

VATIS UPDATE

Non-conventional Energy

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Highlights

- Software on energy conservation ●
- Solar generator uses ocean for storage ●
- Power from the water wheel ●
- Sunlight collection/transmission system ●
- Chemical energy from solar energy ●
- Europe's largest wind farm ●



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

Europe's largest wind farm in Wales, UK.

(Courtesy: Spectrum)

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Non-conventional Energy
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IN THE NEWS

Thailand promotes alternative fuel

The Electricity Generating Authority of Thailand (EGAT) has begun a second round of electricity purchases from small power producers (SPPs), who use non-conventional fuels such as biomass. The state utility is aiming to promote power generation from non-conventional fuels including rice husks, community wastes and wood wastes. Unlike the previous SPP purchase round, which set the limit at 1,720 MW and was fully subscribed by 50 groups, there is no restriction on EGAT purchases from SPPs during this round.

In a related development, the Soon Hua Seng Group of Thailand has begun construction of its seventh power plant with a capacity of 300 MW. GEC Aisthom will supply the turbogenerators for the plant, while Goster Wheeler will supply two Pyroflow Compact CFB boilers. The plant, which is planned for commissioning in 1998, will partly use local bio-fuel. EGAT will buy 60 per cent of the power output. The remainder, along with the generated steam, will be distributed among customers within the Prachinburi industrial zone. (COGEN Special Issue, March 1997)

Alcohol as vehicle fuel

As India has abundant biomass reserves, alcohol as an alternative transport fuel is viable. Ethanol and petrol mixed in the ratio 20:80 per cent can be used in cars without modifying the engine. Ethanol does not have any greenhouse effect and, when mixed with petrol, reductions in carbon monoxide emissions of 10-30 per cent can be achieved, depending on the vehicle's fuel system and the emission control technology.

Ethanol has approximately two-thirds the energy value of an equivalent volume of petrol. Hence, a petrol-ethanol mix containing 10 per cent ethanol by volume, will have 3.3 per cent less energy per litre of petrol. However, since ethanol is an octane enhancer, the fuel will burn more efficiently and offset this disadvantage. Trial

projects with alcohol fuel conducted by the Indian Institute of Petroleum and sponsored by the Ministry of Non-conventional Energy Sources have revealed that there is a 33 per cent reduction in visible smoke emission when blends containing 12-15 per cent ethanol were used. (Down to Earth, 30 April 1997)

Open renewable energy window in the Philippines

The National Power Corporation (NPC) of the Philippines, in support to the Department of Energy's (DOE) policy for the development of new and renewable energy sources (NRES), is considering to open a window in its Power Development Programme for the entry of 50 MW per year NRES projects starting from 1998. The goal is to have installed 300 MW of generating capacity from NRES by the year 2003. The objectives of the new policy are:

- to support the establishment of renewable energy power projects that could be economically added into the grid;
- to sign long-term power purchase agreements (PPAs) with a broad spectrum of renewable energy technologies; and
- to supplement petroleum-based generation in small islands with indigenous NRES technologies.

It is expected that renewable energy projects will be implemented in greater magnitude and will encourage the private sector's participation in the utilization of these resources. (COGEN Special Issue, March 1997)

Power from sewage treatment plant

In India, the National Bioenergy Board (NBB) has signed Memoranda of Understanding (MoU) with various organizations for initiating waste to energy projects. An MoU was recently signed for setting up a 1 MW gas-based power plant using methane as fuel, obtained from the sewage treatment plant of the Bangalore Water Supply and Sewage Board (BWSSB) at Koramangla & Challaghatta Valley (K&C valley). The project cost will be borne equally by the NBB

and BWSSB. The Indian Institute of Science (IISc) will provide technical assistance for the project. The K&C Valley treatment plant has a maximum capacity of 163 million litres. However, the present inflow of about 110-120 million litres of sewage generates nearly 8,000 m³ of gaseous fuel. Hence, the initial generating capacity of the plant is likely to be around 600 kW.

An MoU has been signed between the NBB and the Jammu Development Authority for setting up a 10 tpd biomethanation project using vegetable market-yard waste. The civil and mechanical work is expected to be completed by July 1997. (Bio Energy News, March 1997)

Geothermal energy in Germany

The search for oil and natural gas in Mecklenburg-Western Pomerania, Germany, during the 1960s yielded reservoirs of hot water. In the mid-1980s, the first test drills began in Neustadt-Glewe. A reservoir with the highest temperature (100°C) detected so far in Germany was tapped at a depth of 2,250 m here and is now being exploited. The reservoir is accessed with the help of two bores, a delivery and a compression bore. The hot water rises on account of its own pressure up to approximately 100 metres below the earth's surface and is then transported to the geothermal plant. Here, a heat exchanger transfers heat from the water to the piped water which is sent to the consumers. The hot water, which has now cooled to a temperature of 45°C, is injected through the bore and sent back to the depth of 2,250 m.

Geothermal energy enjoys a major advantage over other sources of renewable energy – it is not dependent on meteorological fluctuations and is available on a regular and steady basis, day and night all round the year. Since geothermal energy does not discharge any emissions, in comparison with oil or gas-based power plants which emit around 6,000 tonnes of CO₂ per year, it is eco-friendly. (German News, April 1997)

Irish Energy Research Group

The Energy Research Group (ERG) based at the School of Architecture in University College Dublin, Ireland, undertakes research, devel-

opment, consultancy, education and information activities on energy use in buildings and on climate-sensitive architectural designs. It has a clientele of several Directorate-Generals of the European Commission.

Under APAS-RENA, the group is involved in the field of low-energy building systems and passive solar energy use in a project known as ENERGIEPAKET – energy packages for municipalities, islands and regions for the creation of new supply structures using renewable energies. In the JOULE R+D programme, ERG coordinates SOLINFO – a project that involves working with some of Europe's leading architects and making available the latest design tools and expertise from European R+D. It also participates in DAYLIGHT EUROPE, contributing to the production of design guidelines for the appropriate integration of daylighting technologies in non-domestic buildings and the presentation of selected case studies throughout Europe for practising architects and building engineers. It is also active in the ALTENER and THERMIE programmes. *Contact: Energy Research Group, School of Architecture, University College Dublin, Richview, Clonskeagh, Dublin 14, Ireland. Fax: +353 (1) 283 8908; E-mail: erg@erg.ucd.ie.* (Energy Update, Issue 2, 1997)

Gas-based power plants to be put up in Norway

Naturkraft, Norway, is planning to build two gas-based power plants with concessions from the government. An estimated 58 per cent of the energy in the gas will be converted into power. Each plant will generate about 350 MW but, unless alternative technology is used, emit 1 million tonnes of carbon dioxide (CO₂) and 480 tonnes of nitrogen oxides (NO_x). Hence, the company could be ordered later on to invest in technology to stop CO₂ discharges, which would double the construction cost of the power plants and running costs could also increase by up to US\$25 million a year.

Kvaerner, a Norwegian engineering firm, has conducted research on the separation of CO₂ from exhaust gas in order to re-inject and store the greenhouse gas under the seabed. If successful, the process could be put into

operation by 2002. An alternative to re-injecting CO₂ under the seabed would be to put it to use. A proposal offered involves the utilization of the rock anorthosite – which is composed almost entirely of soda-lime feldspar and found in the mountains at Gudvangen, about 100 km north-east of Bergen. It could be used to convert all the CO₂ emissions into useful products. Dissolved in nitric acid, the rock would react with CO₂ to produce raw materials for aluminium, artificial fertilizer, explosives and cement, as well as for water purifiers. (Norway Now, May 1997)

Sustainable energy policy on the anvil in Australia

In December 1996, the Commonwealth Minister for Resources and Energy, Senator Mr. Warwick Parer, issued a Green Paper on a "Sustainable Energy Policy for Australia" and invited comments by the end of January 1997. The Academy Sustainable Development Committee, had made a submission to the previous government's White Paper process on the same subject, and it was decided to supplement this with another submission building upon the first.

The Green Paper on sustainable energy policy strongly emphasizes the need for greater efficiency in energy use and offers a general background for the development of such a policy. The policy requires the setting out of a strategic energy mix for the near and long terms which should aim to satisfy the energy needs of the present and future generations. Australia's electricity is primarily generated by coal, while the transport industry uses petrol and diesel. Both industries are therefore considerable producers of greenhouse gases. A massive though staged effort is needed to increase the efficiency in electricity generation and utilization.

Some important recommendations are:

- Australia should strongly support the adoption of "emission reduction credits", with consideration being given to joint implementation projects;
- Government should consider the promotion of low-pollution cars, like electric and hybrid cars, and the conversion of vehicles to gas;

- Expansion of energy audits and evaluation of tax concessions for implementation of approved audit recommendations should be considered;
- The government should support and incentives for R&D; and
- There is a need for continued liaison, collaboration and cooperation between the Federal and State Governments on energy and energy related environment issues and initiatives. (ATSE Focus, Jan-Feb 1997)

Sri Lanka looks to wind power

Sri Lankan officials have announced plans to build wind power capacity to boost electricity supply following a drought-induced power shortage last year. Tenders for a 3 MW pilot plant are under way, and the Ceylon Electricity Board plans to invest up to US\$2 billion in wind and coal projects to diversify the energy base in the coming decade. The current 10-year plan would double generating capacity from 1,250 to 2,500 MW. Sri Lanka relies heavily on hydroelectric power, which provides 84 per cent of its current capacity. (Power Engineering International, March/April 1997)

Japan plans largest residential PV programme

If the present budget proposals for the fiscal year beginning this April are approved, some 9,400 residences in Japan will get 4 kW rooftop photovoltaic (PV) systems in what would be the largest residential PV programme in the world.

The budget proposals has already been approved by the Sub-committee of the Basic Policy Directions of the Advisory Committee for Energy. Japan already has the largest residential PV rooftop programme in the world, with 1,866 systems to be installed this year. If the proposed programme for PV system on 9,400 residences is approved, it would represent a five-fold increase. At an average 4 kW per rooftop PV system, this programme alone would create a 35 MW market for the international PV industry during the period April 1997 to March 1998. (Abstracts of Selected Solar Energy Technology, April 1997)

INVENTIONS/ NEW PRODUCTS

Software on energy conservation

CASAMO is a computer tool for designing buildings with pleasant thermal comfort conditions or air-conditioning with low energy consumption, or for calculating the dimensions of an air-conditioning system. The major features of this software jointly developed by the French Environment Management Agency (ADEME) and the Energy Programme, Asian Institute of Technology (AIT) are:

- hour by hour changes of characteristic comfort variables inside a building;
- study of a main area with or without a ventilated or unventilated attic;
- comfort study of room(s) in a building;
- study of the most exposed living area, rather than the entire building;
- analysis for a single day representing the worst climatic condition in the year; and
- study how the various parameters affect overheating.

Based on the data obtained, the software helps narrow down the approach to the best solution. The software comes in two 3-½ or 5-¼ inch floppies and can run on standard PCs. The comprehensive documentation includes a user's guide, technical manual and case studies. The package costs US\$300. *Contact: RERIC/AIT, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand. Tel: +66 (2) 524 5866; Fax: +66 (2) 524 5870; E-mail: enreric@ait.ac.th.* (RERIC News, December 1996)

Solar cell installation on dry riverbeds

The Central Research Institute of Electric Power Industry, Japan, has proposed a new solar cell installation, in which a solar cell power generation system can be installed on a dry riverbed or on structures.

The two methods proposed – monopole and hanging – are expected to decrease installation cost substantially. In the monopole type, a 1 kW panel is supported by a monopole and is installable at dry riverbeds. In the hanging type, the equipment is hung from a hook on existing structures. With such measures, the construction cost will reportedly decrease substantially, by half if the solar systems are mass-produced. The expected power generation capacity of the solar cell system will increase from 247,000 MW to 465,800 MW. (Techno Japan, February 1997)

Solar maize drier

A solar crop drier, which dries 90 kg of maize from about 33.3 per cent moisture content (dry basis, db) to 14.3 per cent db in one day of clear weather conditions, has been developed by researchers at the University of Malawi, Malawi. The drier consists mainly of a solar air collector that can be occasionally oriented to increase solar gain, a small photovoltaic-powered d.c. fan sized to give optimum drying rate, and passive temperature control to ensure that the grain is not heated above 60°C. Solar, thermal and electrical characteristics of the drier have been measured using a simulator in Scotland and under field conditions in Malawi. A collector thermal efficiency of 80 per cent and a drying efficiency of 58 per cent have been obtained for the drier. (ASSET, April 1997)

Solar generator uses ocean for storage

Ocean Thermal Enterprises Inc. (OTE) of Virginia has developed a low-cost solar energy generator that captures and stores solar energy on the surface layer of the ocean and runs 24 hours a day, 365 days a year.

The generator is versatile, because a single module could produce as few as four or up to 16 MW of electricity. The new design has a longer life because it does not consume any fossil fuel and is favourably competitive with conventional fossil-fuel heaters. Patented in the United States, the OTE generator is modular and compact. It can also be configured to produce desalinated water at an effective rate

of \$1.12 to \$3.13 per thousand gallons, making it useful in tropical zones where fresh water is often scarce and expensive. The process employed is large-scale flash distillation, which condenses and collects evaporated water. *Contact: Ms. Linda Welch, Ocean Thermal Enterprises Inc. (OTE), Oakton, Virginia, the United States. Tel +1 (703) 359-6920.* (New and Advanced Materials, 1996/1&2)

Compact solar still using tetrafluoroethylene nets

Researchers from the University of Rhykyus, Japan, has proposed a solar energy-based distilling unit, which consists of an evaporating wick, a condensing wick and a tetrafluoroethylene net sandwiched between them.

Water vapour diffuses through the spaces in the net from the evaporating wick to the condensing wick. After theoretically and experimentally analysing this unit, a 10-unit model of a multi-wick solar still was made. Compared with a conventional 10 mm gap unit, its internal temperature drops were found to be drastically lower, at the cost of only small decreases in productivity. As the net-unit stills are only about one-third as thick as the a still consisting of ten conventional 10 mm gap units, they allow a much more compact design and have greater productivity than the latter. These findings have led the researchers to propose a wick/net/wick layered unit for a multi-wick solar still. (ASSET, April 1997)

Better selective-surface coating developed

Manufacturers of solar thermal absorber plates in the United States will soon be able to use a new selective-surface coating that has better performance and is more stable at high temperatures than the widely used black chrome. The new four-layer coating is being developed for high-temperature, flat-plate applications by Sandia National Laboratory of New Mexico and Energy Laboratories of Florida.

The coating process starts with a substrate, usually copper. The first step is to activate the

copper surface and then electroplate it with electrically enhanced nickel. Then a binary-compound crystal is grown to create upward-pointing dendrites or bumps that, under an electron microscope, resembles a pine forest – hence the process is named “Black Forest”. The final layer is an amorphous, transparent glassy material – a nanometre thick, that fills in the spaces between the binary-compound “pine trees” – applied through an evaporation process like cladding quartz and becomes an oxide barrier freezing the dendrites. Epsilon (emissivity) of the surface of a commercial product using Black Forest is anticipated to be about 0.10 to 0.12, with better ratings demonstrated in lab runs. A prototype coating line for copper strips to be fabricated into solar absorber plates is also being tested. The process does not use chrome or other toxins or carcinogens. The materials used are safe enough to allow for landfill disposal. The coating was tested at 300°C for 400 hours and no property changes were found. (New and Advanced Materials, 1996/1&2)

Low-cost water pasteurization

Solar puddle is a new device for decontaminating water in a relatively inexpensive way. A 3-½ x 3-½ ft pit is dug and filled with a solid insulation – wadded paper, straw, grass, leaves or twigs could be used – to a height of 2-4 in. This layer of insulation should be made flat, except for a low spot in one corner of the puddle. A layer of clear plastic and then a layer of black plastic are placed over the insulation with both the edges of the plastic extending up and out of the pit.

Water is poured and the insulation flattened out so that the water depth is 1-3 in and even to within about half an inch throughout the puddle, except in the trough which should be about an inch deeper than the rest. A pasteurization indicator is placed in this trough, since this is where the coolest water will collect. A layer of clear plastic is placed over the water again with the edges extending beyond the edges of the pit. An insulating air gap is formed by putting one or more spacers on top of the third layer of plastic (large wads of paper will do) and putting down a fourth layer of plastic, which must also be clear. Dirt or rocks are piled on the

edges of the plastic sheets to hold them down. The puddle is drained by siphoning the pasteurized water out. Fresh water can be added every day for pasteurization. (New and Advanced Materials, 1996/1&2)

Thinner and higher capacity batteries from Japan

The world's thinnest lithium primary cell has been launched by Yuasa, Japan. The PowerFilm is a 3 V lithium cell that can be as thin as 0.2 mm and measures 29.3 x 22.3 mm. It incorporates a lithium anode and manganese dioxide cathode separated by a solid polymer electrolyte and is encased between two micro-thin metal foils that also act as an external case and the positive/negative collector. The PowerFilm has passed the UL standard for safety, making it the safest lithium polymer cell in production.

Another product from Yuasa is the high capacity nickel-metal hydride batteries with a capacity that is more than twice that of conventional Ni-Cd alternatives. These batteries achieve excellent high-temperature performance by combining a positive electrode made from high-energy-density nickel with a negative electrode that contains a unique element combined with a hydrogen storage alloy based on MnNi_5 . The sealed cylindrical secondary nickel-metal hydride batteries offer a choice of models covering capacities of 550 mAh to 3,500 mAh. A typical size is 10.5 mm (dia.) x 43.5 mm for a 550 mAh cell. The new 1.2 V batteries are also environmentally friendly, since they do not contain cadmium. (PTI Science Service, 16-30 April 1997)

CHCP software

Total Energy Supply (TES) is a user-friendly, intelligent, flexible and speedy software for consultants, engineers, utilities and cogeneration developers. TES, developed by the French Environment Management Agency (ADEME) and the Energy Programme, Asian Institute of Technology (AIT), was conceptualized with the integrated energy systems approach for buildings and industries where electrical and thermal requirements co-exist. It allows to conserve energy and reduce energy costs by combining

energy services in a central supply facility. From the given demand patterns of electricity, heating and cooling utility, energy and equipment unit capacity costs and other financial parameters, the software predicts the optimum sizes and the scheduling of the Combined Heating, Cooling and Power Generation (CHCP) plant, refrigeration system, auxiliary boiler and marginal costs of the services provided. The package also estimates the reduction in pollutant emissions.

The software comes in two 3-½ or 5-¼ inch floppies and can run on standard PCs. The comprehensive documentation includes a user's guide, technical manual and case studies. The package costs US\$300. *Contact: RERIC/AIT, P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand. Tel: +66 (2) 524 5866; Fax: +66 (2) 524 5870; E-mail: enreric@ait.ac.th.* (RERIC News, December 1996)

Power from the water wheel

The Pedley Wheel constructed by Mr. Paul Bromley – who runs a conservation trust, the Pedley Wood Conservation Trust – at a village in north-west England promises to be an inexpensive device to generate electricity for small communities.

The Pedley Wheel was constructed next to a brook having a flow of 70 litres/second and a fall of three metres – much less than the fall required by existing micro-hydroelectric plants. Its 12 rpm was converted into 1,000 by transmitting its drive shaft the "wrong" way through an old Ferguson tractor back axle and gearbox, and a simple generator was to produce d.c. electricity. A control box, capable of regulating the speed of the wheel regardless of the weight of the water passing over it, and the capacity to generate alternating current were added with the help of Dr. Nigel Smith. The trust is now helping villagers in Sri Lanka to produce their own electricity. A small turbine provides nearly 2 kW of electricity, enough for the daytime needs of a school and, in the evening, for domestic appliances and electric lights of 20 households. *Contact: The Pedley Wood Conservation Trust, Pedley House, Adlington, Cheshire, the United Kingdom, SK10 4LB. Tel/Fax: +44 (1625) 875072.* (BCN, May-June 1997)

R&D IDEAS

Continuous generation of 5.1 kW with SOFC

In Japan, a cooperative effort by Chubu Electric Power Co. Ltd. and Mitsubishi Heavy Industry Co. Ltd. has succeeded in achieving continuous operation of flat-plate solid oxide fuel cell (SOFC) with an output of 5.1 kW. Continuous generation of 5.1 kW is the highest output in the world, although temporary 5.4 kW output generation is the record. There are two types of SOFC under development, cylindrical and flat-plate. The flat SOFC reportedly costs lower. (Techno Japan, February 1997)

Hydrogen storage cartridges

Researchers at the University of Boston, the United States, have developed cartridges made from graphite nanofibres, which are claimed to store ten times more hydrogen at room temperature than conventional tanks. The nanofibres, are made from stacks of graphite platelets that vary from 5-10 mm in length and 5-100 nm in diameter, and have a closely packed structure. Several layers of hydrogen molecules get condensed inside the pores between the platelets by capillary action. The narrow pores stop larger molecules like oxygen from squeezing in, minimizing the chances of an explosive reaction. The researchers claim that these cartridges will enable hydrogen-powered cars to travel up to 8,000 km. (Down to Earth, 30 April 1997)

Effects of brackish water on biogas production

Researchers from Agarkar Research Institute, Pune, India, have studied the effects of brackish water on biogas production. Experiments were carried out on anaerobic digestion of cattle dung and cultures of the methanogens: *Methanobacterium bryantii*, *M. formicicum* and *Methanosarcina barkeri*, which are commonly found in anaerobic digesters. The analysis showed a high content of anions and cations in the brackish water compared to tap water – chlorides and

Mg⁺⁺ were in the highest concentration. Results indicated that brackish water up to 5,000 µS/cm was not inhibitory to the process, and there was 18.5 and 6.5 per cent stimulation in gas production owing to the use of 1,000 and 5,000 µS/cm conductivity water, respectively, when compared with the control. However, there was a linear decrease in gas production with the increase in conductivity above 5,000 µS/cm. There was not much difference in the methane content of the gas and pH of the fermenting slurries of all the plants (50-53 per cent CH₄ and pH 6.5-7).

Culture studies showed that *M. formicicum* and *M. barkeri* produced more methane than the control when grown in the media with low conductivities, up to 5,000 µS/cm. *M. bryantii* produced maximum methane at 7,500 µS/cm conductivity and tolerated waters of conductivities up to 10,000 µS/cm, after which methane production fell below the control. *Contact: Dr. T.Y. Yeole, Agarkar Research Institute, Agarkar Road, Pune 411 004, India.* (TIDE, March 1997)

Chemical energy from solar energy

The Research Centre for Carbon Recycling and Utilization, Japan, and the Paul Scherrer Institute, Switzerland, have jointly generated carbon monoxide and hydrogen from a mixture of magnetite and coal powder using concentrated solar irradiation.

Magnetite powder and coal powder were mixed in the ratio 1:1, and the mixed samples were encapsulated in an octagonal rotating device. The device was placed in a solar furnace and one surface of the samples irradiated using the solar energy concentrated by a parabolic concentrator. The samples were rotated and the reaction time was varied. A reaction was observed when the furnace temperature was below 1,100°C and the irradiation time was 0.8 to 1 second, and completed in only 0.2 second after absorbing 26.8 joules of heat. The solar energy conversion rate was as high as 47.6 per cent. *Contact: Tokyo Institute of Technology Research Centre for Carbon Recycling and Utilization, 2-12-1, Okayama, Meguro-ku, Tokyo 305, Japan. Fax: +81 (3) 5734 3436.* (New and Advanced Materials 1996/1&2)

SOLAR ENERGY

Solar concentrator for plastics processing

A research team from the Queensland University of Technology (QUT), Australia, has developed a solar-power concentrator for processing materials such as polyvinyl chloride, polyethylene, polypropylene and polystyrene. The concentrator complements the existing power beam and power jet technologies, such as laser-beam, abrasive-water jet and microwave induced plasma jet systems. It is equipped with a fully automated sun-tracking capability and interfaced with a six-axis robot to enhance the manipulation capability of the power beam. This will enhance the flexibility of the system and allow processing of components with intricate geometric shapes.

In the concentrator, solar energy is harnessed by a 600 mm diameter parabolic mirror used to focus the rays of the sun. The sun rays, in turn, are reflected from a secondary mirror and directed through a lens system to obtain a power beam. The 250 Watt facility concentrates solar energy and delivers a power beam density on a 2 mm diameter spot. The power supplied is enough to process relatively low-melting temperature materials such as polymers, polymer matrix composites and solders. It could also be used for cutting, joining, curing and heat treatment manufacturing operations. The QUT team is seeking collaborative association for continued research or company interest in developing and marketing the equipment. (New and Advanced Materials, 1996/1&2)

Solar energy collector

Israeli researchers at the Weizmann Institute of Science, Jerusalem, have successfully tested a prototype solar energy collector capable of producing enough hot air from the sun's rays to drive the turbines of a 50 kW power station. Many modern power stations use hot gas to drive the turbines that produce electricity. The gas must be between 1,200 and 1,350°C and must reach pressures of 10-30 bar. Existing solar collectors focus the sun's rays on tubes

of air, while the new device focuses the rays through a quartz window to heat ceramic pins around which the air flows. The array of pins – nicknamed 'porcupine' by the researchers – absorbs solar energy and transfers it to the air. As the ceramic pins have a large surface area, they transfer heat to the surrounding air very efficiently. (Down to Earth, May 1997)

Aussie-Indian venture for solar water systems

Solar Edwards, an Australian ISO 9001 company that manufactures centralized water heating systems, has tied up with Delhi-based Solar Energy Systems to market the latest model of indirect water heating systems.

The Edwards System being introduced in India has a water storage cylinder constructed of marine grade 316 stainless steel. This has the dual advantage of being corrosion-resistant and maintenance-free. It also makes the cylinder lighter than conventional systems. Besides, the system functions on the heat transfer method, wherein the heating fluid absorbs the solar energy and transfers the heat to the water in the cylinder. The company is a leader in the Australian solar water systems market, and has a presence in 50 countries in Asia, Europe and Latin America. (TERI Newswire, 16-30 April 1997)

Sunlight collection and transmission system

Laforet Engineering Co. Ltd, Japan, a joint venture of Mori Building Co. and Asahi Glass Co., has started marketing its "Twelve-Eyed Sunflower", a sunlight collection and transfer system for use by general households. A special type of optical lens and an optical fibre cable are used to induce sunlight into rooms with poor illumination. The system uses a larger lens whose light collection area is increased by about 20 per cent, while the diameter of the optical fibre has been increased from 0.8 mm to 1.0 mm, thereby increasing the volume of collectable light by about 40 per cent than the conventional 18 eyed system. A built-in microcomputer computes the sun's position from the year, month, day and time, and directs the lens towards the

sun. A light sensor performs angular fine adjustment each minute to track the sun accurately.

Two optical fibre cables are used, each of which supplies light equivalent to a 100 W incandescent lamp. When the sunlight passes through the Fresnel lens, the light is divided into ultraviolet, visible, near-infrared and far-infrared waves. By setting the optical fibre input terminal plane to the domain concentrating visible light, it is possible to input only visible light, while virtually all other wavelength components either shorter or longer than that of visible light are cut off to prevent overheating of rooms. The sunlight can also be used for applications like culturing decorative plants and tanning the body. *Contact: Public Relations Department, Laforet Engineering Co. Ltd., 2-7-12, Bakuro-cho, Nihonbashi, Chuo-ku, Tokyo 103, Japan. Tel: +81(3) 5640 6511; Fax: +81 (3) 5640 6517.* (New and Advanced Materials, 1996/1&2)

Crystalline silicon to dominate despite thin-film advances

The National Renewable Energy Laboratory, the United States, expects crystalline-silicon PV to retain commercial dominance for several years to come – because of its reputation for stability and the availability of PV-module warranties for up to 20 years – although thin-film technology has greater flexibility in product configuration, surface appearance and colour. The following highlights some recent developments.

- Ames-based Iowa Thin Films is developing amorphous-silicon PV modules on continuous polymer substrates, and believes it can reduce the overall manufacturing costs by 68 per cent;
- United Solar Systems Corp. has developed a triple-junction amorphous-silicon module with higher initial and stabilized efficiencies;
- Solarex, hopes to increase average PV cell efficiency from 12.8 to 15 per cent; and
- ASE Americas Corp. – which is making PV modules based on edge-defined, film-fed growth (EFG) ribbon technology – is focusing on reducing EFG wafer, cell and module manufacturing costs.

(New and Advanced Materials, 1996/1&2)

WIND ENERGY

Europe's largest wind farm powers up

The recently commissioned Carno, Europe's largest wind farm spread over six hectares and located at Wales in the United Kingdom, consists of 56 turbines capable of generating up to 33 MW of electricity. Each wind turbine is 31.5 m high to the hub and the three-bladed rotor is 44 m in diameter.

This fourth wind farm to be constructed by the British company, National Wind Power, will mean that more than 40 per cent of electricity demand in the Powys region of Wales will now be met by the wind. The four wind farms consisting of 205 wind turbines produce nearly 225 million kWh of electricity, thereby reducing estimated emissions contributing to global warming by 180,000 tonnes. *Contact: Mr. Hugh Babington Smith, British Wind Energy Association, London, the United Kingdom. Tel: +44 (171) 402 7102.* (BCN, May-June 1997)

New wind turbine in the Philippines

A 10 kW wind turbine generator (WTG) has been installed by the National Power Corporation to supply the power demand, mostly for lighting, of Barangay Ayoyo, a small fishing village in Ilocos Norte of the Philippines. The 2.1 million pesos (approximately US\$84,000) pilot project was undertaken in cooperation with the Department of Science and Technology's Philippine Council for Industry and Energy Research.

The WTG, a BWC Excel R120 model, is mounted atop a 24 m lattice tower. The system includes a switch panel, charge controller, deep-cycle lead-acid batteries, static inverter, and the associated transmission system to distribute 220 Vac power to end-users. A minimum wind speed of 3.5 mps is required for power generation. A peak capacity of 10 kW is attained at wind speeds of about 15 mps. The WTG was used for research, and based on the wind data and the power curve, it is projected to generate

20-115 kWh per day of electricity, depending on the wind speed. The estimated load of Ayoyo is only 16 kWh per day for lighting. (Energy Infonet News, January 1997)

5-MW wind plant in New South Wales

The Australian utility Pacific Power is planning a 5 MW wind project in a rural area in New South Wales, Australia. The proposed Crookwell Project, to be completed by late 1997, will provide enough electricity for 3,500 homes. The project will be located on a 600-ha cattle grazing land known for persistent westerly winds and has a 66-kV line crossing it. Local electricity distributor, Great Southern Energy, will offer consumers the opportunity to buy green power at a price 5-10% higher than coal-fired power. It may also sell wind power to eco-enthusiastic consumers throughout New South Wales and beyond. (Wind Energy Weekly, 11 November 1996)

Two wind plants for southern Mexico

A wind energy developer, Entec SA of Mexico, is planning to install two major wind projects in the La Ventosa region in the southern state of Oaxaca. One is a 20 MW independent power producing facility that will sell electricity to the state utility, CFE, and the other a 27 MW plant that will deliver power to the local municipality for municipal services.

The projects will comprise 600 kW turbines built by the Danish manufacturer, Vestas, which provided machines for an initial small Entec plant of seven 225 kW units in La Venta, Oaxaca, and has introduced changes in the new Model V39 600 kW (turbine) to improve performance in high-speed wind conditions. Although the machines supplied earlier were not optimized for the strong wind conditions, the 1.575 MW facility generated more than 7 million kWh in the first year of operation and had a capacity factor of 51 per cent, well above the 30 per cent level that is generally considered good within the industry. One of the units in the project had an individual capacity factor of 57 per cent. (ASSET, April 1997)

BIOMASS ENERGY

Fuel-efficient biomass burning devices

ASTRA, Indian Institute of Science, India, has been actively involved since the early 1980s in developing energy-efficient firewood and other biomass burning stoves and furnaces for a variety of applications. The concepts utilized for developing these devices can be summarized as:

- burn the fuel properly to generate the highest possible temperature of the combustion products; and
- utilize the principles of heat transfer to maximize the transfer of heat to the job on hand (to the cooking pot in a cookstove, for example).

Proper combustion to generate the highest flame temperature is achieved by burning the fuel in an enclosed fire-box over a proper-sized grate, with suitable ports for controlled entry of primary and secondary air, and adequate combustion chamber volume and chimney of suitable height and diameter to disperse smoke away from kitchen area. Higher percentage of heat utilization is achieved by:

- providing large area for heat transfer;
- proper shape of stove interior to reflect radiation onto the vessel surface;
- as small a distance between stove body and vessel surface as practical to increase the velocity of flue gases past the vessel surface to increase the convective heat transfer; and
- baffles to ensure full utilization of heat transfer surface by avoiding bypassing.

Heat loss through the stove body to surroundings is reduced using masonry structure with an inside lining of mud mortar containing rice husk to give an insulating porous structure. Using these concepts, heating appliances for domestic cooking, bath water heating, arecanut processing, and drying of raw and processed agricultural and horticultural produce have been developed and disseminated through government and non-government organizations. (BUN India, March 1997)

Desulphurization of biogas for power generation

Syn-Energy Carbon Pvt. Ltd., Pune, India, has developed a technology for cleaning biogas and making it suitable for engines.

Biogas obtained by bacterial digestion of various liquid effluents typically contains 65 per cent methane, 30 per cent carbon dioxide and 2 per cent hydrogen sulphide and some moisture. Electric power can be generated from biogas by utilizing it in engines. However, biogas generated from sewage, distillery effluent and other chemical plant wastes contain 1-7 per cent hydrogen sulphide. Power generating engines can at most tolerate 0.15 per cent sulphide in biogas. The most widely used process for desulphurization is the amine process, in which the hydrogen sulphide is selectively absorbed from biogas and carried out at near-atmospheric pressure. The hydrogen sulphide content can be reduced to 800 ppm, and such installations are mostly found in fertilizer and petrochemical industries. The Syn-Energy installation of amine-based desulphurization for a biogas-based power plant cleans biogas at a rate of 1,000 m³/h and feeds it to a dual fuel engine. The engine is rated at 2.5 MW of power generation. (Bio Energy News, March 1997)

Small-scale cogeneration in biomass furnaces

Researchers from Joanneum Research in Austria have tested small-scale combined heat and power (CHP) production in biomass furnaces (0.5-10 MWh) using a Stirling engine (SE). An alpha-type SE was used because many parts from industrial mass production can be used for this type of SE. A hot heat exchanger for the SE was designed using tubes without fins for easier cleaning by water or steam jets, and working gas air (nitrogen) with a maximum pressure of 50 bar was used. These measures led to relatively large dead spaces of the heat exchangers for the engine.

A biomass-fired SE with a shaft power of 3 kW was designed and constructed for lab tests. Performance diagrams and partial load efficiency

curves were measured. It was found that the electricity/biofuel ratio for the "Austrian case" (supply of district heat plant electricity demand) is 0.06, which is satisfactory for this application. But if small-scale electric energy production should be the primary goal of the Biomass-SE operation, then the electricity/biofuel ratio can be increased to 0.2 by using additional components. Compared to other CHP production methods, a biomass-fired SE could provide the cheapest electric energy, it is claimed. (BUN India, March 1997)

Biogas from sewage

Aided by the Bharatiya Vikas Trust, a NGO of the Manipal Institute of Technology of Karnataka, India, has set up a sewage-based biogas plant in a colony on its campus housing about 3,300 students and faculties. The colony has a well-planned waste collection system. The sewage and liquid wastes from the kitchen are conveyed to a sedimentation tank where the heavy solids settle down, and the effluent from the tank is led to an oxidation pond where it gradually undergoes natural purification. The methane generation unit uses the sewage discharged from the treatment plant, animal dung and garbage found within the campus as the raw material.

Two 45 m³ biogas plants were commissioned in October 1995. Each plant consists of an inlet chamber, a digester and gas holder. The raw material is partially digested in the inlet chamber. The outlet from the sewage sedimentation tank is also connected to the inlet chamber of the biogas plant. An asbestos pipe discharges the contents of the inlet chamber to the bottom of the digester. A partition wall in the digester enables the digestion to take place in two stages, besides preventing channelling of slurry. The gas holder drum is made of fibreglass-reinforced plastic. The plant produced methane gas equivalent to 39 kg of LPG per day at the time of commissioning. The plant is still in operation and is being fed around 1.2 tonnes of organic waste per day, which is enough raw material for one plant. The project has resulted in multiple benefits to the colony. The saving in the fuel bill is about Rs. 500 (approx.

US\$ 13.5) per day, besides the sale of manure which fetches Rs. 300 (US\$8) per day. The project cost of Rs. 494,000 (approx. US\$13,350) is expected to be recovered in just two years. The water released by the biogas plant is used to green the estate. (Bio Energy News, March 1997)

Biomass-fired engine

Stirling Dynamics Ltd. of Chennai, India, has introduced a new engine – 'Hamara ST-5' – which offers an immense potential as a power source for water pumping, electricity generation and chaff cutting in farms.

Hamara ST-5 utilizes combustible biomass wastes like rice husk, saw dust and wheat husk for power generation, unlike the currently used engines based on diesel or grid electricity. The system has been developed on a mobile chassis so that it can be easily transported to the field. (Down to Earth, 15 February 1997)

Biomass ethanol

Biomass is not yet a factor in the commercial market, but it has the potential to become the low-cost technology of the future. Swan Biomass Company, a partnership between Amoco Corp. and Stone & Webster Engineering Corporation of the United States, is launching a study to see whether manufacturing biomass ethanol could be an economical and environmental means of getting rid of waste rice straw in California's Sacramento Valley. Swan intends to convert crop wastes into ethanol and a variety of by-products. The company's technology is based on research by Amoco, NREL, Iogen Corporation, Purdue University and others.

The study will be conducted at a 1 tpd pilot plant at NREL's facility in Colorado. Town officials will then decide whether to build a commercial biomass facility before legislation banning the burning of rice straw comes into effect. In another move on rice straw-to-ethanol technology, Ark Energy, in cooperation with the Sacramento Municipal Utility District, is planning a 148.5 MW, natural gas-fired cogeneration plant that will use a rice straw-based facility to produce 12 million gallons per year of ethanol. (Genetic Engineering and Biotechnology, 2, 1996)

TECHNOLOGY OFFERS

A few selected technology offers from APCTT's computerized database are given here. For further details on these technologies and others in the database, please contact APCTT.

AUSTRALIA

Village Electrification System (Ref. No.: APCTT-002455-TOF)

An Australian company is offering photovoltaic-based village electrification systems, with sophisticated PV/diesel hybrid inverter power control unit systems, solar regulators, and remote communication and control.

A 3-kVA inverter and a 4-kVA generator, coupled with a 100-200 Ah, 96 V battery will be sufficient to supply loads of up to 5-20 kWh/day. This combination has a motor starting ability of 8 kVA without the generator and 12 kVA with the generator. It can sustain a continuous load of 4 kVA, and a 7.6 kVA load for one hour. The diesel will run about 1-8 hours/day depending upon the energy consumption. The system uses sealed gel type or lead-acid batteries and an inverter contained in a lockable steel case. The operator can connect to the inverter via a modem and obtain a full diagnosis of the system.

Transfer Forms: Turnkey; Joint venture; Technical assistance; Manufacturing licence; Distribution licence.

CHINA

Silicon Solar Cells (Ref. No.: APCTT-001714-TOF)

A Chinese company, which is a member of China National Photoelectric Technology Developing Centre, is offering a new technology for the production of silicon solar cells. The cells have applications in navigation lighting, microwave relays, meteorology, railway lighting, telecommunications, domestic power supply, etc. The company has advanced technology and

equipment introduced from the United States. Its products have won State Silver Medal for stable and reliable performance.

Terms of Trasfer: **Negotiable.**

GERMANY

Solar Energy – Flat Vacuum Collectors (Ref. No.: APCTT-001394-TOF)

A German company is looking for cooperation in flat vacuum collector technology with capable companies which have an established sales network or are willing to establish a reliable sales network. The cooperation process would be in four steps: (1) training in Germany; (2) importing into the target country single products or complete systems; (3) manufacture under licence agreement (components, modules, systems; using locally made materials to avoid import duties etc.); and (4) joint venture. Project dead line is 30 November 1997.

The company is a European market leader with own plants in Germany and neighbouring countries. Major products are flat vacuum collectors in varying designs, sizes and types of performance. All products have a guarantee of 30 years life duration. The company has its own R&D facilities.

Transfer Forms: **Agency licence; Manufacturing licence; Joint venture.**

INDIA

Solar Water Heaters (Ref. No.: APCTT-002105-TOF)

An Indian company is offering technology for a solar water heating system which comprises solar collectors along with support structure, insulated water tank and piping, water circulation pump, and necessary controls and instrumentation. The solar collector consists of an absorber panel, housing, glass cover and insulation. The absorber panel has water tubes connected to the metal fins. The complete surface is painted matte black to absorb maximum solar thermal energy.

Transfer Forms: **Manufacturing license; Technical assistance; Training.**

RECENT PUBLICATIONS

Rural and Renewable Energy: Perspectives from Developing Countries

Rural areas are being viewed as the next frontier for application of renewable energy technologies. This book attempts to synthesize the experiences in policy formulation and programme implementation in this area. The papers deal with rural and renewable energy policies and implications for intervention programmes, technology development, and the environment. The use of analytical tools for resource assessment is also discussed.

Contact: Outreach Cell (TIS), TERI, Darbari Seth Block, Lodi Road, New Delhi 110 001, India.

Financing Investments in Renewable Energy: the Role of Policy Design and Restructuring

This book covers: financial models of wind power and PV; tax policies and tax appetite; electric industry restructuring and long-term contracts; surcharge-funded policies, production incentives, above-market contract payments; green marketing programmes; and low-interest subsidized loans and guarantees.

Contact: Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory, University of California, the United States. Tel: +1 (510) 486 5474; Fax: +1 (510) 486 6996; E-mail: pajuergens@lbl.gov.

Renewable Energy and Sustainable Development in a "Liberalized" Energy market

This book focuses on legislation in the European Union and Denmark, as well as other European countries. Translated and shortened from Danish,

it is published by the Danish organization for renewable energy "OVE - Europe", in co-operation with INFORSE-Europe.

Contact: OVE-Europe, Gl.Kirkevej 56, 8530 Hjortshøj, Denmark. Tel: +45 (8) 6227000; Fax: +45 (8) 6227096; E-mail: ove@inforse.dk.

Solar Heating in Cold Regions

This book is for professionals interested in solar heating systems in cold regions of developing countries where heating is an issue of utmost importance. It is solely involved with space heating and does not look at issues involved in solar cooking or photovoltaic systems.

The book is divided into three parts. Part 1 discusses the issues involved in solar heating, including the problems caused by the lack of heating which many communities in developing countries face. The benefits of using passive solar heating for houses, community buildings and agriculture are also examined. Part 2 looks at specific solar elements which can be used in household and agricultural situations, and discusses how they are constructed and how they work. Part 3 is considerably more technical than the other two, and looks at factors affecting radiation, atmospheric conditions, atmosphere thickness, angle of incidence, etc. In short, it takes a look at the physics involved in solar heating.

Contact: IT Publications Ltd., 103-105, Southampton Row, London WC1B 4HH, the United Kingdom. E-mail: ztpubs@ztpubs.org.uk.

Biomass Energy Systems

This book, which is the proceedings of an international conference on biomass energy systems, provides a comprehensive account of each element of biomass energy systems. The coverage includes biomass produced from consumptive life-styles and the generation of organic wastes in large metropolitan areas. It also addresses the issues of technologies and business opportunities available in biomethanation and biomass-based power generation.

Contact: Outreach Cell (TIS), TERI, Darbari Seth Block, Lodi Road, New Delhi 110 001, India.

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| <p>31 Aug-10 Sep
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United Kingdom</p> | <p>Development of Effective Solar Power Generation Seminar
Contact: International Seminars, British Council, 1 Beaumont Place, Oxford OX1 2PJ, The United Kingdom.
Fax: +44 (1865) 557368;
E-mail: international.Seminars@britcoun.org.</p> |
| <p>September
Malaysia</p> | <p>7th Asian Battery Conference
Contact: Mr. John Manders, Technology & Product Development Manager, PASMICO Metals, Kuala Lumpur, Malaysia.
Tel: +61 (3) 92880294;
Fax: +61 (3) 92880205.</p> |
| <p>27 Sep-1 Oct
Dublin
Ireland</p> | <p>Hydroenergia: 5th International Conference and Exhibition
Contact: Conference Secretariat, Environmental Institute, University College, Dublin Rechview, Chlonskea, Dublin 6, Ireland.</p> |
| <p>1-3 Oct
Montreal
Canada</p> | <p>Upgrading and Refurbishing Hydro Power Plants VI
Contact: Alan Wagstaff, Events Manager, International Water Power & Dam Construction, Wilmington Publishing Limited, Wilmington House, Church Hill, Dartford, Kent DA2 7 EF, The United Kingdom.
Tel: +44 (1332) 277788;
Fax: +44 (1332) 276474.</p> |
| <p>6 Oct-8 Nov
Enschede
The Netherlands</p> | <p>Energy Management and Cleaner Production in Small and Medium Scale Industries (Training)
Contact: Course Administration, Technology & Development Group, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands.
Tel: +31 (53) 4893539/4894377;
Fax: +31 (53) 4893087;</p> |
| <p>13-16 Oct
Jakarta
Indonesia</p> | <p>Asia Pacific Initiative for Renewable Energy & Energy Efficiency
Contact: Alternative Development Asia, 5F, 3 Wood Road, Wanchai, Hong Kong.
Tel/Fax: +852 25749133/25741997;
E-mail: altdev@hk.super.net.</p> |

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