March 2000

Hot air systems for thermal recycling



Talbott's C9 system at Laminated products

Talbott's Ltd., the United Kingdom, is pioneering a novel "thermal recycling" concept, which promotes on-site combustion of waste. One of Talbott's thermal recycling system installed at a decorative mouldings production facility eliminates waste and concurrently provides heat to the facility. The C9 automatic warm air heating system produces 2,500 kW/h and 55,000 CFM at a high working pressure to ensure good and distant distribution of the warm air. This output is produced by combusting 50-60 t/week of waste. Talbott's range of systems are designed to meet all current and future emission requirements.

Contact: Talbott's Ltd., Drummond Road, Astonfields Industrial Estate, Stafford ST16 3HJ, the United Kingdom. Tel: +44 (1785) 213 366; Fax: +44 (1785) 256 418; E-mail: sales@talbotts.co.uk.

British Commercial News, January/February 2000

Novel solar cooker developed in India

Humanity Association, India, has developed a solar cooker which uses a fixed hot plate, where sunlight is focused. An insulated "cage" built around the hot plate consists of glass windows, through which sunlight is concentrated on the hot plate with the help of mirrors. A centrifugal governor incorporated in the system allows the mirror/window structure to rotate at 15º per hour, the same rate at which the sun moves across the sky. The motive force of the tracking system is derived from falling weights. Once the unit is set to work by lifting the weight and adjusting the mirrors at the beginning of cooking, no supervision is essential until the cooking is completed. *Contact: Dr. S. Mullick, Humanity Association, 39 Hem Chakraverty Lane, Howrah 1, India. E-mail: subir.mullick@gems.vsnl.net.in.*

Solar Cooker Review, December 1999

New analysis software for assessing RETs

RETScreen™, a software package that can assess or 'screen' the costs of a project using renewable energy technologies (RETs) has been developed under Canada's Renewable Energy Strategy. Natural Resources Canada (NRCan) and NASA, the United States, are together offering RETScreen users access to satellite weather data such as the amount of solar energy that strikes the surface of the earth, global temperatures and wind speeds. This information

will be included in links in the software or from NASA's internet site, allowing RETScreen to become an international standard to determine the potential of renewable energy projects.

RETScreen preliminary feasibility analysis software runs on Microsoft Excel (Version 5.0 or higher) and can be used to prepare a preliminary evaluation of the annual energy production, costs and financial viability of RET projects around the globe. The RETScreen Wind Energy Model can be utilized to evaluate grid-connected and wind energy applications. The RETScreen Small Hydro Model can be applied to evaluate projects classified under small hydro, mini-hydro and micro-hydro projects. The RETScreen Photovoltaic Model can be used to evaluate grid-connected projects, from large-scale central generation plants to small-scale distributed greenhouse applications. *Contact: Internet: http://www.cedrl.mets.nrcan.gc.ca.*

Australian Energy News, September 1999

Solar home system for developing countries

Free Energy Europe has developed a new solar home system (SHS) concept which costs about US$100. A 12 W_p SHS system consists of a single 12 W panel, a charge regulator, three lights and cables. Fourth generation amorphous silicon solar cells are used in this system and the polymer injection framing has an expected lifetime of 20 years.

Contact: Mr. Frank van der Vleuten, Free Energy Europe, Eindhoven, the Netherlands. Tel: +31 (40) 2901 245; Fax: +31 (40) 2901 249; E-mail: f.vleuten@free-energy.net.

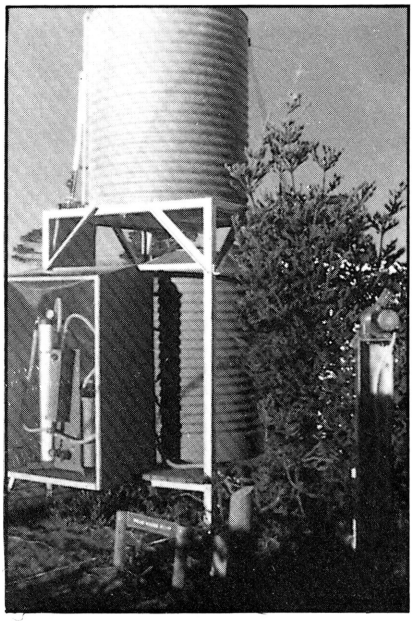
Boiling Point, No. 43, Autumn 1999

New fuel cell energy storage system from the United Kingdom

National Power, the United Kingdom, has developed utility-scale fuel cell energy storage technology. The new Regenesys technology makes use of an electrochemical process and operates akin to a giant rechargeable battery, capable of storing several hundred megawatts of electricity. It can be built in sizes ranging from 5-500 MW output and with variable energy storage capacity, achieved by increasing the quantities of stored electrolytes. Regenesys has been granted 'Millennium Product' status by the government.

Renewable Energy World, January 2000

Solar-powered pump and water purification system



Village Water Potable System

A new solar-powered water pumping and purification system, which can supply 1,200 l/day of potable water, is being tested in Australia. Developed by Solar Energy Systems, Venco Products and Murdoch University, the Village Water Potable System incorporates a water pump together with a method for cleaning polluted, salty and brackish water.

Water is first pumped into an overhead tank from a borewell by a solar-powered pump drive. The water then flows down through two filters and is forced through a custom-made membrane and purified. The reverse osmosis purification process separates out dissolved salts and waterborne particles, including harmful pathogens. Low-voltage photovoltaic panels supply power to the system and no batteries are required. The system would be ideal for use in remote areas and developing nations. The pump in this system could also be used for stock watering and irrigation. At present, a 400 l/day system is available.

Australian Energy News, December 1999

New tidal current turbine developed in the United Kingdom

Marine Current Turbines Ltd., the United Kingdom, has developed the world's first commercial-scale tidal current turbine with a capacity of 300 kW. The system incorporates a 15 m propeller-like rotor on to a tubular steel pile set into a socket drilled in the seabed. This is similar in principle to a "submarine windmill". The resulting electric energy is transmitted to the shore through a marine cable. *Contact: Mr. Peter Fraenkel, Marine Current Turbines Ltd., The Warren, Bramshill Road, Eversley, Hampshire RG27 0PR, the United Kingdom. Tel: +44 (118) 9324 416; Fax: +44 (118) 9730 820; E-mail: peterfraenkel@compuserve.com; Internet: http://www.marineturbines.com.*

British Commercial News, January/February 2000

Rankine cycle heat engine

Students at RMIT University, Australia, recently completed a portable demonstration Rankine cycle heat engine (RCHE) which utilizes low-grade heat to produce electricity. In this system, low-grade heat of about 50ºC is used to vaporize the refrigerant R-123 in the evaporator. The high pressure vapour expands through the rotary screw expander where work is produced. The exhausting low-pressure vapour is condensed in a condenser, using mains cold water at 15ºC, and accumulates in a receiver. The refrigerant pump draws liquid from the receiver as required and increases the pressure to that corresponding to saturation temperature in the evaporator. RCHE can easily utilize heat from a solar pond to produce electricity, and simultaneously reduce the level of salinity in the water table. *Contact: Mr. Phil Munari, Australia. Tel: +61 (3) 9387 0238/5443 3732.*

Australian Energy News, December 1999

Environment-friendly biofuels

Scientists are striving to obtain eco-friendly fuel from substances that have been normally discarded – from grass clippings and chips to used vegetable oil. An important benefit of biofuels is their biodegradability. Biofuels used for transportation include bioethanol, biodiesel, biomethanol and pyrolysis oils.

Researchers at Penn State University have undertaken a project to run vehicles with clean-burning dimethyl ether (DME). DME is presently being used as an alternative to fluoro-chloro carbons in spray cans. Though DME is normally produced from methanol, it can also be obtained from natural gas and coal-derived syngas. Researchers found that DME had lower carbon monoxide emissions and similar or lower nitric oxide emissions than either butane or propane.

News Digest, Vol. 12, No. 36, 24 October 1999

Innovative renewable energy projects in Australia

The Australian federal government has offered financial assistance for nine novel projects under the Renewable Energy Commercialization Programme (RECP). Two of these projects are related to hot dry rocks (HDR), a resource with the potential to provide electricity from renewable energy. HDR energy is extracted by pumping water from the surface at high pressure down a bore hole into hot granite 3-5 km underground, where temperatures could exceed 200ºC. Under pressure, the water passes through fractures in the hot rock and is transformed into steam. This high pressure steam returns to the surface and drives a conventional turbine to generate electricity. A 1994 Energy Research and Development Corporation report indicates that Australia is likely to have substantial hot rock reserves.

The Australian National University (ANU) and Pacific Power will utilize the RECP grant to explore the extent of HDR resource in the strategically located Hunter Valley. The project involves drilling to a depth of 2.2 km to find out the hot rock temperature, and evaluate the feasibility of a HDR project. Results so far indicate a potential to deliver up to 4,800 MWe.

A prototype reservoir of fractured HDR will also be developed, with RECP funds, on a defunct gas and oil exploration well by the New South Wales' School of Petroleum Engineering. This project is aimed at resolving technical issues relevant to rock fractures, so that water can pass through without dispersing too widely and losing its heat and pressure.

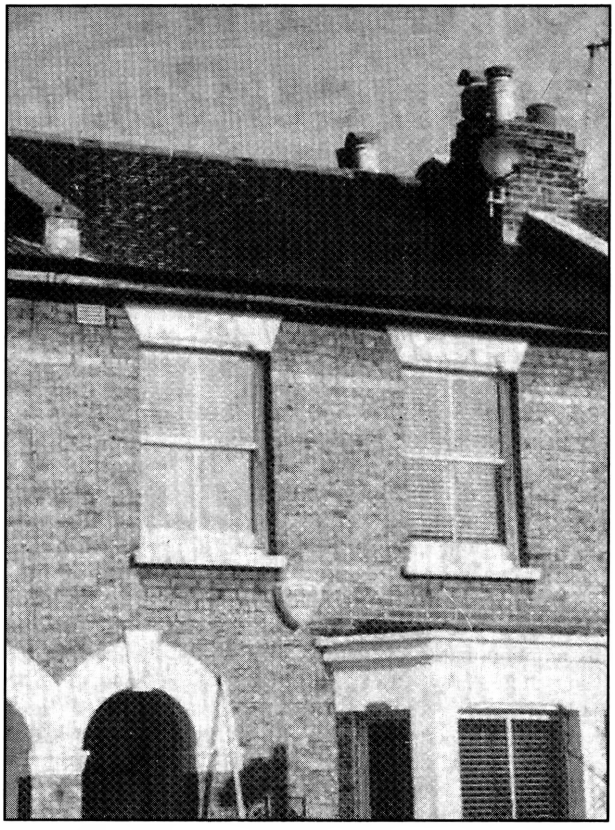
A model of the 80 kW integrated PV system

RECP grants have also been offered for developing:

- Better batteries;
- Solar pond technology;
- Inverters to link renewable electricity to the grid;
- Wind turbine technology; and
- Biofuels.

Australian Energy News, December 1999

Energy from aesthetic rooftops



A PV-tiled house that generates 68 per cent more energy than consumed by the household

New developments in photovoltaic (PV) technology are expected to replace roof-mounted solar units with PV tiles laid rooftops. Such rooftops are virtually indistinguishable from normal roofing tiles. The PV-tiles are fabricated using amorphous silicon with stainless steel. Nearly 8 per cent of solar energy falling on these tiles can be harnessed.

SolarCentury, has undertaken a pilot mortgaging project in the United Kingdom under which loans provided to install the equipment are paid back by exporting surplus energy to the grid. While the field trial will take place over 100 rooftops in the United Kingdom, Germany has reportedly committed to 100,000 solar-tiled homes by 2005. Japan plans to install 10,000 PV roofs in a year and the United States has targetted a million solar roofs by 2010. *Contact: Dr. Jeremy Leggett, SolarCentury. E-mail: solarcentury@hotmail.com.*

Appropriate Technology, Vol. 26, No. 2, September 1999

Solar products from the United States

United Solar Systems Corp., the United States, manufactures a complete line of standard solar electric panels from 3-64 W. All Uni-solar® panels feature a polymer lamination technique that does not use glass. A new series of Uni-solar roofing products emulate conventional roofing materials and are available in two varieties: standing seam metal roofing; and shingles.

Uni-solar flexible battery chargers are useful in marine and outdoor environments. They can easily be fitted under seat cushions or inside lockers and unlike other modules, they can continue to charge even when partially covered by shadows. Each individual unit of the Uni-solar rigid power module is packaged with efficient compact fluorescent lights, controller and other hardware. The power modules can be assembled into arrays to meet power needs of any size.

Contact: United Solar Systems Corporation, Corporate and Sales Office, 110, West Maple Road, Troy, MI 48084, the United States. Tel: +1 (248) 3624 170; Fax: +1 (248) 3624 442; E-mail: unisolarinfo@ovonic.com; Internet: http://www.ovonic.com/unisolar.html.

New range of German electronic solar regulators

Resol Elektronische Regelungen GmbH, Germany, is offering a range of electronic solar regulators. Resol-Midi is a user-friendly unit which combines a knob with integrated push button and allows users to access system menus and change control parameters within set limits. Some features of the regulator include:

- 4-digit text display to indicate measured values and adjustment of the control parameter;
- Six sensor inputs;
- Six relay outputs - one of them with speed control for controlling the solar pump; and
- Data output for connection of data teleindications and additional modules.

Resol Midi with the systems software RS600 is programmed with different basic systems for universal application in solar systems and has up to three stores. Individual programmes may be selected by the user as required. Optional additional programmes may be added to enable optimum control of the system and to facilitate expansion later on.

Other products from Resol include: Weather-compensated temperature regulators; combined heating and solar regulators; BUS-system and accessory parts; temperature sensors; and solar valves.

Contact: Resol Elektronische Regelungen GmbH, Heiskampstr. 10, D 45527, Hattingen, Germany. Tel: +49 (2324) 96480; Fax: +49 (2324) 964 855.

Breakthrough in solar cell technology

Developments at the Swiss Federal Institute of Technology could make solar cells almost as cheap as glass. Solar cells developed by researchers at the Institute have a photosensitive layer over a thin layer of titanium dioxide (TiO_2). These cells can convert light to electricity with energy efficiencies almost double that of current solid state silicon or germanium-based cells. When photons hit the photosensitive layer, electrons are freed and collected by the TiO_2 layer, creating an electric current. An amorphous organic material performs the functions of an electrolyte.

Chemical Weekly, 25 January 2000

Technology to maximize PV performance

PowerMax®, Siemens' proprietary technology, can optimize electrical performance of photovoltaic (PV) cells and modules in all types of environment. It includes the growth of high-purity single crystalline silicon ingots and special processes to optimize efficiency. The new multi-stage propriety TOPS™ process (Texture Optimized Pyramidal Surface) is part of the PowerMax technology. A key feature of the TOPS process is the special textural etching system which creates a pyramid-shaped surface, combined with an optimized anti-reflective oxide coating and surface passivation. This enhances light absorption even in low light.

Some features of Siemens' solar modules include:

- All solar cells are electrically matched to guarantee optimum power outputs;
- PowerMax single-crystalline solar cells deliver optimum power output even under reduced light or poor weather conditions;
- The PowerMax solar cell's textured surface has an anti-reflective coating which enables more light to be absorbed and hence achieves higher efficiency;
- Highly transparent tempered glass offers protection against wind, rain, hail and sand;
- Multiple contacts on the front and rear surfaces of each cell ensure maximum operational security;
- The use of a soft ethylene vinyl acetate (EVA) embedding medium offers protection from moisture, ensures ultraviolet stability and provides electrical insulation; and
- A multi-layer high-strength polymer back-sheet seals the rear of the module, providing protection against moisture and mechanical damage.

Internet: http://www.altonet.com/~solarpv/0800.htm

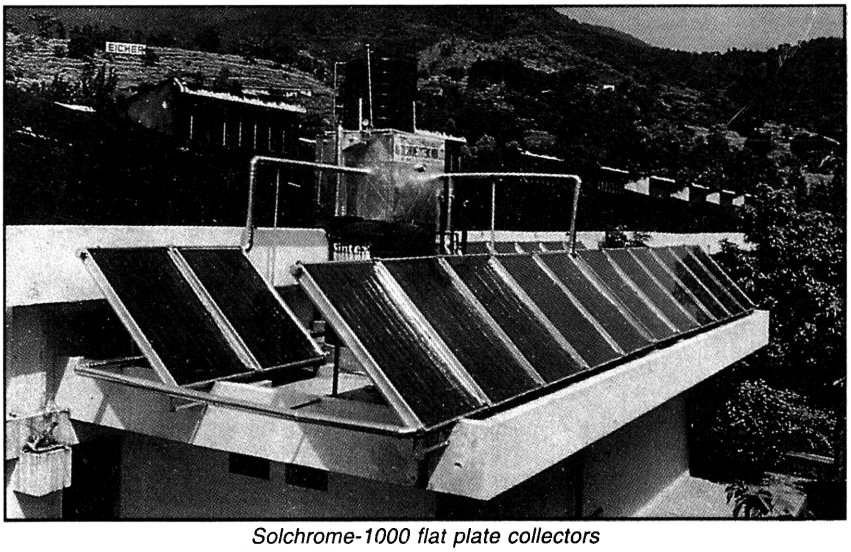
Flat plate collectors

Solchrome Systems India Limited, New Delhi, India, is offering solar flat plate collectors. Solchrome, a quality selective coating, is applied to one side of a clean copper sheet, nickel plated and finally electroplated with black chromium. About 96 per cent of the solar energy falling on Solchrome is absorbed while only 12 per cent of the absorbed energy is emitted. Even during low sunshine a collector using Solchrome can outperform a painted surface by delivering 2-3 times more energy.

Solchrome 1000 flat plate collectors are glazed with toughened/tempered glass. The unit's frame is fabricated using extruded aluminium while the back is made of an aluminium sheet. Some of the advantages offered by these modules include:

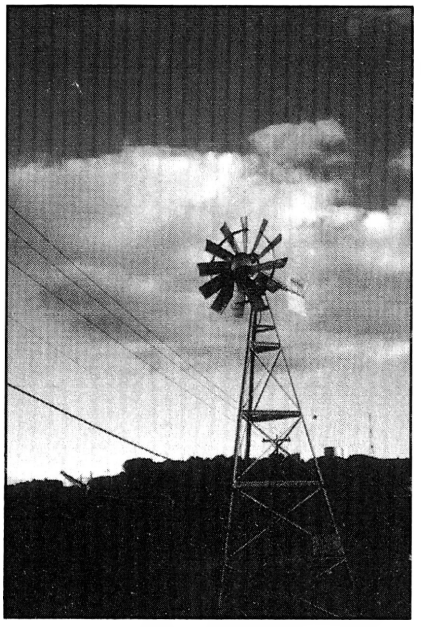
- 100 per cent thermal conductivity: through Tig weld interface eliminates the need for wraparound fin construction or deep solder fillet joints to achieve optimum heat transfer; and
- Joint durability: Weld strength, service life and corrosion resistance are on par with that of the parent metal.

Contact: Solchrome Systems India Limited, 161, Sukhdev Vihar, New Delhi 110 025, India. Tel: +91 (11) 6838 365/6848 228; Fax: +91 (11) 6835 160; Tlx: 031-75122.



Solchrome-1000 flat plate collectors

Windmill to clean contaminated soil in remote areas



Windsparge cleaning a petroleum-contaminated site at North Ontario in Canada

Conor Pacific, Canada, has developed a wind-powered system that can clean contaminated soil. The Windsparge system can clean-up biodegradable contaminants including petroleum, diesel, fuel oil and jet fuel. This inexpensive, low-maintenance and portable system is very useful for soil remediation in remote locations, where electricity is not available. Typical locations where the new system can be used include former gas station sites, areas along pipelines and wellheads, railway lines, airports, military bases, etc.

Windsparge consists of a simple windmill that directly drives a diaphragm pump to generate an effective flow of oxygen through the soil and groundwater. Air thus introduced promotes microbial growth which degrades the contaminants. To create sufficient airflow in the groundwater, air is allowed to accumulate in a pulse tank until adequate pressure and volume develops, at which point a strong pulse of air is released through the wells into the subsurface. Either a solar-powered control panel or a specialized mechanical pressure-release valve can be used to control the release of air.

Contact: Ms. Alexandra Marshall, Conor Pacific, Canada. Tel: +1 (905) 8220 331; Internet: http://www.conorpacific.com.

Renewable Energy World, January 2000

Enron turbines for Spain

Enron Wind Corp. will supply 100 variable speed wind turbines to Energias Eolicas Europeas (EEE), Spain. Energia Hidroelectrica de Navarra (EHN), Spain's largest renewable energy developer, has 50 per cent stake in EEE. The EHN/EEE group had about 418 MW of installed wind power capacity ending December 1999. Enron will supply TZ-750 kW series turbines which will be manufactured by its Spanish manufacturing entity, Tacke Energia Eolica.

Renewable Energy World, January 2000

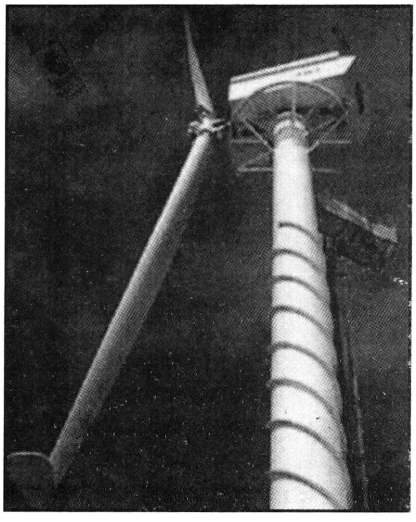
New tool for designing turbine blades

A Numerical Manufacturing and Design Tool (NuMAD) to help design better turbine blades has been developed by Sandia National Laboratories, the United States. NuMAD is a user-friendly, X-windows based (GUI) pre-processor and post-processor for the ANSYS® commercial finite element engine. It helps users to quickly and easily create a 3-D model of a turbine blade and perform structural and modal analyses. The modal capabilities allow for both unstressed and pre-stressed blades. Structural analysis allows for both static and dynamic loads as well as linear and non-linear buckling solutions.

The model types accessible through NuMAD include 3D beams and 3D structural shells/solids. NuMAD is intended to reduce model development time and increase usage of advanced finite element analysis capabilities. Users can import blade geometry descriptions from other packages or even interactively "build" blade geometries by selecting airfoil profiles, chord lengths, etc. The materials database contains both isotropic and composite materials and all databases for materials, loading conditions and airfoil profiles are text-based and can be easily modified or augmented.

Contact: Mr. Daniel Laird, Sandia National Laboratories, Albuquerque, NM 87185-0708, the United States. Tel: +1 (505) 8446 188; E-mail: dllaird@sandia.gov.

Wind turbines from the United States



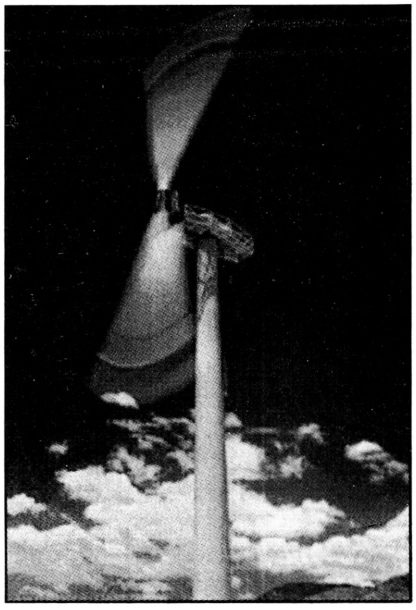
275 kW Advanced wind turbine

In the United States, Advanced Wind Turbines is offering a 275 kW windmill. AWT-26 is a downwind, stall-regulated, free-yaw machine which

incorporates a innovative two-bladed teetered motor. An ESI-80 turbine is coupled with 26 m rotor comprising aerodynamically efficient wood-composite blades. The new blades improve the turbine's energy capture from 20 per cent to about 70 per cent, depending on wind speed and the degree of blade soiling from dirt and insects. AWT-26 also features a redesigned high-speed shaft brake and new aerodynamic tip vanes.

Atlantic Orient Corporation's AOC 15/50 is an improved and simplified version on the Enertech 44/60 wind turbine. The three-bladed, downwind, stall-regulated turbine has a rotor diameter of 15 m and features passive yaw control, wood epoxy composite blades incorporating special airfoils, aerodynamic tip brakes, an electrodynamic brake and an integrated drivetrain. It is ideal for remote, stand-alone applications, village power systems and small wind plants.

FloWind's 300 kW EHD is a Darrius (eggbeater-shaped) vertical-axis wind turbine. Its three blades spin about an axis perpendicular to the ground, capturing energy from winds blowing from all directions. High-performance 17-21 m rotors incorporating advanced airfoils are used in the EHD series. The EHD's low-cost blades are manufactured using a new, automated pultrusion technique wherein fibre-resin blades are pulled through a die.



250 kW two-bladed windmill

New World Power Technology Company has developed a 250 kW windmill. North Wind 250 is a two-bladed teetered, upwind machine which features an integrated drivetrain, aileron controls and an innovative rotor that is fabricated as a single unit. The unique flow-through, teetered-rotor design eliminates structural discontinuities at the blade/hub interface by fabricating the rotor as one continuous structural element. The hub incorporates teeter dampers and an active teeter brake. The rotor is made of a hybrid composite material. *Contact: National Wind Technology Centre, National Renewable Energy Laboratory, Department of Energy, the United States. Internet: http://www.nrel.gov/wind/index.html.*

Offshore turbines

The new 2-2.5 MW turbines have made 1.5 MW machines look small. N-80, Nordex's latest 2.5 MW model has a 80 m rotor diameter and a hub height of 60-100 m. This model will be used in the forthcoming Rostock offshore wind farm, set to be the first off the German coast. Vestas already has a 2 MW offshore version of its V66 machine. NEG Micon has adapted its 1.5 MW machine as a 2 MW offshore model. A 2.5 MW unit is being developed with assistance from the European Commission.

Tacke has also created a 2 MW offshore version of its 1.5 MW machine. The latest version incorporates additional features to reduce maintenance efforts. Bonus' 2 MW turbine prototype has been selected for the Middelgrunden wind farm. The 70 m rotor turbine uses CombiStall® technology.

Enercon has announced development of its E-112 4.5 MW offshore turbine, which is expected to have a hub height of 130 m and a rotor diameter of 112 m. Aerodyn has a 5 MW 'Multibrid' turbine which it plans to use in a 300 MW project off the coast of Schleswig Holstein.

Renewable Energy World, January 2000

1998 Winners in Wind Power

The ten leading countries in terms of installed wind power capacity for 1998 are as follows:

Countries	Cumulative capacity beginning 1998 (MW)	Cumulative capacity beginning 1999 (MW)	Growth during 1998 (%)
Germany	2,080	2,873	38.1
United States	1,584	1.819	14.8
Denmark	1,116	1,380	23.7
India	950	968	1.9
Spain	512	907	77.1
Netherlands	325	359	10.5
United Kingdom	320	330	3.1
China	166	190	14.5
Italy	100	154	54.0
Sweden	117	148	26.5

(Renewable Energy World, May 1999)

Direct-hydrogen fuel cell systems for automobiles

In the United States, the Department of Energy, with Ford Motor Company and International Fuel Cells as research partners, is developing a new zero-emission fuel cell system for automotive applications. The novel fuel cell system operates on direct hydrogen and is expected to achieve weights and volumes competitive with that of conventional internal combustion engine propulsion units. Some of the benefits of this technology include:

- With a weight of about 140 g and a volume of 8 ft^3, the system can be easily fitted under the hood of a car;
- Achieves 2-3 times higher fuel efficiency compared with that of conventional engines;
- Uses non-petroleum fuel; and
- Zero-pollution.

Contact: Ms. Donna Lee Ho, the United States. Tel: +1 (202) 5868 000; Internet: http://www.ott.doe.gov/oaat/dhfuel.html

Petroleum-based fuel cell demonstrated in the United States

In the United States, fuel cells using petroleum as the fuel have been developed under the Partnership for a New Generation of Vehicles. A consortium comprising Arthur D. Little, Ballard Power Systems, Plug Power L.L.C., Los Alamos National Laboratory and the Department of Energy, has successfully demonstrated a fuel cell system which can generate electricity from various fuels including petroleum, natural gas, methanol and ethanol. Some advantages of the new fuel cell system include:

- Compared with petroleum-based conventional vehicles, fuel economy offered by the new system could double;
- Runs 100 times cleaner than conventional automobiles;
- Reduces greenhouse gas emission by 50 per cent;

  and
- Uses readily available fuel, e.g. petrol.

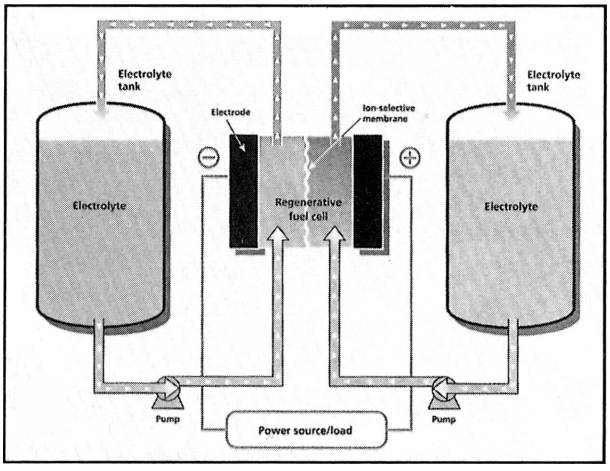
Contact: Mr. Pat Davis, the United States. Tel: +1 (202) 5868 061. Internet: http://www.ott.doe.gov/oaat/gtfuel.html

Fuel cell based on hydrogen and air

BG Technology and Alston are trying to develop a fuel cell based on proton exchange membrane technology. The cell will transform energy from hydrogen/oxygen reactors into electrical power without producing toxic emissions.

In this cell, hydrogen and oxygen react without mixing. Hydrogen

Regenerative fuel cell



Electrolyte and electrical connections in a single regenerative fuel cell

National Power Plc. (NPP) is planning to build an energy storage plant, with a capacity of up to 15 MW/120 MWh, at one of its site in the United Kingdom. The Regenesys™ system to be utilized in this project is based on regenerative fuel cell (RFC) technology. A RFC is neither a battery nor a fuel cell. The fuel, electrical energy in this case, is converted into chemical potential energy by charging two liquid electrolyte solutions. The stored energy is subsequently released on discharge. Unlike batteries, RFCs have no restrictions regarding energy capacity and they have inert electrodes which act only as an electron transfer surface. These electrodes do not take part in the electrochemical process and thus have no influence on energy storage capacity. The Regenesys system uses electrolytes of concentrated solutions of sodium bromide and sodium polysulphide.

RFCs, also known as flow batteries, have dynamic operating capabilities including quick start, quick switching from charge to discharge modes and can be modulated by a control system. They neither emit pollutants nor consume water. Moreover, RFCs do not require either large areas of land or storage reservoirs. NPP's scheduled utility-scale energy storage plant construction is expected to proceed in parallel with module component fabrication and assembly. The total installation cost of a Regenesys system includes power modules, power conversion system, energy costs (tanks and chemicals), process plant (thermal and environmental management), pipes, valves, electrical, instrumentation and control, building works, project management, contingency and grid connection.

Renewable Energy World, January 2000

and air streams pass on either side of an electrolyte membrane which allows only hydrogen ions and electrons to pass through. BG Technology has also developed a compact steam reformer for converting natural gas into hydrogen by using water shift reactors, where methane and water react over a nickel catalyst to yield carbon monoxide and hydrogen.

Chemical Industry Digest, November/December 1999

PEM fuel cell in the offing

International Fuel Cells, the United States, is developing proprietary PEM fuel cell technology suitable for vehicle, stationary, portable and aerospace applications. This development builds on solid polymer electrolyte technology provided by General Electric. IFC's PEM cell utilizes the carbon/graphite design and manufacturing, and the associated electrode catalyst technologies developed for the PC25 fuel cell power plant. The company's passive water management approach simplifies the power plant system and achieves maximum performance from the electrode and membrane technology under any operating condition.

A 50 kW power plant has been designed and fabricated for air operation under a Department of Energy subcontract to Ford Motor Company, under the Partnership for New Generation Vehicle initiative. Current IFC development activities include: advancing the size, weight, performance and manufacturing cost of the PEM cell stack to establish the basis for commercial application.

Contact: International Fuel Cells, 195, Governors Highway, P.O. Box 739, South Windsor, CT 06074, the United States. Tel: +1 (860) 7272 200; Fax: +1 (860) 7272 319; Internet: http://www.international fuelcells.com/experts/pem/activities.shtml

Fuel cell powered by methane from wastewater plant

GEW Koln AG, Germany, will use a fuel cell to recycle waste methane from a sewage treatment plant to produce electrical and thermal energy. The PC25 fuel cell was developed by International Fuel Cells Inc., the United States, and supplied by ONSI Corporation. In this fuel cell system, an electrochemical process converts chemical energy into electricity and hot water. Each ONSI PC25 fuel cell generates 200 kW of electricity and more than 700,000 Btu/h of heat, which will be utilized in the sewage treatment process.

At present, IFC's fuel cell system has been installed at four wastewater treatment plants and two landfills in the United States, at three wastewater plants in Japan and at nearly 200 other sites.

Renewable Energy World, January 2000

SOFC technology developed in Australia

Ceramic Fuel Cells Ltd. (CFCL), based in Victoria, Australia, has developed and patented technology for solid oxide fuel cell (SOFC). SOFC comprises a thin sheet of zirconia-based electrolyte, which is coated on both sides with porous electrode materials. When fuel is passed over one side of the sheet and air over the other, a chemical reaction occurs, which involves a flow of negatively charged oxygen ions across this sheet. This creates an exploitable electric current which continues to flow as long as the fuel and air are available.

SOFC is the most efficient fuel cell technology which can reduce both energy costs and greenhouse gas emissions. These cells also produce high-grade heat for cogeneration applications. Some of the benefits offered by CFCL's products include:

- Customer control over generation to ensure power integrity;
- Easy to operate;
- Reliability;
- High-grade waste heat, for heating and cooling;
- High-efficiency operation;
- High-quality power availability;
- Quiet and low-emission operation; and
- Easily connected modular units, to facilitate incremental expansion if required.

Contact: Ceramic Fuel Cells Limited, 170, Browns Road, Noble Park, Vic 3174, Australia. Tel: +61 (3) 9554 2300; Fax: +61 (3) 9790 5600; E-mail: enquiries@cfcl.com.au.

Renewable Energy in Australia

IN THE PAST YEAR, THE AUSTRALIAN GREENHOUSE OFFICE HAS COMMITTED $22 MILLION TOWARD PROJECTS TO COMMERCIALISE AND SHOWCASE RENEWABLE ENERGY. OVER THE NEXT FIVE YEARS ANOTHER $45 MILLION WILL BE INVESTED IN INNOVATIVE RENEWABLE ENERGY EQUIPMENT, TECHNOLOGIES, SYSTEMS AND PROCESSES.

UP TO $20 MILLION IN GOVERNMENT FUNDING THROUGH THE RENEWABLE ENERGY EQUITY FUND WILL SUPPORT INNOVATIVE COMPANIES TO DEVELOP RENEWABLE ENERGY TECHNOLOGIES THROUGH PROVISION OF VENTURE CAPITAL. THE FUND IS TO BE MATCHED ON AT LEAST A 2:1 BASIS WITH PRIVATE SECTOR FUNDING.

ALL TECHNOLOGIES ARE BEING DEVELOPED WITH A VIEW TO MASS PRODUCTION FOR BOTH DOMESTIC AND, WHERE APPLICABLE, INTERNATIONAL MARKETS.

CONTACT: *AUSTRALIAN GREENHOUSE OFFICE, GPO BOX 621, CANBERRA ACT 2601, AUSTRALIA TELEPHONE: +61262741888, FACSIMILE +612627411729, EMAIL: COMMUNICATION@GREENHOUSE.GOV.AU, INTERNET: WWW.GREENGOUSE GOV.AU*

Solar Air Systems: Product Catalogue

This booklet provides an outline of the types of systems used and a description of the components, including: collectors, storage, fans and dampers, controls and heat exchangers. Their uses and typology have been outlined and samples of product sheets from manufacturers have been provided.

Solar Electricity

Photovoltaic (PV) engineering is of an interdisciplinary nature. The main objective of this book is to summarize the prerequisite knowledge in the areas of semiconductor devices, materials, solar radiation, statistics, etc. Topics covered in this book include:

- Energy problems and PV solutions;
- PV generator;
- Solar radiation;
- Sizing of stand-alone PV systems;
- Concentration cells and systems; and
- Manufacturing technology for silicon solar cells.

World Directory of Renewable Energy Suppliers and Services 1999

This ninth edition of the World Directory is the most comprehensive annual guide to the renewable energy industry. It features contact details of about 5,000 companies worldwide and updated information on their activities. More than 700 classification headings facilitate easier identification of specific suppliers. Companies active in the following fields have been listed:

- Photovoltaics;
- Solar thermal;
- Geothermal;
- Hydro, wave and tidal;
- Energy storage;
- Finance, insurance and legal issues; and
- Rational use of energy.

For any of the above publications:

Contact: James and James (Science Publishers) Ltd., 35-37, William Road, London NW1 3ER, the United Kingdom. Tel: +44 (171) 3878 558; Fax: +44 (171) 3878 998; E-mail: orders@jxj.com; Internet: http://www.jxj.com.

18-21 Apr
Shanghai
China

International Exhibition on New Energy, Renewable Energy and Energy Saving 2000
Contact: Coastal International Exhibition Co. Ltd., Rm. 3808, China Resources Building, 26 Harbour Road, Wanchai, Hong Kong.
Tel: +852 2827 6766.

30 Apr-4 May
California
United States

Windpower 2000
Contact: American Wind Energy Association, 122 C Street, N.W, 4th Floor, Washington D.C 20001, The United States.
Tel: +1 (202) 3832 500;
Fax: +1 (202) 3832 505;
E-mail: laura_keelan@awea.org.

28 May-10 Jun
Kyushu
Japan

World Geothermal Congress 2000
Contact: New Energy and Industrial Technology Development Organization, 3-1-1 Higashi-Ikebukuro, Toshima-ku, Tokyo 170, Japan.
Fax: +81 (3) 3987 5796;
E-mail: info@wgc.or.jp

5-9 Jun
Sevilla
Spain

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

1-3 Jul
Brighton
United Kingdom

Renewable Energy 2000
Contact: Sales Manager, Renewable Energy 2000, Reed Exhibition Companies Ltd., Oriel House, 26 The Quadrant, Richmond, Surrey TW9 1DL The United Kingdom.
Tel: +44 (1763) 838 639;
Fax: +44 (1763) 837 320;
E-mail: marilyn.driscoll@reedexpo.co.uk.

30 Jul-4 Aug
Aspen
United States

IPS-2000: 13th Intl. Conference on Photochemical Conversion and Storage of Solar Energy
Contact: The Secretariat, IPS-2000 NREL, 1617 Cole Blvd., Golden, CO 80401-3393, The United States.
Tel: +1 (303) 3846 611;
Fax: +1 (303) 3846 655;
E-mail: ips2000@nrel.gov;
Internet: http://www.nrel.gov/ips2000/

ENVIRONMENT INDIA 2000

Water India 2000

3rd Annual International Exhibition, Conference & Film Festival
18 - 21 April 2000 Pragati Maidan, New Delhi, India

Environment India 2000

- Environment India 2000 will cover all aspects of modern environmental management.
- Solutions in areas of effluent treatment, pollution control, solid waste management, alternate energy sources, environmental engineering / protection, impact assessment, environmental audit etc. will be showcased.

Water India 2000

- Water India 2000 will lay special emphasis on appropriate technology and infrastructure for industrial and municipal wastewater treatment.
- Management, products and services for drinking water, water supply, conservation, recycling, distribution, sampling, analysis and purification, including pumps, pipes, valves, filtration equipment, etc. will be displayed.

European Union Pavilion

- A European Union Pavilion will be a major attraction at the event.
- 50 European and Asia based organisations that are 30% owned by EU Companies will showcase their technological advancement and services offered.
- EU Pavilion participants are entitled to a 40% subsidy upto 4000 Euro per organisation.

Co-organiser :
Government of India, Ministry of Water Resources

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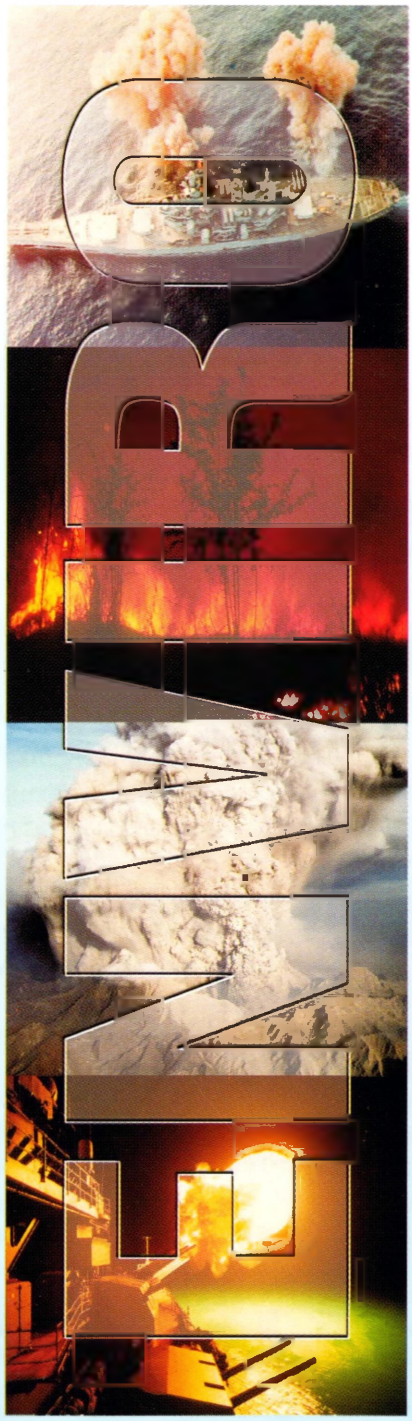

2000 ENVIRO INTERNATIONAL

2nd INTERNATIONAL TRADE FAIR + SEMINAR ON TECHNOLOGIES FOR ENVIRONMENTAL MANAGEMENT
SEPTEMBER 27 - 29, 2000, PRAGATI MAIDAN, NEW DELHI, INDIA

Exhibitor Profile

■ Air Pollution, Gas and Dust Control Equipment & Technology ■ Audit Refractory Equipments ■ Nature & Natural Resources Conservation of the Flora Fauna, Wild Life, Forests, Genetic Resources, Water, Soil and Eco - Systems, Bio - diversity, Endangered and Threatened Plant, Spices Technologies and Management ■ Aquatic Eco - Systems Fresh Water, Marine Estuarine and Soil Ecology Technologies and Managment ■ Biotechnology in Waste & Water Treatment Plants & Technologies ■ Environmental Conservations & Renewable Energy & Technology ■ Eco-Friendly Building Systems ■ Environmental Projects & Finance Institutions ■ Green Production Technology ■ Industrial Pollution & Recycling of Industrial Wastes ■ ISO 1400 Standards ■ Land Fill Projects ■ Noise & Vibration Abatement ■ Sewage Treatment and Sludge Disposal

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Objectives

● Major exposure to latest innovations in Technologies, Equipment and Services ● Participation of Indian and Overseas Companies ● Display of high growth and export potential areas ● Participation from Central and State Govt. Organisations, PSU's and Private - Large, Medium and Small Enterprises ● Over 25,000 business visitors expected to Visit and Interact ● One to one business meetings will be arranged during the Exhibition.

सत्यमेव जयते

Ministry of Environment & Forests, Govt. of India

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