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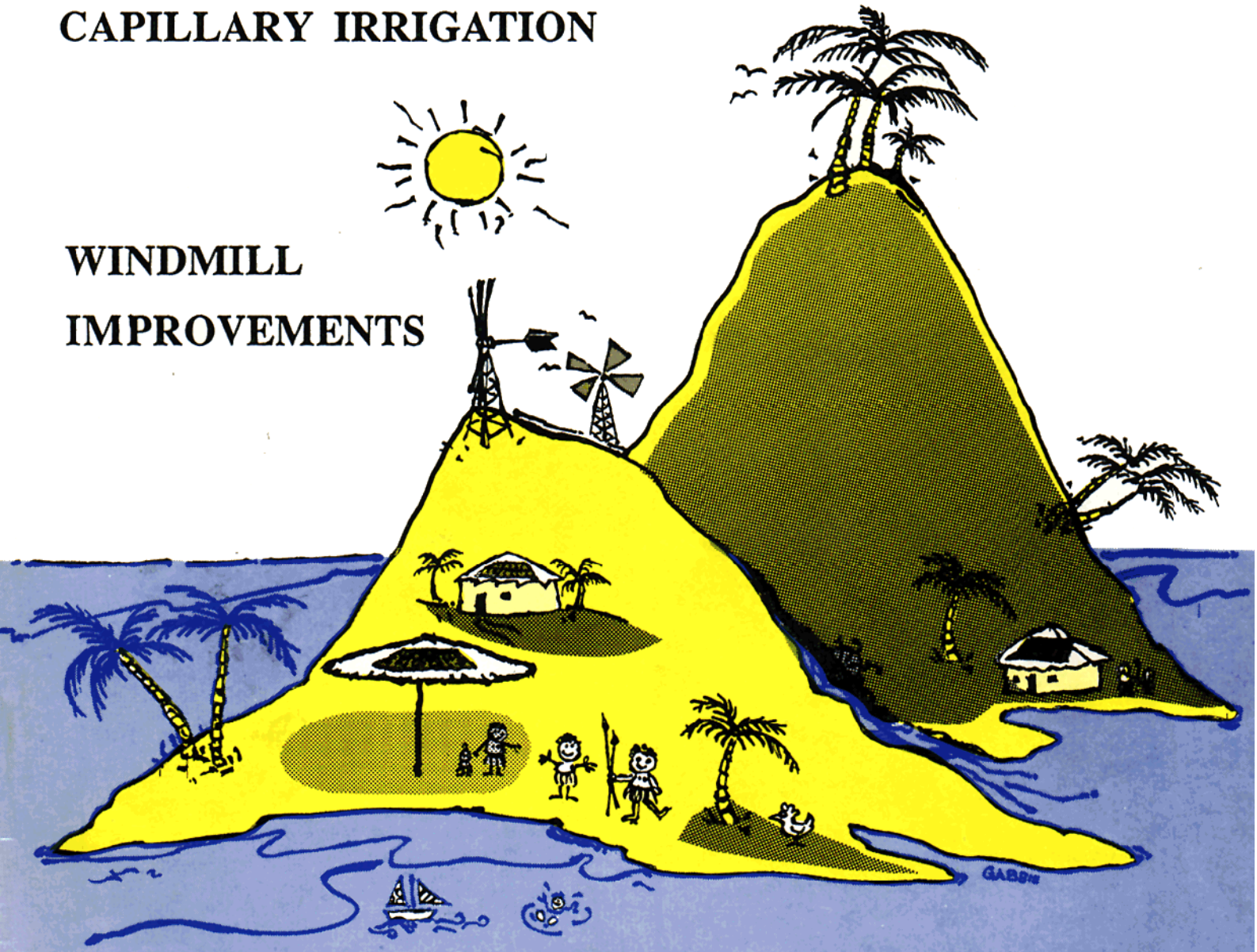

ALTERNATIVE TECHNOLOGY IN THE SOUTH PACIFIC

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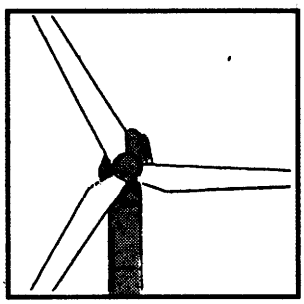
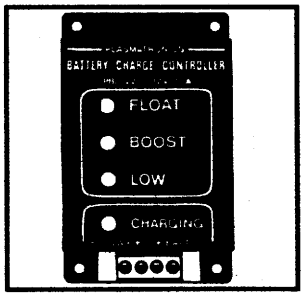




ENERGY FLASHES

National News

WA to study Tidal Power

THE WESTERN AUSTRALIAN Government has set up a select committee to inquire into harnessing ocean tides in the Kimberley region to produce electricity. The aim is to see if the electricity can be commercially transmitted to the State's north west and other cities and towns in the state.

The Kimberley region has long been recognised as having the largest single potential for tidal power in southeast Asia by far, and is of world importance (the Walcott Inlet site is one of the very largest in the world; capable of delivering 3,950,000,00 kW-hr per year).

The resource still remains untapped because the many plans have been shelved, despite the many exceptional attributes of the main sites, due to the remoteness of the region. The tidal power resources along the Northwest coast between Broome and Darwin Harbour are estimated at 300 million kW. What could be a more ideal location for Australia's energy-intensive industries? *Scitech*

Birdsville goes Geothermal

GEOTHERMAL POWER from Birdsville's main artesian bore will soon be producing 120 kW of electricity. Until now, Birdsville's electricity was powered by two diesel generators, which will now be used for back-up power.

The new system uses a Rankine cycle engine which utilises the heat energy of the bore water, which reaches the surface at nearly boiling point

The system will be studied to see if more such installations are feasible for remote areas. *Electrical World*

Coober Pedy Wind Generator go ahead

SOUTH AUSTRALIA'S first grid-connected wind generator proposal can now proceed thanks to Federal Government funding.

The Electricity Trust of South Australia and SA's Office of Energy Planning now have a substantial proportion of the funds for a wind turbine electricity generator of several hundred kilowatts capacity to link into Coober Pedy's diesel-powered electric

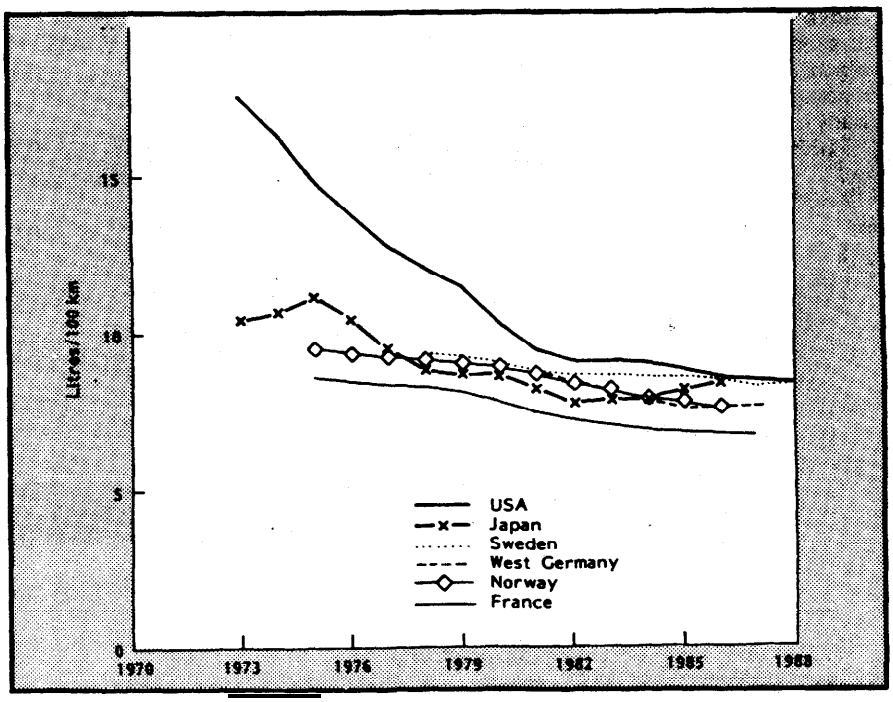
Disturbing Trends in Energy Conservation

More efficient use of energy levelled off the rate of growth of energy consumption in many first world countries between 1972 and 1985. Recent evidence suggests a new trend to increasing energy use, particularly by consumers.

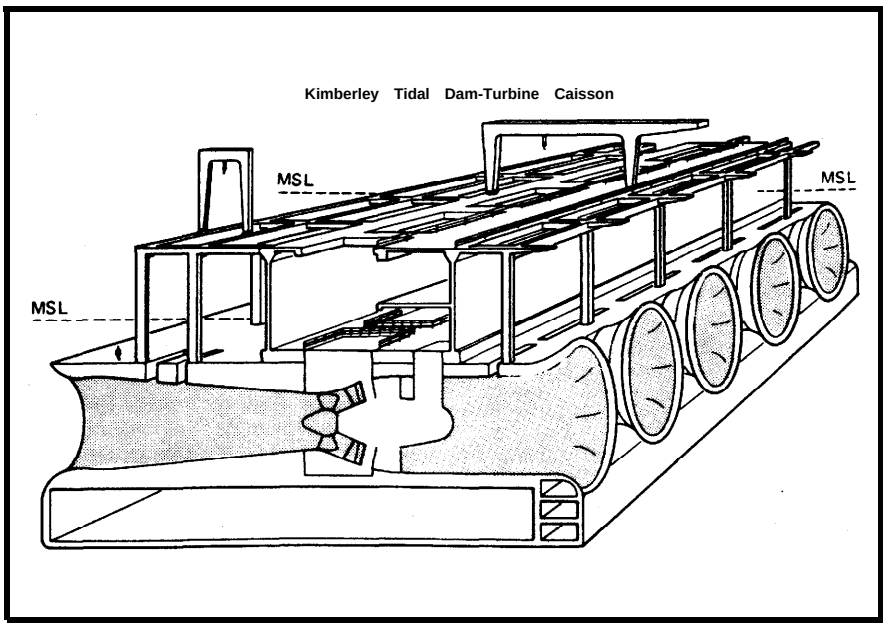
A recent appraisal of energy conservation among OECD countries by Lee Schipper and Andrea Ketoff of the International Energy Studies group at Lawrence Berkeley Laboratory, California, argues that in the industrialised countries, some sectors are seeing increasing energy use again, and the technological improvement toward energy efficiency of consumer goods has almost halted.

The implications of these trends are a greater use of energy in the future than many expect, and an aggravation of the greenhouse effect. The evidence supporting the analysis that there has been a backslide in energy efficiency and savings is twofold.

Firstly it relates to the fact that the rate of use of space heating energy in homes ceased to decline in the early 1980's and began increasing in some countries after 1985.



Energy intensity of new cars: average in given years



Kimberley tidal power plant (Maunsell:Kimberley Tidal Power)

Secondly the rate of improvement of efficiency in new equipment has slowed or reversed. Again the mid-1980's marks the turning point, Schipper and Ketoff give the example of the refrigerator market. 1985 marked the halt to a declining use of energy in refrigerators in Japan, West Germany and Japan.

The trend toward increasing energy efficiency of cars, too, halted by 1989. The researchers suggest that 'more engine muscle and heavier cars' are emerging consumer priorities across all OECD countries, at the sacrifice of energy efficiency.

These results are interpreted as a present situation where there is a levelling off in the trend to energy efficiency - and some small indications that we may be seeing the emergence of a turning point back to less efficiency.

Schipper and Ketoff provide some social analysis that may explain their results. They argue that consumers are not interested in investing in more energy efficient commodities unless the payback period is extremely short. During the period when energy prices were climbing, consumers paid more attention to energy efficiency and could justify the extra outlay for efficiency. But as energy prices rose, energy efficiency measures were then adopted and consumption cut as a result. This led to a decline in demand and price of energy; thus the key factor that stimulated greater efficiency in energy use after 1973, and particularly after 1979, is not in force now and may not operate again for a considerable period of time. Consumers are once again indifferent to energy conservation issues, argue Schipper and Ketoff.

Manufacturers of energy-using commodities and services - including the aircraft, car and appliance industries - are aware of current consumer indifference. The manufacturers do not see energy efficiency as nearly as important as they did even three years ago. Appliance manufacturers can still list many options for reducing energy use in their products, but are not interested in pursuing these in the present energy price and policy climate.

The trend away from energy efficiency has ramifications not only in CO2 reduction, but also may be reflected in the industrial development of the East and developing countries; technology transfer from the Western developed countries is now less likely to display the attributes of energy efficiency.

Schipper, L., and Ketoff, A. Energy efficiency - the perils of a plateau. *Energy Policy,* December 1989 pp. 538-542.

system. This is thanks to a $200,000 grant from the Commonwealth National Energy Research, Development and Demonstration Program (NERDPP).

The project is expected to take three years, with the turbine due online in March 1991, followed by an extended period of monitoring. *Energy news for Industry and the Community.*

Victorians Want Artichokes for Transport

SPECIAL JERUSALEM ARTICHOKES are the most appropriate biomass for Victoria's proposed alcohol fuel industry, according to recent trials.

After several years of research Dookie College has found a Jerusalem Artichoke/Sunflower hybrid with a high sugar content can be grown for $20 per tonne, at yields of 100 tonnes/hectare.

There is still quite a lot of work before the crop becomes a commercial solution for Victoria's target of a 10% blend of alcohol in petrol by 2005. The work on alcohol fuels, funded by the Victorian Solar Energy Council, is motivated by a desire to conserve Victoria's crude oil reserves and boost the octane rating of unleaded petrol. *Solutions (VSEC)*

Technology for Community Development

A SEMINAR is to be held between July 9th and 11th in Alice Springs on "Technology for Community Development in Australia, S-E Asia and the Pacific".

The aim of the seminar is to provide a forum for discussion of technology for sustainable development, technology policy and planning for rural and peri-urban communities. The seminar hopes to bring together people experienced in technology and development in these areas. Further attention will be given to issues of participation of women, children and young people in technology and development; and the role of appropriate training for self-determination and employment.

Papers are invited, with a deadline of end-April for approval. More details are available from:

Development Technologies Unit, Faculty of Engineering, The University of Melbourne, Victoria 3052.

National Evaluation of Energy-efficient Houses

A NEW COLLABORATIVE SURVEY by the Universities of NSW and Adelaide is aimed at linking considerations of occupant comfort to energy-efficient architecture.

The study is an attempt to improve the current low demand for energy-efficient architecture by shedding light on previous studies that show users tend to prefer energy-efficiency measures that neither diminish personal comfort nor involve personal inconvenience or added costs. Essentially the study is seeking to identify climatically and socially appropriate energy efficiency measures for housing, and to discover effective messages to inform target user groups.

The two year project involves eighty energy-efficient and eighty standard houses across Victoria, NSW, South Australia and Western Australia. ***Australian Energy Research***

Oz must get Energy Efficient

A STUDY BY the Australian Institute of Petroleum calculates that Australians must increase their energy efficiency by 40% in the next 20 years just to keep carbon dioxide emissions at present levels. *Electrical World*

Sun and fire add spice to cardamom

The Development Technologies Unit at the University of Melbourne has recently been awarded a grant ($22,500) from the Australian International Development Assistance Bureau (AIDAB) to assist in the commercialisation of three small scale crop driers in PNG.

The Driers have been developed to improve the final quality of dried cardamom - a crop which many rural families grow successfully to generate small quantities of cash income.

The driers have been under development in PNG since 1986 by the Appropriate Technology Development Institute (ATDI) based in Lae.

Two of the new driers are wood fired and the third is a solar/ charcoal unit designed to dry 5 kg of fresh cardamom pods in approximately two days. *Bob Fuller*

International News

Big Increase in Windmill Performance

MASS PRODUCTION of a new high performance wind turbine blade is soon to begin. The new blade design, by the U.S. Solar Energy Research Institute (SERI) has an increased performance of between 15 and 20 per cent in medium winds.

The increased energy output means that wind power costs could be cut by 20%, making wind power more attractive to energy investors around the world. The airfoils have also been designed with the windmill blade replacement market in mind, worth many tens of millions of dollars.

According to SERI, the blades are the first to be specifically designed to the needs of horizontal axis wind turbines.

In another development, six months of field tests have proved a 25% to 40% increase in efficiency of a new blade design now marketed by Zond Corporation. The secret lies in both a new high-efficiency airfoil profile and longer blades. ***Windpower Monthly***

Paper from Bananas

A WAY OF MAKING PAPER from sugar-cane waste and banana-tree stems has been found by researchers in Japan.

The process is free of the noxious chemical processes associated with conventional paper-making. And the process has enormous income potential for tropical farmers who currently burn off the raw materials as waste. The low costs of the process also make small scale production feasible.

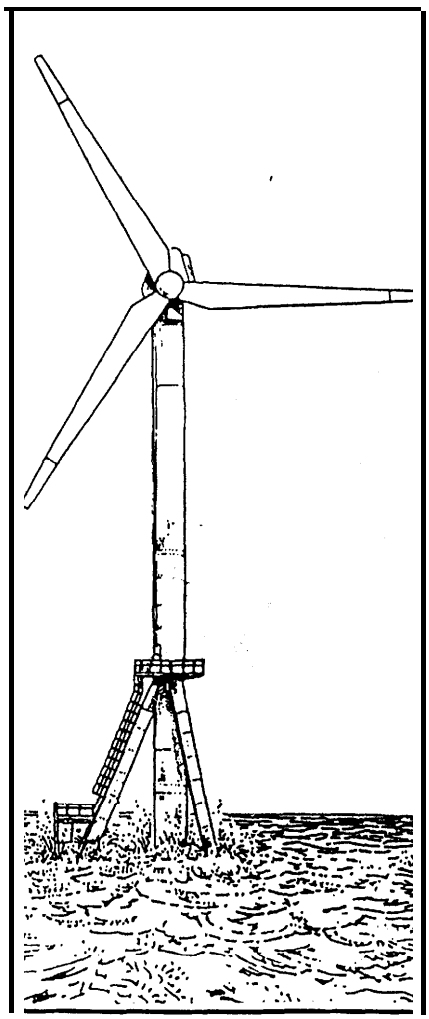
The researchers, at Japan's National Chemical Laboratory for Industries, plan to set up a commercial pilot plant in collaboration with a private company. ***Asia Pacific Tech Monitor***

Solar/charcoal Cardamom Drier attracts attention in PNG

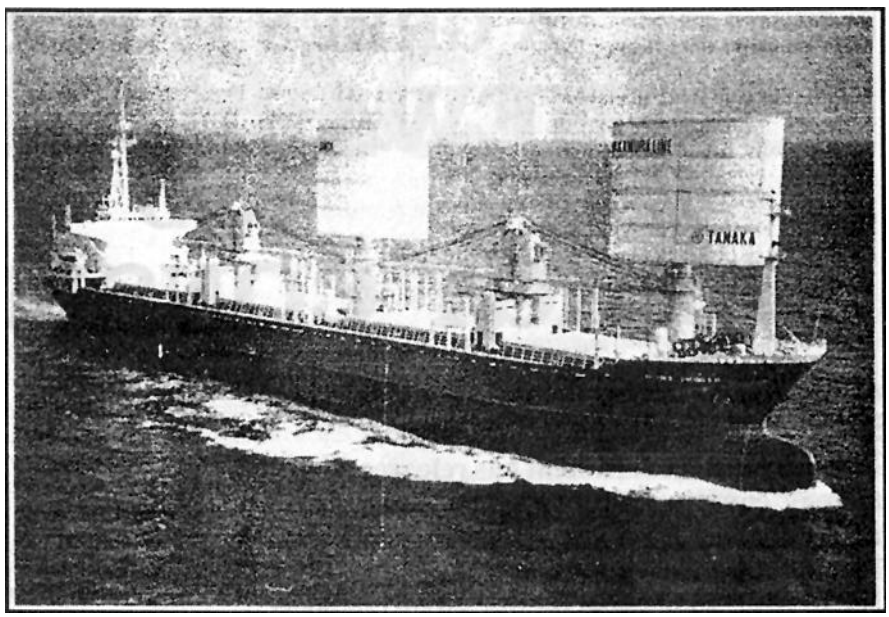
Offshore Windfarm in Denmark

THE DANISH ELECTRIC utility Elkraft is now deciding which company will get the job to supply machines for the world's first completely offshore windfarm.

The windfarm is to be built 70 kilometres offshore south of Copenhagen. The plant is to have a capacity of almost 5MW, producing 10.6 million kilowatt hours annually. To be built are 11 turbines of 450kW capacity. Grid connection will be via a 10kV sea cable, and there will be no causeway link, making it truly offshore. The project cost of $US10.7 million is double that of placing the same capacity on land



Offshore windpower near Copenhagen



Wind-assisted ships: now commercially viable

The plant is not meant to be cost-effective; rather the idea is to see whether offshore windfarming is feasible. Elkraft is looking ahead to the time when all the good wind sites on the well populated main island of Zealand have been used, as Elkraft is already finding it difficult to find enough sites to meet the windpower capacity target set by the government. Windpower Monthly

PV Sales Up

WORLD PHOTOVOLTAIC Module shipments are estimated to be up 20% in 1989 over the previous year, from 35 MW in 1988 to 42MW.

The U.S. experienced the largest growth, at 33%. European consumption grew 40%, attributed to experiments with large-scale installations and development assistance programs.

Shipments in 1989 were divided between the suppliers as follows: U.S., 15MW; Japan, 13MW; Europe, 9MW; and the rest of the world, 5MW. PV News

Wind Assisted Ships Viable

CARGO SHIPS powered in part by the wind have reached a level of economic viability, according to the Japan Marine Machinery Development Association JAMDA.

Two companies have already contacted the Marine Technology Development Co. concerning production of the ships, and other countries, including China and Korea, have also expressed interest. The Chinese government approached JAMDA to help develop wind-assisted tankers plying the Yangtze River which would have 15-20% lower energy consumption than present vessels.

The first wind-assisted ship was launched in 1980, and since then 15 other ships have been built combining conventional propulsion with sails. Wind assisted ships have a significantly lower rate of fuel consumption than comparable ships, with up to 20% saving in fuel consumption so far.

The wing sail system developed by JAMDA uses steel and canvas to produce a rigid airfoil that can be furled and unfurled as needed. The sail cost is about 10% of total construction costs. ***Windpower Monthly***

Japan, U.S. to test methanol cars

Japan and the U.S. plan to collaborate on testing cars running on methanol fuel. fuel.

The aim is to improve performance of the vehicles, so that they will start in cold weather or high altitudes.

The research is under a four year program run by the Industrial Science and Technology Agency and the U.S. Environmental Protection Agency. *Asian Wall Street Journal*

A GREEN PAPER ON RENEWABLE ENERGY AND ENERGY CONSERVATION

VICTORIA DRAFTS A $55 MILLION ENERGY STRATEGY

The Victorian Government has released a draft strategy covering both renewable energy and energy conservation in the 1990s.
The highlights are proposals for:

a 10MW wind farm on the Victorian coast,
new regulations requiring wall and ceiling insulation for all new residential buildings (from mid-1990),
minimum energy performance standards for all major domestic appliances (gas, electric and solar)

The Department of Industry, Technology and Resources has released for public comment the Green Paper on "Renewable Energy and Energy Conservation".

This Green Paper forms the basis for four months of public consultation leading to the eventual preparation of a ''Renewable Energy and Energy Conservation Strategy" for Victoria. It is intended to provide a framework for debate to assist the government in making critical decisions about energy policy for the 1990s.

A broad range of programs and activities are proposed. They cover renewable and alternative energy sources: solar energy, hydroelectricity, wind power, geothermal energy, biomass, land fill gas and wave energy. Energy efficiency improvements are proposed in all major energy use sectors: residential, commercial, industrial, transport and public sector.

Following its release, there is now a period of public consultation which will lead to the publication of a White Paper later in 1990. The green paper is heavy on motherhood and well established policies but rather thin on substance. There is very little in the way of new initiatives that haven't been released before. Its a good politicians document: lots of laudable sentiments regarding renewable energy sources and conservation of energy but little which commits the government to significant changes in energy use patterns.

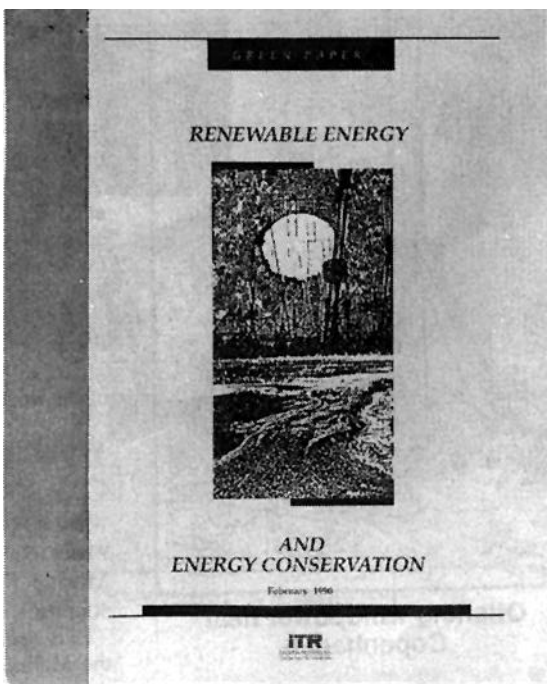
One interesting aspect of this was that the Victorian government engaged Amory Lovins to help in preparing conservation strategies. (Amory Lovins is an American well known for promoting non nuclear alternatives).

Comments from interested groups and individuals are sought, particularly on the proposed strategies and initiatives. During the public consultation period, the Department of Industry, Technology and Resources (DITR) will continue to develop the initiatives and officers of the DITR will be available to meet with groups and pursue areas of particular interest.

A public seminar was held on the 8th of March 1990, to discuss the proposed strategy.

Submissions and comments on this paper from individuals and organisations should be sent to:

Project Officer (Green Paper)
Department of Industry, Technology and Resources,
P.O. Box 173,
East Melbourne Victoria 3002



New and Renewable Sources of Energy in the SOUTH PACIFIC

For many developing countries, naturally occurring fossil-fuels are precious few, and the new and renewable energy resources hold out hope for a measure of energy independence. In many cases, such countries are rich in renewable resources waiting to be exploited by them in the form of a sunny climate, ample river water or accessible geothermal resources. The island countries and territories in the South Pacific arc examples. Most of them, like Papua New Guinea, French Polynesia, New Caledonia, the Solomon and Cook Islands, the Northern Marianas and Guam, are already engaged in the development and application of systems based on NRSE technologies such as mini-hydros, photovoltaic systems, wind-driven generators and pumps, biogas digesters and charcoal kilns.

Background

The South Pacific area consists of a number of small island countries and a few large ones. Australia, New Zealand and Papua New Guinea are the bigger island countries. The first two are not discussed in this report because their energy issues have a different magnitude.

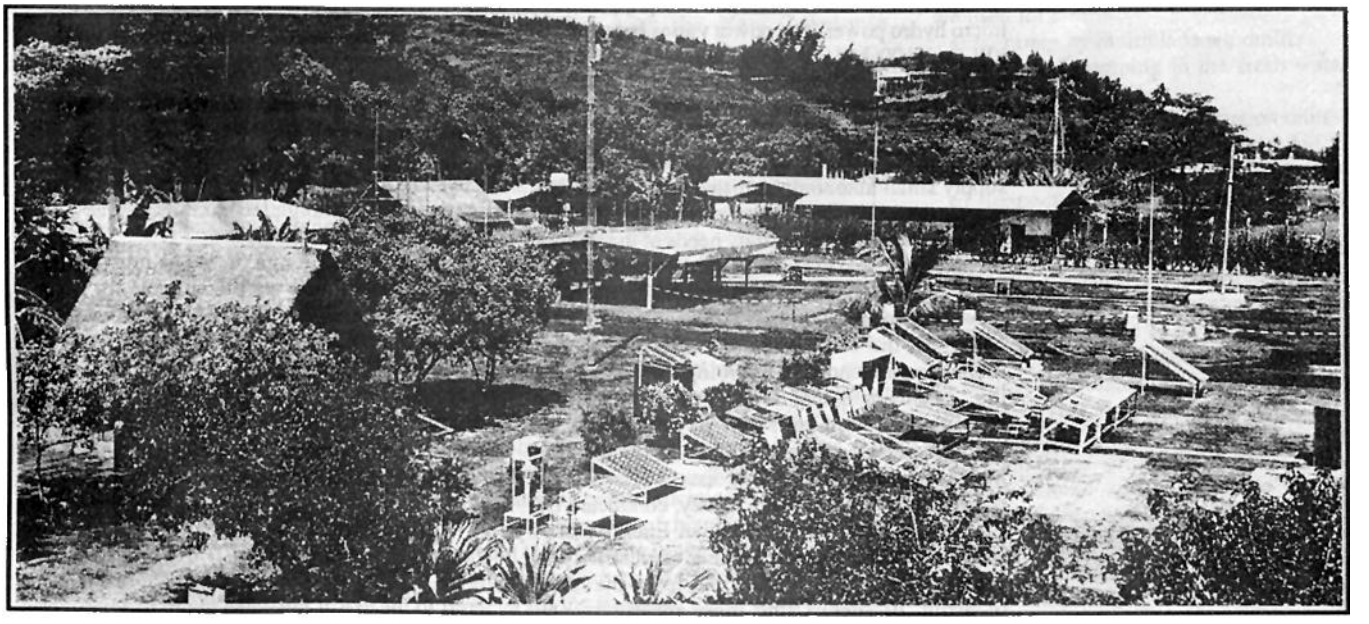
Most of the pacific island countries have been engaged in the development of new and renewable sources of energy. The main sources are mini hydro, photovoltaics, wind and biomass.

In Papua New Guinea the potential for energy from renewable sources is very large. A substantial part of the land area is under forests, estimated at 40 millon hectares. Only a small part of this resource is being used at present. In addition, agricultural products and wastes could be used either directly as an energy source or in the form of biogas or ethanol. There is also a high rate of insolation spread over the year and so application of solar energy for heat and electricity becomes possible. However, wind and wave energy are likely to have negligible potential. Some of the more important renewables are discussed in this report.

French Polynesia's involvement in photovoltaics for village electrification is very extensive. They have training programmes, maintenance and small spare parts provision. To date 87% of Polynesian households are connected to a mains supply and 7% to solar systems.

The Cook Islands development of renewable energy sources is slow due to lack of awareness, lack of local experts, expertise need to be imported for short term, urgent need for plans for manufacture of energy devices and installation and lack of public education to the use of alternatives to imported fuel.

Fiji is known to have some work on solar village lighting and wood fired domestic and institutional stoves. Details of other renewable energy sources were not available.



The test facilities at the South Pacific Institute for Renewable Energy in Tahiti.

By 1990, nearly 50% of Tahiti's energy will be hydroelectric. Plans are to provide the other 50% by the thermal energy of the sea

Most of these projects are funded through overseas aid, eg. EEC, UNDP, SPC, World Bank, Asian Development Bank and French, Australian, US and New Zealand governments.

Mini Hydro

There are approximately 30 mini or micro hydro schemes (ie. up to 100 kW installed capacity) in Papua New Guinea, producing an estimated 3 GWH (Gigawatt-hours) per year.

The only other installations in excess of 100 kW is a 200 kW mini hydro which supplements Elcom's diesel powered supply in Mendi.

During the last few years, the Department of Minerals and Energy (DME) has conducted studies to replace most of the outstation diesel powered generators with hydro. Most of these are yet to be constructed. During 1988, DME initiated a programme of installing two micro hydro systems (20 kW range) in each of the 20 provinces.

The hydroelectricity potential is limited to a few islands in French Polynesia: Marquesas Islands, Iles Sous le Vent, and above all Tahiti. In Tahiti great hopes are placed on the use of hydro energy. An extensive development programme is now under way, carried out by private companies. The power that can be provided in the island is estimated to be of 15 MW to 20 MW. By 1990, nearly 50% of Tahiti's energy consumption will be provided by hydroelectricity. Considering that the remaining 50% will be supplied by the thermal energy of the sea, one can see how important these two programmes are for the island.

In the archipelago, only a few sites of the Marquise or Sous le Vent islands can be equipped with micro hydro power. The power varies between 10 kW and 100 kW for both high and low falls. Eighteen such projects are planned during the period 1993 to 2010. Funding for these will partly come from the EEC.

The small hydropower stations designed to supply small autonomous distribution networks, are particularly appropriate and cost- effective way of meeting the electricity needs of the remote Melanesian tribal villages located near one of the many high waterfalls existing in the Territory of New Caledonia.

In 1981, the Territorial Committee for Energy Management funded a hydrological survey for the establishment of a network of measuring stations, the long-term aim of which was to produce precise maps of the sites suitable for hydro development and to assess the energy potential, site by site. This survey, conducted by ENERCAL, the New Caledonian Energy Company which is the major supplier of electricity to the rural areas of New Caledonia, led to the study of about 70 sites. Using these measurements, ENERCAL has, since 1982, set up eight small hydropower stations producing from 26 to 62 kW, which give a large number of households an electricity supply comparable to that provided by conventional means. The New Caledonian Committee for Energy Management (CIME) paid about 15% of the capital cost of these stations.

Some of these small hydropower stations replaced previously used fuel-driven generators that were costly to run and provided only a staggered supply. They thus give better service at lower cost to the user and also entail considerable savings on the Territory's imported fuel bill.

At present a small hydropower station with a capacity of 100 kW is being built by the Caledonian Water and Electricity Company and the ENERCAL company is shortly to undertake construction of a 160 kW hydropower station.

The first, and presently only, Solomon Islands Energy Authority (SIEA) operated hydropower scheme is at Malu'u on Malaita Province. This plant has a rated capacity of 30 kW and at present has a maximum demand of 10 kW. Only two other known hydropower generating schemes exist in the Solomon Islands and these are:

(i) Ato'ifi - on Malaita at a Seventh Day Adventist Hospital, with a capacity of 30kW, run by the mission.

(ii) Iriri - on Kolombangara serving a village and small local industry (carpentry), with a capacity of 7 kW, run by the village. Others that are proposed are: Komarindi (6 MW), Lower Kwaibala (100 kW), Huro (100 kW), and Jejevo (100 kW). These schemes will form the basis of the Solomon Islands Hydropower Development Programme.

The proposals are based on the requirement of replacing of existing diesel generating plants located at the main provincial centres where there is already an identified electrical demand and use requirement. The rural electrification development has not yet shown significant potential to warrant development as most rural installations would be limited in their use. It has been identified that the major requirements are cooking, lighting, navigation/telecommunications, small industry and handicrafts.

Apart from Rarotonga, the constituents of the Cook Islands group are not suitable for hydroelectric generation. However, Rarotonga is mountainous with high rainfall. River flow has been investigated and from general observations a preliminary assessment is that about 14% of the electricity generation on Rarotonga could be met from hydro-electric sources.

Recently a number of studies have been done by the Guam Energy Office and Water and Energy Research Institute of the Western Pacific University of Guam (WERI) utilising low head hydro. This study indicated that the primary interest to the use of low head hydro in Micronesia

is using waste water discharge and existing water falls for power as well as mechanical generation.

Solar Energy

In Papua New Guinea, photovoltaic (PV) cells can be used to provide light or refrigeration or to run water pumps and fans. At the high cost of K550 (US $825) for a two light installation in villages isolated from the power network, it is uneconomical. Aside from cost, there is also the equipment reliability problem. PV is, therefore, more likely to be used for the power supply of telecommunication equipment or refrigeration of medical supplies in isolated areas. However, as the cost of cells declines in the future with improved technology, these and other applications may become more attractive. Individuals have taken up PV for lighting and water pump ing.

The government has launched a highly successful programme of conversion from electric to solar hot water heating. A typical installation, imported from Australia to install or retrofit an existing electric hot water installation costs about K77 for a 70 gallon tank. Solar water heating equipment is now being manufactured in P.N.G.

Some 1000 solar water heating units have been installed. The high rate of installation reflects a response to Government regulations which effectively banned installation of electric hot water heaters in new buildings and homes and provided tax write-off incentives to retrofit existing electric installations. These solar installations will result in a substantial reduction of electricity peak and energy demand.

Solar electrification of the islands is the main axis around which the efforts put forth by the Renewable Energy Programme of French Polynesia are centred. The expansion of conventional diesel networks is very fast in the little islands of Polynesia. However, diesel-based electrification has several negative points, for example, the extremely high cost of the initial outlay and the operating cost as compared to the small size of the network; sporadic operation; and expensive maintenance.

In the face of this pressing demand for access to **a** better living standard, the Renewable Energy Programme offers the alternative of photovoltaic electrification. Each building is equipped with photovoltaic cells providing self-sufficiency. Compared to a conventional network, this involves little running and maintenance costs and energy is available around the clock.

Apart from individual dwelling units, photovoltaic cells can provide lighting to schools, community halls, the aquaculture farms and public places. Whole atolls such as Puka-Puka, Napuka and Fangatau will be entirely equipped and will make up the first projects of this type in the world. At the end of 1985, 2000 solar homes will have been operational in Polynesia and by 1990, 8000 to 10000. Funds for these systems come from the French Polynesian Government, EEC, National & Territorial funds, etc.

In recent years CTME of New Caledonia has been endeavouring to extend the scope of its electrification projects by setting up and financing installations in the isolated Melanesian villages of the Territory. Five tribal villages have thus been completely electrified with solar systems and two more are in the process of being electrified in the same way.

In addition, the EDF regional solar photovoltaic electrification programme coordinated by the South Pacific Commission will shortly be implemented in New Caledonia. Under this programme 1983 photovoltaic kits will be installed in about 40 tribal villages on the mainland and in the islands. The CTME chose the sites for this programme and is paying about 24% of the total cost. The first stage of the programme, which involves installation of 16 photovoltaic systems in community halls and dispensaries, is to be completed very shortly.

Water pumping in isolated rural areas has been a major technical and financial priority in the past few years for the CTME in conjunction with the New Caledonia Department of Rural Economic Development (DIDER). Photovoltaic water pumping (during sunlight hours, i.e. without storage) has been installed at five sites for drinking water supply to three tribal villages, stock watering ponds and troughs on a cattle station, and small scale irrigation at an agricultural research centre, for. a total installed capacity of about 3.5 kW. Although this technology is particularly well suited to New Caledonia, its extension is handicapped by the high cost of drilling and equipment. So far over **a** period of eight years 600 PV generators with a combined capacity of 100 kW have been installed.

Solar energy is widely used in the Cook Islands for water heating, drying applications, communication and electricity. A large number of houses on Rarotonga, with a few on the outer islands, have solar water heating panels and a great deal of solar drying is carried out in open air. Solar dryers which improve the quality of drying fruits have been designed at the Totokoitu Research Station. Most houses on Mitiaro are equipped with solar PV systems. However, the systems are not performing as anticipated.

The Guam Energy office has done studies on solar energy from Guam and the other islands of Micronesia. The solar energy can be used for telecommunication, refrigeration and pumping.

In the Northern Marianas interest has been shown in photovoltaics as the sun is the most abundant energy source in the Northern Marianas. At the present time a plan is being put together for a PV standalone project for individual homes and an SSB (Single-Side Band) for the remote islands.

Wind Power

Wind energy in French Polynesia offers a promising potential.

Wind-driven machines have not yet experienced a similar degree of development as compared to solar energy. This is because wind-driven systems and wind generators are more adapted to medium power installations, rarely present in dwelling units. Several wind-driven units are already in operation in Polynesia and the Renewable Energy Programme has recently stressed perfecting of medium power (2 kW to 20 kW) wind generator techniques. The improvements envisaged basically concern problems of installation. Wind-driven units are used for :

a) pumping by multiblade windmills

b) electrical pumping in the fresh water lenses of the atoll soils

c) supply of seawater desalination units

d) supply to cold storage rooms and to iceflake making machines

e) connection of machines to existing electrical networks.

Since 1987, the CTME has also started promoting French wind-powered systems for water supply to stock watering places, irrigation of pastures and vegetable crops. About 30 slow multi-blade wind-pumps are to be installed under this programme, the first two having already been ordered.

In the Cook Islands wind pumps are being installed on the islands of Atiu, Mitiaro Mauke and Mangaia to supply water from deep wells.

Biomass

In Papua New Guinea fuelwood contributes about 40% of total energy consumption

Nearly 95% of the fuelwood is consumed in households and the remaining 5% is used in the industrial sector for drying and other low grade heat applications, particularly in agricultural processing.

At present, about 1 million tonnes of woodfuel are being used per annum. Expansion of wood utilisation especially in the industrial and power sectors, has been one of the objectives of energy planners. Over the years there has been a major swing from diesel to wood fuels for crop drying industries namely copra, tea, cocoa and coffee. This saving has been possible by the development of simple low cost wood-fired equipment such as the waterside burners

Ramu Sugar Ltd. constructed a distillery annexed to the sugar factory to produce 6 to 10 million litres of fuel ethanol per year. The unit was commissioned in 1983 and ethanol sold to oil companies in the region for blending and distribution.

Some direct applications of use of living matter has already been carried out in French Polynesia. A gas production unit has been in operation since 1978 for Electricite de Tahiti (EDT). This gas generator operates off coconut shells and husks. Gas can be used to power a dual-fuel engine coupled to a 190 kW alternator and needs 50 grams of gas-oil and 1.3 kg of coconut husks for each kW-h of energy.

A programme for development of small gas generators has been in operation since 1978. This programme is being executed by the "Service de Economic Rural" and the Atomic Energy Commission (CEA).

Since 1980, tests on the use of refined and heavy coconut oil in automobiles have been carried out by EDT and CEA. The results have been quite promising. After several thousand kilometers covered, the EDT vehicle continues to operate quite successfully.

Moreover, research is being carried out to obtain gasoline from copra.

Biomass is one of the most widely utilised fuels in the Cook Islands, mostly in the form of wood for cooking, but also coconut husk for copra drying, especially in the outer islands, where this form of cooking predominates. Cleaner, more efficient wood burning methods are available for utilising this resource.

In the Northern Marianas, the first concrete biogas digester was built in 1981 for demonstration and in 1984 a fibreglass digester was built At the present time there are 4 ongoing biogas digesters, three concrete and one privately owned fibreglass digester.

This article is based on a paper, ***New and Renewable Sources of Energy in the South Pacific: a sub-regional report,*** *presented by Gario D. afiye, Acting Director Appropriate Technology Development Institute, Papua New Guinea, at the* Regional Workshop-cum-Mission on Utilisation of New and Renewable Sources of Energy (NRSE) *organised by APCTT in the People's Republic of China during 19-28 October 1988.*

This article originally appeared in Asia-Pacific Tech Monitor, December 1988.

Plants Water Themselves!

Capillary Irrigation Systems

by Lisa Pittle

Water usage is a critical point in a dry continent such as Australia. We are faced with recent predictions of onset of drought driven by El Nino at the same time as we are coming to realise we need to grow millions of trees to counter the Greenhouse effect. The issue is how to effectively start plants off in pots with the most efficient use of water possible. And if that can be done at the same time as actually IMPROVING plant growth, so much the better! Here we bring you details on a new irrigation system that does both.

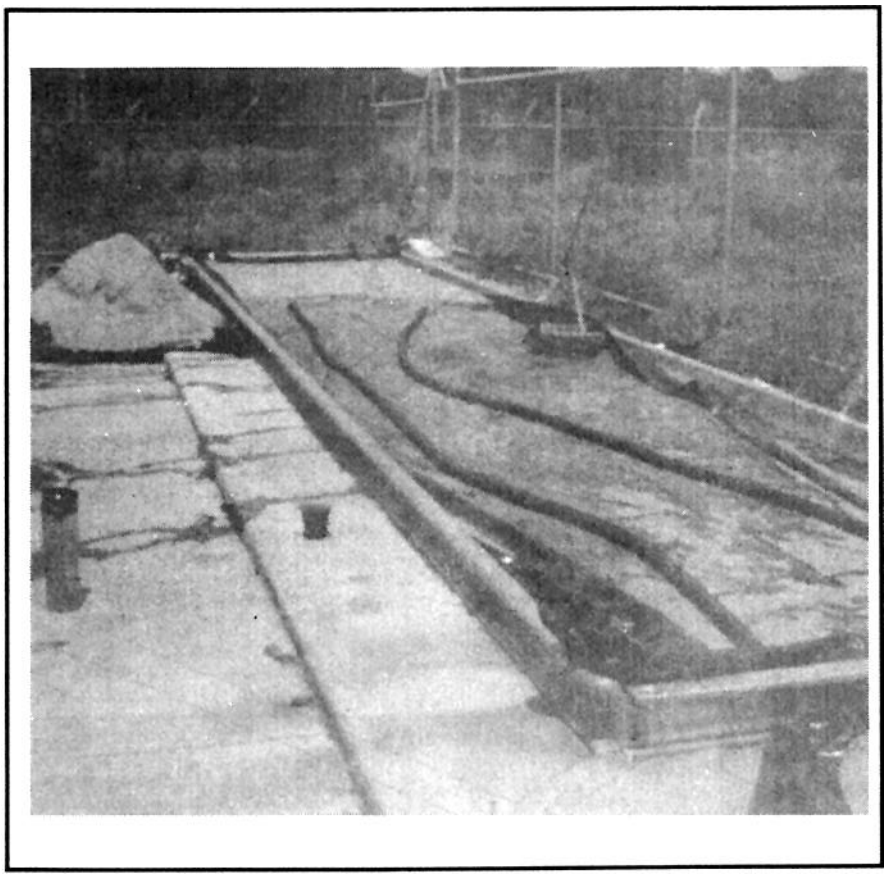
Problems in Pots

Plants growing in pots are living in an unnatural environment. This is because the root environment is restricted. In open ground the roots grow out laterally from the stem, exploiting a large surface area. In a container the reservoir is limited and the supply of water is critical. 15 cm diameter pots need to be watered twice daily during the Melbourne summer months to avoid severe water stressing of young plants.

The best technique for watering plants can be very easily described. Provide a growing medium with a high water holding capacity. After potting, water the medium until it is holding all the water it can retain against drainage i.e. it is at container capacity. From then on, as one drop of water is removed by the plant, it should be replaced, so that the medium is maintained at container capacity all of the time.

Evapotranspiration

Plants cycle large quantities of water on a daily basis. Water is lost continuously from small pores (stomata) concentrated on the undersurface of plant leaves. Stomata are open during daylight for gaseous exchange. Carbon dioxide, used in photosynthesis, is taken in and oxygen is given off. Water loss or evapotranspiration is then a consequence, in most plants, of this exchange. Evapotranspiration in plants performs much the same purpose as perspiration in people. Heat is lost in the process of converting the liquid water into vapour and this helps to prevent plant tissue from overheating.



The capillary bed being filled with sand

Transpiration Stream

The flow of water into the roots, along the stem, out through the leaves and into the atmosphere (the transpiration stream) is driven by evapotranspiration. The transpiration stream is continuous along this pathway and is essential. Water is required in all plant life processes, as either a participant or a medium. As the availability of water declines below the level required for the maintenance of the transpiration stream, the stomata close, photosynthesis ceases, tissues overheat and death impends.

Plants in containers are quickly droughted. Pots are usually made of black plastic; due to the ensuing absorption of solar radiation ambient temperatures tend to be higher and evapotranspiration is accelerated.

Traditional Watering Strategies

Nurseries producing plants in containers have traditionally used hoses and sprinklers to irrigate. These overhead irrigation methods mimic rainfall and, like rainfall, only a percentage of the water is effective. With sprinklers, water is applied usually until it can be seen to drain from the bottom of the pot.

The efficiency of an irrigation system can be calculated as:

Water applied from a sprinkler - (minus) drainage water - water evaporated as applied - water not entering containers = water available to plants.

During warmer weather pots are generally watered once in the morning and once in the afternoon. Water availability fluctuates between high (post watering) and low (pre watering). At low water availability the plant is stressed and growth is slowed.

A major problem with overhead sprinkler irrigation is that distribution is always uneven and the distribution pattern is easily skewed by wind. The actual amount of water that any one plant receives has as much to do with its location in the sprinkler distribution pattern as it has to do with sprinkler output.

Essentially, overhead irrigation methods are a gross waste of water. Wasted water is the compromise made in trying to water adequately using an inherently inefficient system. Large scale production nurseries can be directly responsible for the eutrophication of local waterbodies due to the large water runoff containing fertilizers leached from containers.

Drip irrigation methods avoid the water wastage of sprinklers. It allows a regulated amount of water to be delivered to each plant and comes close to the 'best' technique described above. The particular problems associated with drippers are:

1. one spaghetti tube and dripper/pot equals lots of plastic and high cost;
2. as pots are removed from the system, drippers not in use need to be plugged; and
3. water is still supplied according to an amount determined by the system manager rather than the plants requirement.

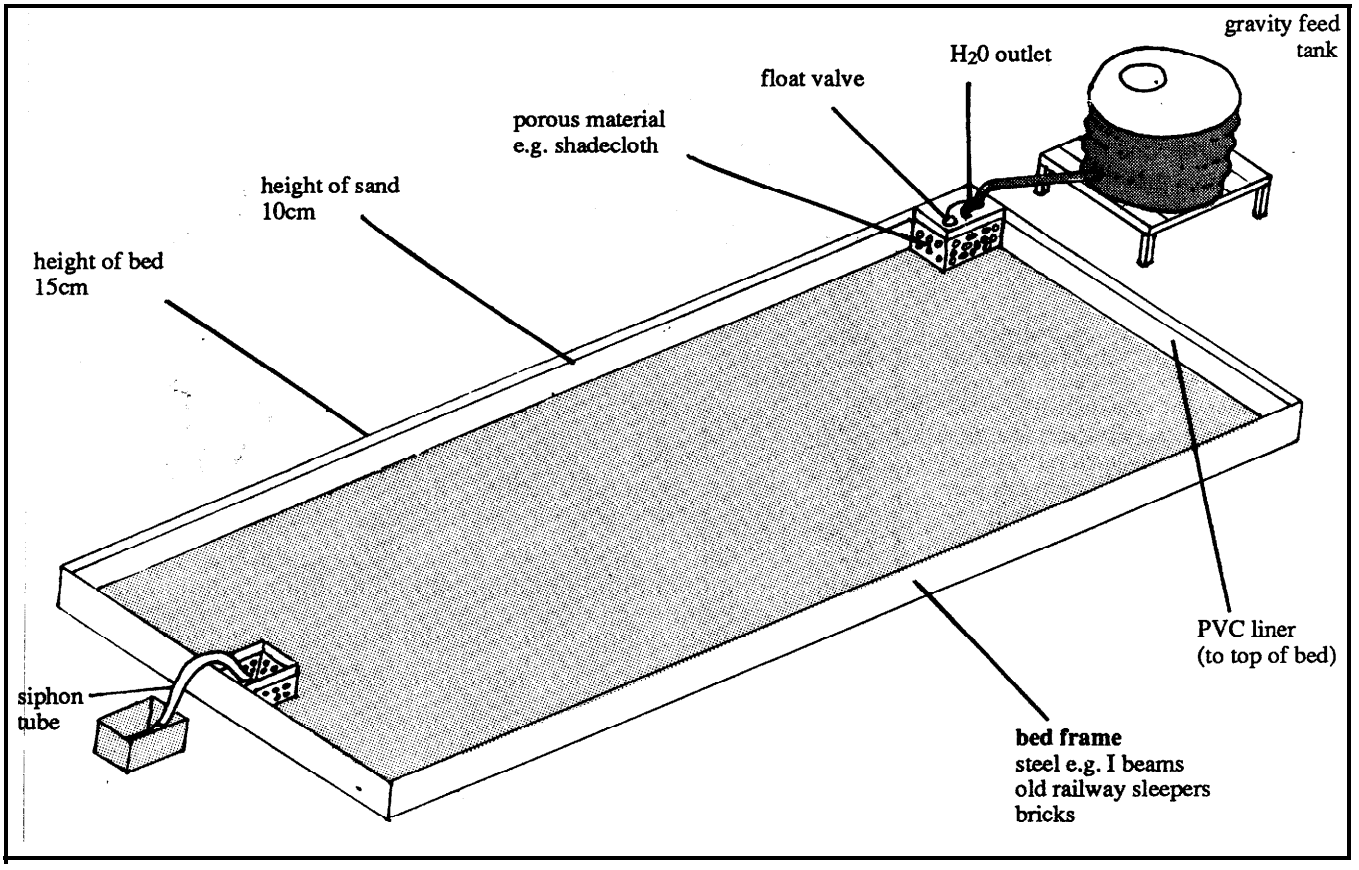


Diagram of system layout

A Better Solution

Capillary irrigation provides a practical means of achieving the 'best' watering technique. Capillary irrigation makes use of capillary rise which results from the adhesive and cohesive properties of water. The text book example uses a glass tube of fine bore as a model. The tube (capillary) is held upright in a reservoir of water. Water in the tube rises slowly above the general level in the reservoir. The phenomenon of capillary rise is used in the Coolgardie safe where coarse material is used as a wick drawing water up from the reservoir. In a capillary irrigation system pots are placed on a porous medium that contains a reservoir of water. Water is drawn into the pot through the drainage holes by capillary action.

In addition to the system described below Cuming (1986) uses a mat based capillary system to produce farm trees in tubes. Another recent innovative use of capillarity are Grow Pots.

Advantages of the Capillary System

A capillary sandbed has advantages over both sprinklers and drippers.

1. Minimum pressure is required. 1 mH is sufficient pressure for the system to operate. The system can be operated from a header tank which can be filled at intervals.
2. The sandbed is fully automatic and this is probably its most attractive and impressive feature. Water flow into the bed is directly regulated by the amount of water plants use and a float valve. No timing equipment is required. The bed can be left unsupervised for periods of time given that the system is operated from mains or tank supply is adequate for that time.
3. The amount of water in the root environment remains relatively constant.
4. Each pot has available to it the amount of water the plant requires.
5. Lower rates of fertiliser should be used because the medium is not constantly leached by overhead irrigation.
6. When part of the system is not in use it can be covered to prevent evaporative water loss.
7. The system is relatively simple to install and little maintenance is required.

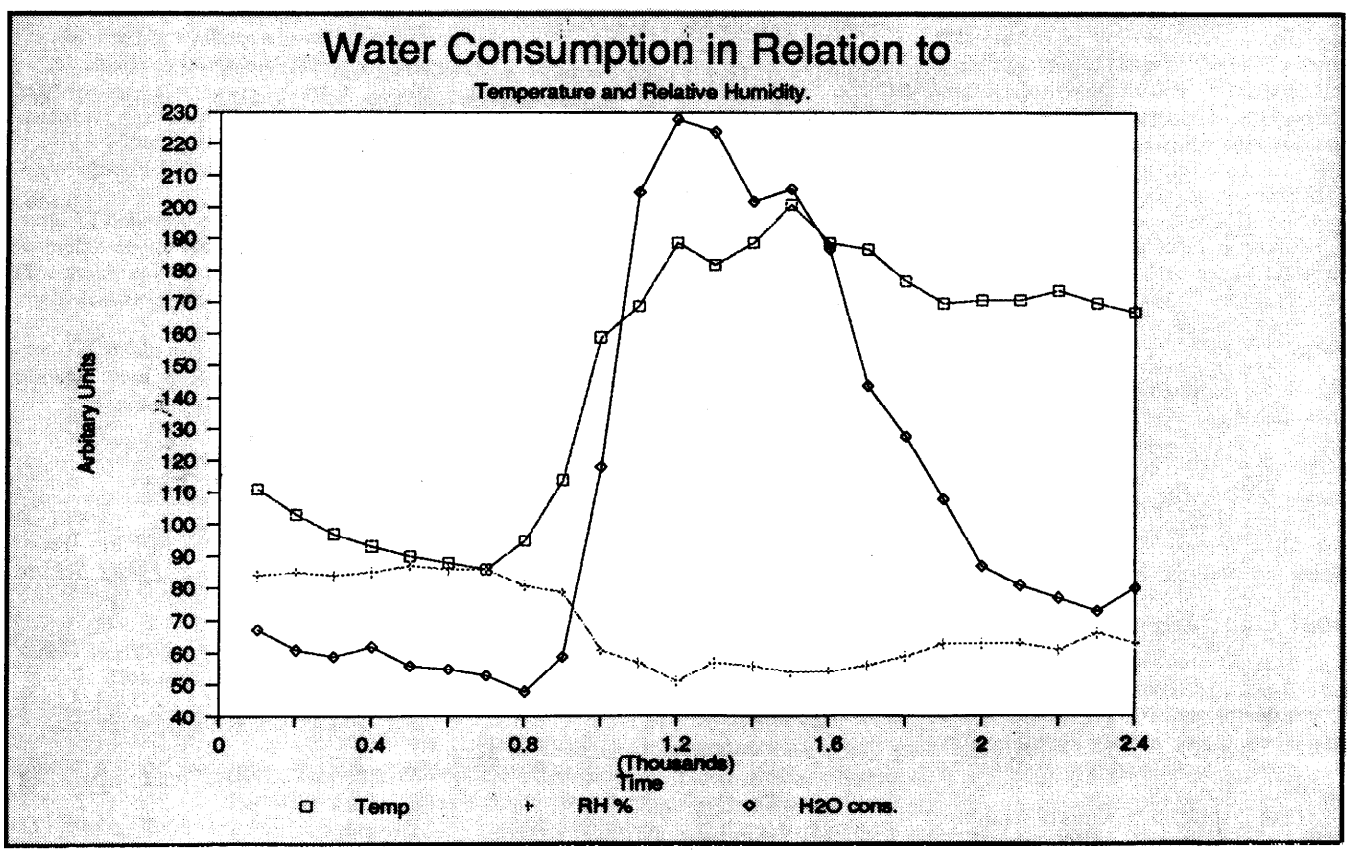
System Construction

The following is a description of the sandbed constructed in Melbourne. The design is based on that used by Margaret Scott in her work at the Efford Experimental Horticulture Station, U.K.. Plants were grown on the bed in a controlled experiment that compared the amount of water used on the sandbed with the amount of water used by sprinklers.

Framework

The base of the bed should be level. A slope in the bed results in variation in the reservoir level. This is particularly critical where the bed is fed by single point application than when fed by a soaker hose.

The frame should be at least 15 cm deep. Enough to contain the sand and a lip to



Temperature, humidity and evaporation plotted against time

contain the pots. Maximum width is 2 metres, any wider and its difficult to reach pots in the middle of the bed.

The frame can be made of a variety of materials as long as it can contain the sand.

Liner

The bed must be watertight. Leaks mean increased water consumption, defeating one of the main design features. PVC or swimming pool liner is preferable. We found polyethylene liners of maximum available thickness, doubled over, developed leaks within days of shovelling in the sand. Do it again... PVC has more stretch and will tend to mould around sharp objects where polyethylene is brittle and will 'crack'.

Drainage/Overflow

Heavy rains leave pots sitting in pools of water causing the root environment to rapidly deoxygenate. Rapid drainage is provided by a 50 mm 'Agflow' drain pipe running the length of the bed.

A siphon overflow avoids making holes in the liner (Any hole in the liner is a potential leak point). An overflow pipe can be a length of flexible plastic (15mm diameter). The pipe is filled with water, all air excluded. One end is submerged in the float chamber (see below), the other in a container that has an equivalent height of water as the sandbed. Excess water is then siphoned off. The siphon needs to be checked regularly as gases tend to dissolve out of the water in the tube when the water has been stationary for a period of time.

Sand

A range of sand grades should be represented in the fill. The recommended range is:

30 - 45% 0.5mm
40 - 60% 0.2 to 0.5 mm
5 - 15% 0.2 mm

We filled the bed to 10 cm, packed and levelled the sand.

Float Chamber

The float chamber ensures that the height of water in the reservoir is kept constant It is important to maintain the flow of water into the bed. If the capillary flow is broken plants need to be watered from overhead to re-establish capillarity.

The float chamber is kept free of sand. We used a cut down plastic crate, the outside of which was lined with shadecloth (porous plastic material). The chamber needs only to be big enough to accommodate the float valve.

The float valve is what is used in toilets to turn off the water flow when the cistern is full. The float - a light plastic ball - drops as the water level in the bed drops. This opens the valve and water flows until the float reaches a preset level and closes off the valve.

When water was supplied via the mains at high pressure and flow, we used a solenoid valve with the plunger removed to reduce both flow and pressure. A pressure reduction valve may also be used.

Notes on using the system

Place plants pot to pot to reduce the area of exposed sand.

The largest pot size recommended is 20 cm (this refers to top-of- the-pot diameter).

You can use a wire carry basket to put small pots (tubes) in and helps with handling and transporting (see Cuming, 1986).

Overhead irrigation may be required from time to time to leach salts which may build up in pots. If rainfall is frequent as it is in Melbourne, this is not a problem.

Results of the Trial

We grew 500 plants on the capillary bed and 500 similar plants under sprinklers. Water consumption trials were conducted on a day where temperature ranged from 12 to 24 degrees Celsius and relative humidity ranged from 40 to 85 %. Plants drew 14 litres of water off the sandbed.

On the other hand, plants under sprinklers were irrigated twice in the same period and the amount of water actually reaching the pots was 17.5 litres per irrigation (i.e. 35 litres over the same 24 hour period). This figure does not include the amount of water not reaching the pots. So, at each irrigation, more than 17.5 litres was actually applied. Visually there was little difference in the quality of plants grown under either system. Water consumption on the sandbed was correlated with temperature and relative humidity. It appears that plant water consumption correlates more strongly with relative humidity than with temperature.

Discussion

Our results showed that plants of comparable quality could be produced on a capillary sandbed both using less water and wasting less water than under sprinkler irrigation. Basically, plants used 14 litres of water to make growth comparable with plants using 35 litres of water under sprinklers.

The results also indicate the importance of relative humidity in the rate of evapotranspiration. This has implications for management of plants in containers. The lower the relative humidity the higher the water consumption. Sprinklers should water according to humidity rather than temperature. Growing areas should be sheltered from winds. One of the effects of pots sitting on a permanently moist surface is that the ambient humidity is higher than if the surface were dry. A high ambient humidity would hold down the evapotranspiration rate and contribute to reduced water consumption over time.

Plants are stressed at various times under the sprinkler system because at periods of high evapotranspiration the sprinklers may not be supplying water. However, the plants are not exposed to the same stress under capillary irrigation. Supply is always perfectly regulated to demand - in the parlance of the engineer, we have perfect load matching!

Our trials demonstrated the water conservation ability of a sandbed and how, simply and passively, the system provides for a plants water requirements. In contrast, sprinklers oversupply water at a rate determined not by plant needs, but by a human manager and sophisticated timing equipment.

Sprinklers on average provided 17 litres, but in fact the distribution of delivered water was uneven. This is a problem with sprinkler systems - some pots get more, others less.

The bottom line is that plants are less stressed, and less water is used, when a capillary irrigation system is chosen.

References

Cuming, B Production of Farm Trees. *International Plant Propagators Society* Vol 36, 1986 pp 208 - 211

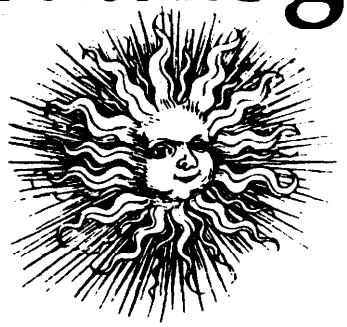
Handrek & Black 1984 *Growing Media for ornamental Plants and Turf* N.S.W. University Press. Gives a good list of Do's and Don'ts as well as construction ideas.

Whitcomb C. 1984 *Plant Production in Containers* Lacebark.

Discusses relative merits of the range of irrigation options.

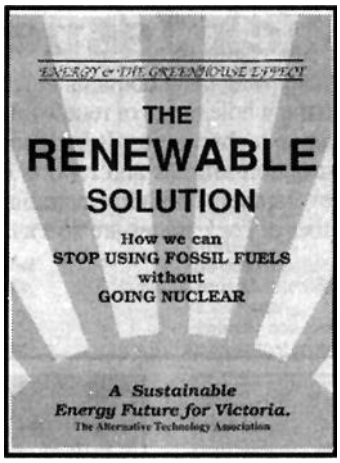
Alternative Technology Association

Solar Energy Resources Catalogue



The ATA is a community based organisation involved in the promotion of technology which works in harmony with the environment. The group runs a wide range of activities including meetings, film nights, field trips and practical workshops.

The ATA also produces a quarterly magazine Soft Technology and a bi-monthly newsletter. It built and manages the Solar Workshop and maintains the Alternative Technology Resource Library.



Sustainable Energy and Greenhouse

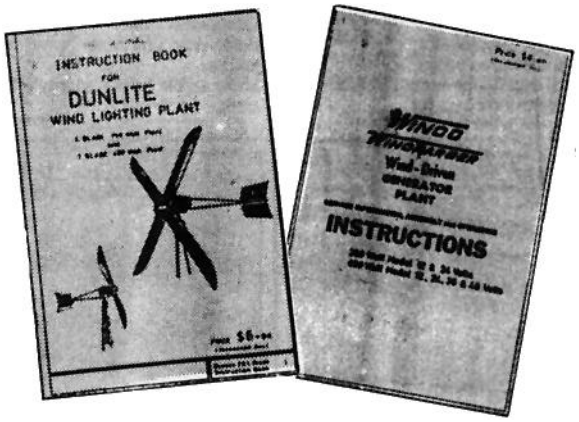
The Renewable Solution presents the case for energy conservation and the substitution of fossil fuels with renewable energy sources in Victoria. The information presented is particularly relevant in the context grappling with the greenhouse effect. A quantitative assessment of Victoria's present energy use and how this can be affected by conservation measures and renewables is central to the argument.

As format, 20pp., illustrated. $2.80 posted

Energy Conservation

Energy to Burn?: A guide to saving energy and money around the home is a comprehensive booklet giving many hints and information about insulation, lighting, appliances etc. Published by the Con-a-eon council of Victoria

A4 format, 48pp, illus., $4.20 posted



Windpower Information

These booklets give technical details of individual windgenerators. They give information on installation, maintenance and basic repairs. A must for owners or people reconditioning old generators but who have no printed information on the machines. The booklets cover the range of Australian made Dunlite windgenerators as well as the imported "Windco" and "Rutland" machines.

Soft Technology: Back Issues

Soft Technology magazine contains current Australian information on the whole range of renewable energy sources and alternative technologies. It includes a balance of practical construction articles and reports of Alternative Technology developments both in Australia and overseas. A limited number of back issues are still available.

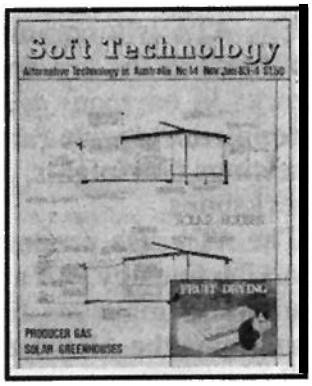
Number 8.
Appropriate Technology.
Methane digestion.
Electric vehicles.
Wind measuring methods.
Electric moped race.
Solar ponds.

Number 10.
Solar mudbrick flats.
Storage batteries.
Solar electric fridge.
Solar power station.
Australian Centre for Appropriate Technology.

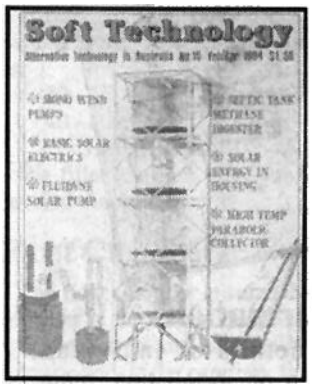
Number 11.
Build a cheap solar water heating collector.
Wind generator towers.
Human powered vehicles.
Natural cooling for summer heat.
Energy saving checklist.

Number 12.
Savonius rotor for water pumping.
Coolgardie safe.
Solar, wind and water-powered house.
Make an old house energy efficient.

Number 13.
Home made water wheel.
Window box air heater.
Simple solar pumping.
Solar controller.
Wind turbines of Rottnest Island.



Number 14.
Producer gas.
Solar greenhouses.
Suburban solar houses.
Blacksmith bellows.
Solar fruit dryer.
Solar pumping.



Number 15.
Basic solar electrics.
Septic tank methane digester.
Solar energy in housing.
Mono wind pumps
Parabolic collector.
Fluidyne solar pump.

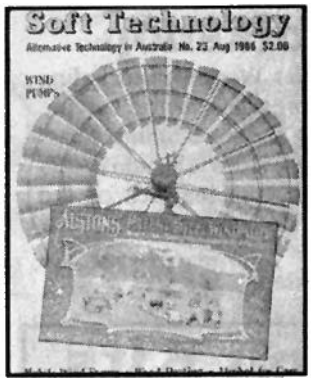
Number 16
Community built and run solar greenhouse.
Bicycle trailers.
Nepalese watermills.
Solar system in a suitcase.
Siddons solar heat pump.

Number 19.
Solar cell buyer's guide.
Suntrac tracking solar water heater.
Solar still.
Wind power on French Island.
Planning for the sun.
S.E.C. goes solar.

Number 20.
Battery buyer's guide.
Flying foxes.
solar car project.
Australia's solar future.
The Wales Centre for Appropriate Technology.

Number 21.
Adelaide's Solar Village.
A low technology waterwheel.
Solar powered 12V timer.
Designing cities for people.
High efficiency solar elec pumping.
Journey of the Solar Seeker.

Number22.
Windpower in the future.
Building a solar car.
Darrieus wind rotor.
An electric Go-cart
Low-tech solar water heater.



Number 23.
Run your car on alcohol.
Pumping with windmills.
Wood for heating.
Portable wind farm.
Shepparton: Solar City.
Pedalling for power.

Number 24.
Low-tech reaction water turbine.
Clivus Multrum compost toilets.
Wood heating.
Sunbottle solar water.
Solar school camp.

Number 25.
Breadbox solar water heater.
Bicycle wheelbarrow.
Erecting windgenerators.
Car radiator solar water heater.
Solar heat pump.

Number 27.
Solar electric power systems.
Telecom battery maintenance
Mudbrick solar house.
Savonius rotor.
Solar chook house.
RAPAS in NSW.

Number 28.
Solar electric houses.
Wood heating buying guide.
Wind powered wool spinning.
Haybox cookery.
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Greenhouse effect.
Solar kit homes.
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Simple anemometer.
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1988-89 Solar Directory.
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Spiral staircase.
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Number 31
Buying solar hot water.
Low cost generators.
12V practice amplifier.
Segner hydro turbine.
Solar hot water for remote communities.

Number 32/33
Low head hydro.
Solar hot water buying guide.
Community electricity loops.
Energy conservation vs. nuclear.
Rainforest timbers.
Nimbin soft technology.
Windmill efficiency.
Dunlite Blades.

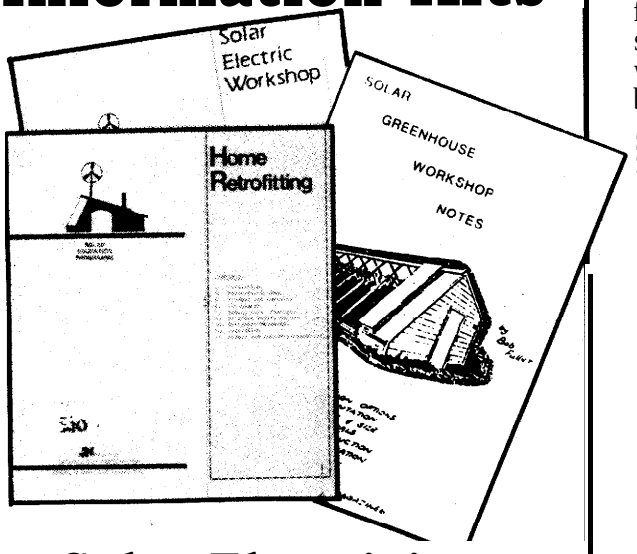
Number 34
Renewables in Pacific.
Economy irrigation.
Voltage regulators.
12V washing machine.
Windmill conversions.

The Solar Workshop

A detailed description of the Solar Workshop including information on the wind generator, solar electric system, water turbine, solar water heating and the building's passive solar design. The booklet includes diagrams with detailed explanations of the various features of the workshop. It also contains details on materials used, their costs and sources.

A5 format, illustrated, $2.00 posted.

Information Kits



Solar Electricity

Everything you could ever want to know about setting up your own solar electric system. Solar cells, batteries, wiring, inverters and appliances are all covered. How to design and size your own system - and once it's put together how to maintain it with minimal effort.

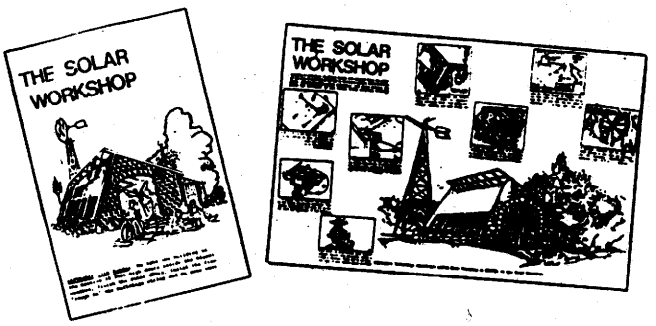
Home Retrofitting

How to make your existing home save energy by adding features which will improve its thermal performance. Includes information on insulation, weatherstripping, building modifications, landscaping, energy use of appliances and emergency measures to save energy.

Solar Greenhouses

Standard greenhouses overheat in summer and are too cold in winter. A correctly designed solar greenhouse gives the plants the best conditions all year round. The kit describes in simple terms how to design a solar greenhouse, materials to use and where to get them. It also gives a recipe for a small Solar Greenhouse and information on a simple greenhouse you can build into your home.

Price: All $4.50 each, posted.



The Workshop Poster

An attractive poster showing the solar Workshop and its features. Includes illustrations and basic explanations of the solar cells, wind generator, waterwheel, back-up generator, wood heater, water supply system, solar water heater and the building's design.

Order Form

Name .....

Address .....

..... Postcode .....

Description	Price	Quantity
The Renewable Solution	$2.80	.....
Energy to Burn	$4.20	.....
Soft Technology Back Issues...		
Up to no. 30	$2.50	.....
no. 31, 34	$3.00	.....
no 32/33	$5.00	.....
(please specify numbers)		
Full set of 22 available issues	$49.00	.....
Windgenerator instruction books...		
Dunlite 400 & 750 watt	$8.00	.....
Dunlite 1000 & 1500 watt	$8.00	.....
Dunlite 2000 watt, brushless	$10.00	.....
Windco Windcharger	$8.00	.....
Rutland Windcharger	$5.00	.....
Solar Workshop booklet	$2.50	.....
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Solar Electricity	$4.50	.....
Home Retrofitting	$4.50	.....
Solar Greenhouses	$4.50	.....
The Workshop Poster	$2.50	.....

Total cost (includes postage) $.....

Send your order with payment to:

ALTERNATIVE TECHNOLOGY ASSOCIATION
247 Flinders Lane, Melbourne, Victoria 3000.

BATTERY CHARGE CONTROLLERS

far more than you ever wanted to know about *REGULATORS*

by Alan Hutchinson

You're buying the batteries for your own remote power system. The salesperson asks what you are using for a regulator ... er what's a regulator and why would you need one?

Why do you need a regulator?

You need a regulator because batteries don't last long if they are being overcharged often or for an extended period of time. The battery's plates corrode and non sealed batteries lose electrolyte and may 'boil dry' if left long enough.

Suppose you have a weekend place up the bush and a solar panel storing energy in a battery while you aren't there. After a few days, the battery will be up to full charge and then will be overcharging the battery until your next visit unless there is something that automatically stops the charging when the battery is full. That something is a regulator.

What does a regulator do?

A regulator is an electronic device which measures how charged a battery is and stops charging when the battery is full. It is basically a battery protection device and since batteries can be expensive and regulators are comparatively cheap it makes sense to use one. After all, as you're half way through a holiday, it isn't much fun to remember that you forgot to disconnect the battery . . .

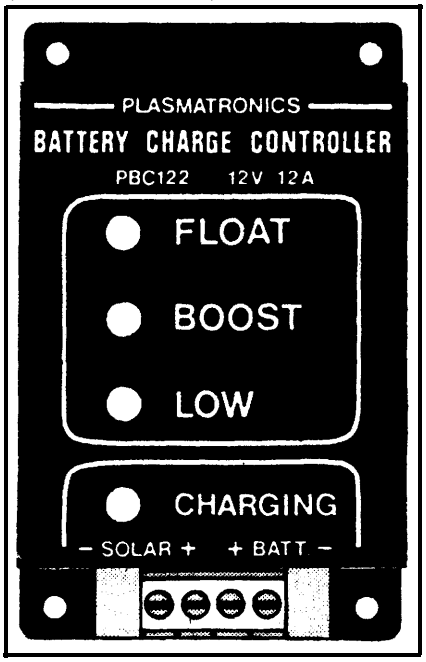
The concept of a regulator is simple but many different designs of regulator are in use. This is because there are a variety of ways of doing the regulating and differing opinions on exactly what the regulator aught to do.

Before going into this, we first need to know some more about charging batteries.

What batteries like.

A battery is a device to allow you to temporarily store energy in a chemical form. This discussion will be limited to lead acid batteries because they are by far the most common.

When you are putting electric current into a battery to recharge it, there are two competing chemical reactions going on. The desirable one stores energy but the other merely wastes energy in 'gassing' (the electrolyte is split up into hydrogen and oxygen) and consequent loss of electrolyte (in unsealed batteries).



Plasmatronics PBC121 is a FET switched series regulator

When the battery is partially charged the charging reaction dominates and very little energy is wasted in gassing. As the battery becomes more than about 3/4 charged the gassing reaction begins to waste a significant proportion of the energy put in. When the battery is almost fully charged, more than 90% of the energy is wasted in gassing. What this means is that it is hard to get the last little bit of charge into a battery.

How does a battery like to be charged? For roughly the first 3/4 of the charging the battery can be charged at full charge.

The recommended method of charging for the last part of the charge is to reduce the current slowly until the battery will hold the maximum charge voltage at very low current. This is constant voltage or taper charging. Once the battery is fully charged, for longest life, the battery should be held at a voltage just below the voltage at which gassing begins. This is called floating the battery.

Regulators that you can buy (or make) perform varying approximations to this regulation scheme. Before discussing regulation schemes we need to look at ways of determining how charged a battery is.

Measuring battery state of charge

As the battery charges up the electrolyte increases in density. This provides a means of measuring how charged the battery is. The hydrometer is a familiar manual tool but to convert it to automatic electronic sensor is not so straightforward. No batteries are made with electronically readable density sensors built in and the only ones available require you to insert them into the battery yourself.

However, the battery voltage also increases as the battery charges up. This provides the simplest way to sense it's state of charge. Unfortunately, the voltage also depends on other conditions as well. It varies with temperature and charging cur-

rent and takes time to settle to a steady value after a change in current. It also depends on whether the battery is in good or poor condition and whether there are any weak cells.

With all these other variables influencing the battery voltage you may think that it isn't much of a guide but, if interpreted intelligently, it's adequate.

Battery voltage variation with temperature is approximately -4mV/°C per cell. Hence for a 12 volt battery this means that the cell voltage falls 0.1 volt for each 4°C rise in temperature. By measuring the battery temperature it is possible to correct for this effect. Since temperature variations are rarely more than 10°C this effect is relatively small.

Because of the battery's internal resistance, its terminal voltage depends on the charging current. A battery in poor condition will usually have a larger internal resistance than one in good condition. This means that, if you are measuring the terminal voltage during charging, the poor battery will appear to be more fully charged than it really is. The only way to eliminate the effect of battery resistance is to measure the voltage with no current flowing. (The taper charging scheme does this by reducing the current flow at the end of charging.)

A weak cell in a battery will also cause a misleading voltage and can only be checked for by measuring each cell in the bank and looking for anomalies. (This isn't possible in most sealed batteries).

REGULATOR TYPES.

There are two basic ways to control the charging current

Series regulators

These control the charging current by turning on or off a switch between the battery and the charging source. This switch may be a relay or a electronic device such as a power FET.

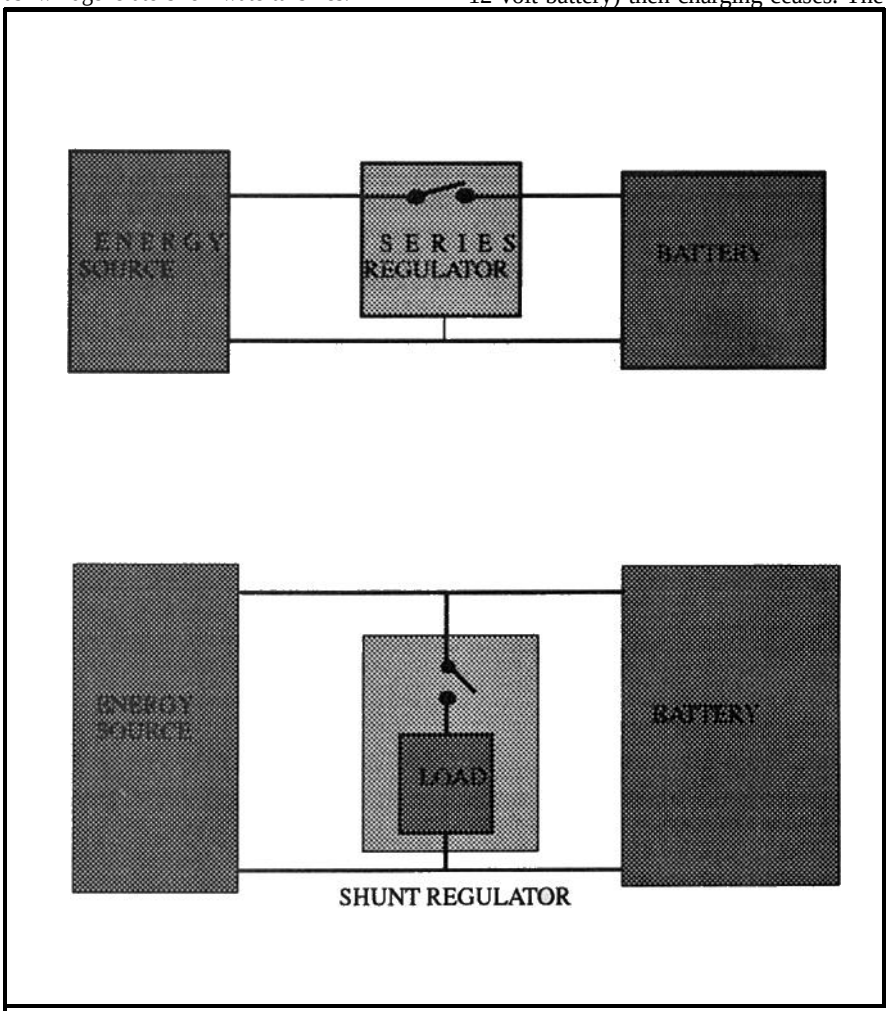
Current control can be either straight on or off or variable.

Variable current can be achieved by turning the current on and off very fast (chopping - not possible with relays) or by having a number of switches and switching in or out portions of a photovoltaic charging array (This is used more on large systems). The main advantage of series regulators is it is not necessary to dissipate the power from the source. This means that series regulators can be small and light but still able to control high current charging systems.

Their main disadvantage is that because they present a varying load to the charging source they are not suitable for generators which need a constant load. (e.g. most windgenerators and water turbines). The switch also has to be capable of carrying the peak charging current from the source.

Shunt regulators

These control the charging current by diverting some or all of it into a load other than the battery. This could be a reserve battery bank or a power resistor (to dissipate the excess power as heat). This type provide a much more constant load to sources such as windgenerators or waterturbines.



How series and Shunt regulators are connected

The main advantage of shunt regulators is this constant load characteristic. It also is only necessary to be able to dissipate the average power from the source (rather than the peak power - this is important for very peaky sources such as windgenerators)

The major disadvantage is that the power has to be dissipated somewhere and power resistors tend to be big and bulky (and rather impractical for large systems).

Regulation schemes.

The regulation schemes used range from the simple to the complex.

On/off maximum voltage limit

This is the simplest scheme. If the battery voltage exceeds the recommended maximum charging voltage (14.5 - 15 volts for a 12 volt battery) then charging ceases. The battery voltage must then fall below a certain voltage before charging recommences. There are two different reconnect voltage ranges -

12.5-13 volts. This means that the battery must be used before reconnection occurs. A fully charged 12 volt battery will settle to about 13-13.2 volts when disconnected (This may take up to 20 minutes).

Just below the disconnect voltage. This will cause the current to disconnect and reconnect repeatedly very quickly which will have the effect of maintaining a constant maximum voltage by effectively reducing the current, (Not possible with relays because the constant switching would wear them out quickly) A possible problem with these fast switching or 'chopped' systems is radio or audio interference caused by the fast switching voltage changes.

Power Zener diodes

A Zener diode is a device that will conduct electricity when the voltage across it is greater than it's rated voltage. Connected in parallel with the battery it forms the simplest form of shunt regulator available.

The advantage of zener diodes is their simplicity and hence reliability. The problems with zener diodes however are:

a. It is hard to get zener diodes of more than 20 Watts. This limits them to a maximum of about 60W (3 diodes in series).

b. The voltage at which the zener regulates varies at least +/-5% due to manufacturing tolerances, is not adjustable and varies as the diode heats up. This means that it is not really accurate enough.

Two stage charging

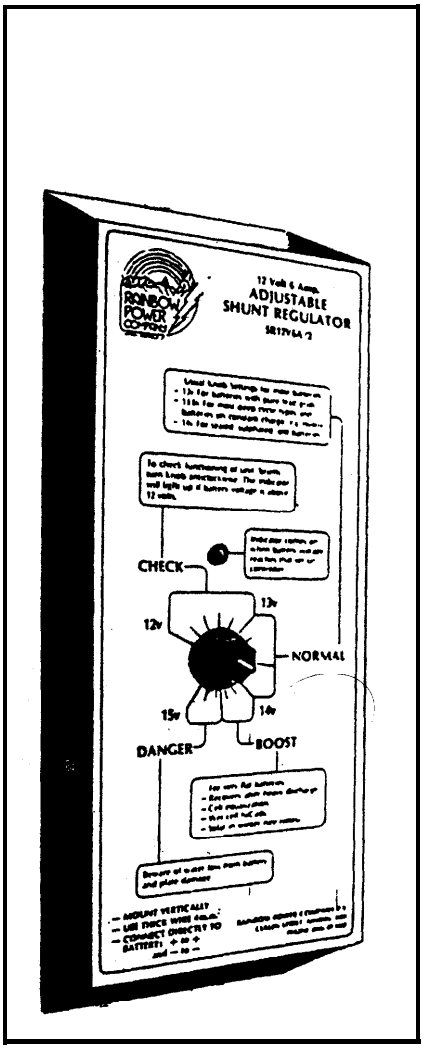
These schemes allow the battery to charge at full current up to a high voltage to get it fully charged and then change over into a float mode in which the battery is kept on just enough charge to keep it just below the gassing level. When the battery is used it's voltage will fall and the regulator is designed to switch back into the boost mode when it falls below some set level. The regulator will then allow charging until the high boost cut out voltage is reached again.

There are two common implementations of this scheme on the market.

One allows full charge up to about 2.4-2.5 volts per cell (14.4-15.0 volts for a 12V battery). It then changes into a float mode and chops the current to keep the battery voltage at about 2.32 volts/cell (14.0V).

The other is the same except that in the float mode the charge current is turned on until the voltage reaches about 14.0 (for 12V bat) and then turned off until the battery voltage drops back below 13.1 volts at which the current is turned on again This causes the battery voltage to oscillate between 13.1 and 14.0 volts. This oscillation is initially rapid but slows down and eventually just about ceases as the battery gets completely charged. Fixed or adjustable cut out voltage?

There is some debate as to whether it is better to have the regulator voltage factory set or adjustable by the user. An adjustable regulator is technically a better solution in the hands of an intelligent and non forgetful user who understands what they are trying to do. The problem is that a lot of people aren't in that happy (or privileged) position and the retailers of solar equipment have a marked preference for the simplicity of non-adjustable systems.



Rainbow Power Company's adjustable shunt regulator

The bee's knees.

A number of microprocessor controlled regulator and monitoring systems are coming onto the market now. These can implement more complex regulation schemes and will even start up a back up generator for you when the battery voltage falls too low. They tend to be rather expensive at present however.

Secondary features

Some regulators provide some additional features such as indicators that bear some relation to the battery state of charge. One regulator has a 'charging' indicator which lights when charge current is actually flowing through the switch. Some regulators also have a low battery disconnect facility to protect the batteries from overdischarge.

Sizes and Pricing

Regulators vary in size from simple one panel (about 3 amps) versions up to 10 to 20 panel versions. For very large installations it is better to use a regulator which switches the solar array in and out in sections. At least 75% of all regulators sold are for 12 volt systems but 24 volt systems are becoming more common. 6, 32, 36 & 48 volt regulators are also available (but often have to be ordered from the manufacturer).

Prices start around $40 for a single panel regulator and get above $100 for a 10 panel regulator. More exotic regulators are in excess of $200. Sometimes regulators are sold as part of a control panel which will also probably have fuses for protection and a switch to bypass the regulator for manually controlled boost charging.

Bias

The author wishes to plead guilty to some bias. He designed the range of regulators manufactured by Plasmatronics. However he has tried to be fair....

How to get the best out of your Dunlite 4-blade Wind Generator

Some Suggestions

by Chas Martin

The following is based on my experiences using a Dunlite 4 blade furling type generator and battery storage to supply electric power to my light engineering workshop. The workshop is used to make blades and other parts for Dunlite wind machines and do repair work. The 32 Volt battery bank runs lighting, a 32 V DC arc welder, electric drills, drill press, benchgrinder, powerhack saw and 1hp metal lathe, all directly - not using an inverter.

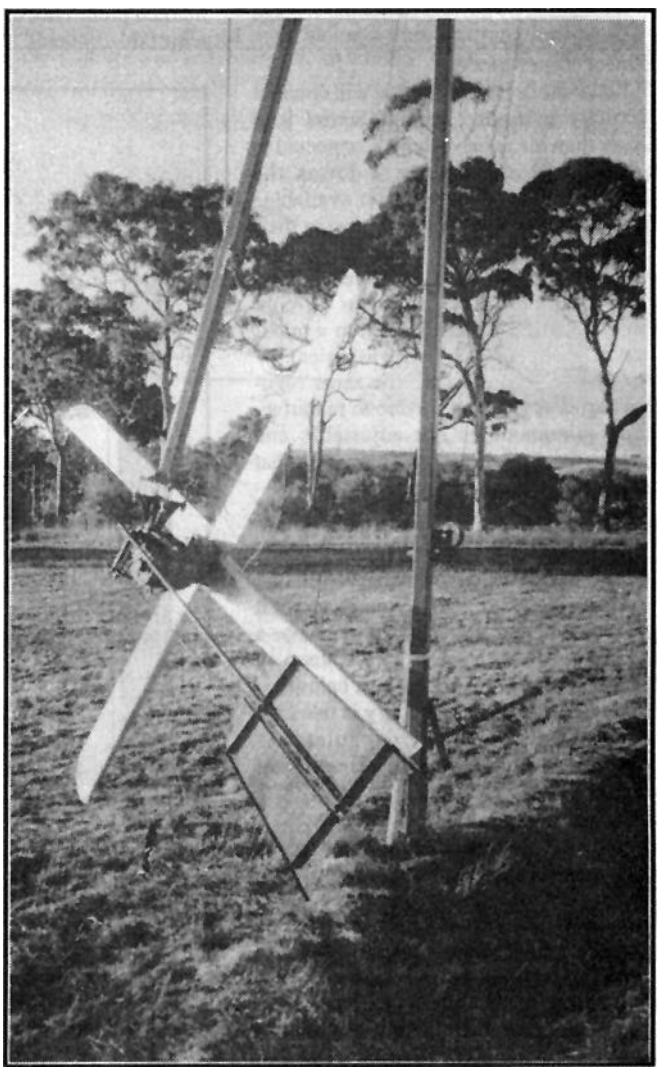
Since I wished to use renewable energy, I looked at the economics of what was available in the short term i.e. photovoltaics or wind (The use of biomass via methane, methanol or wood gas is a longer term option). On the basis of capital cost per kWh per day supplied, it was obvious that wind was the way to go for power in the quantity required and winds are quite good in our area.

The site is at Kuitpo in the hills near Adelaide. I was able to buy an old Dunlite furling type wind generator for a few hundred dollars, but on the basis of past experience in using and repairing these machines, I was dissatisfied with two things about them. Firstly it seemed to me that their cut-in wind speed was unnecessarily high. It would be much more useful if they could produce a few amps (50-100 watts) in a moderate breeze rather than nothing. Secondly they are quite heavy, a major problem and expense to lift up and down for repairs and to access for servicing. This is a major disincentive for people to use these old Dunlites which are otherwise very robust with a good electrical output.

Lowering Cut-in Speed

This involved two modifications. Firstly I fitted oversize blades (1.6 metres) on the four blade hub, which made the rotor 200mm larger in diameter. (Standard blade length is 1.5 metres). To use oversize blades can be asking for trouble, because stresses on hub, bearings and lay shaft are greatly increase. I overcame that problem by making the blades out of sheet aluminium instead of sheet steel, which dramatically reduced blade weight, thereby reducing the centrifugal and precessive forces.

I used 1.6 mm aluminium sheet for the blade sleeves rather than 1 mm steel (Galvabond) and 1 mm aluminium sheet for the blade skins rather than 0.6 mm steel sheet (zincanneal). I think I could increase the blade length by a further 100 mm, with further improvement in low and medium wind performance without exceeding stress limits. I haven't yet tried this in practice so I can't recommend it at this stage. I am at present trying larger blades but it will need six months of use under all wind conditions before I can be sure it will work.



Close-up of the modified design

Secondly, I substituted a 48 volt generator unit for the 32 volt one I had originally obtained and used it to charge the 32 volt workshop system. This resultedin a further lowering of the cut-in speed. I cannot explain why this works, but have tested it in practice by switching the generator from a 48 volt battery bank to a 32 volt battery bank in steady wind conditions and watched it on the ampmeter, cutting in and staying in on the 32 volt bank when it hadn't been charging the 48 volt bank.

Operating a generator in this manner can be risky because its maximum current rating can be exceeded when operating at its rated power. This problem I have overcome by setting the furling to turn the rotor out of the wind at a lower than normal wind pressure. This is easy to do by shifting the upper tail hinge support.

The machine has been working in the above configuration for 10 months now in all conditions including through two gales, without the manual turnout lever being used. Effectively, I have reduced the rated output of my generator but the low wind output is a lot more valuable to me than the high wind output because I can't economically store all of the output in a period of strong winds.

THIS EXPERIENCE SUGGESTS THAT THE MANY THOUSANDS OF 32V GENERATORS AROUND MIGHT BE VERY SUCCESSFULLY USED TO FEED INTO THE INCREASINGLY POPULAR 24V SYSTEMS.

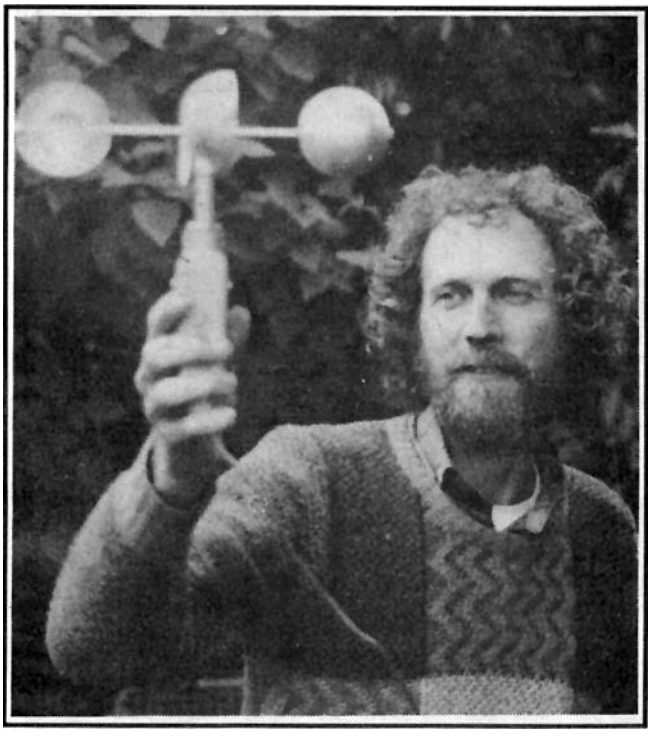
This is a conservative suggestion because the drop between nominal generator voltage and battery bank would be only 8 volts (25 percent) where as I am operating on a drop of 16 volts (33 percent). If you try the above you will need either very careful manual regulation of output or preferably an accurate voltage regulator which can switch the generator output into a load dump when the batteries are fully serviced.

Solving the Lifting Problem for Repair Situations

The most satisfactory alternative to the usual methods involving gin poles, ropes and pulleys and working 40-60 feet above the ground is somehow to swing the whole head assembly down, so it can be worked on at ground level. The smallest Wind Technology machines and some Dunlite installations use a system in which the whole tower can be dropped to the ground using a hinge at its base and a jib, also attached at the tower base. This works very well but tends to create quite high tensile loadings in the lifting cables, requiring heavy winching equipment.

Heavy winches are expensive and I always feel uneasy relying on them, so I needed something which gave me their great benefits without the worries. I decided to try the old seesaw tower idea which I had seen in windenergy magazines and books. This allows the use of a counterweight to balance the wind generator head and lifting cable tensions are reduced to almost nil. Getting the head up and down becomes a more relaxed operation. The long timbers traditionally used in these towers are not easy to get in South Australia and I wanted a lighter more precisely engineered mast which could be erected without a crane, so I designed and built one of steel.

It consists of a fixed 6 metre mast of 80mm x 80mm square mild steel tubing



Chas checks the wind on his visit to Melbourne

The new . . .

with 8mm wall thickness, standing on a hinge on the concrete support pad. This base hinge is to facilitate the initial erection of the tower only. On a very heavy hinge (made of 10 mm steel plate) on top of this fixed mast is an 8 metre length of similar steel tubing pivoting about its centre, with a simple tension truss to prevent droop during raising and lowering.

The pivoting mast and the fixed mast can be clamped together and are separately guyed to heavy concrete pads. The counter-weight end is marginally lighter than the head end, so that only a very light pull using a standard boat winch attached to the count-eight end is required to pull the head up into operating position. Initial tower erection can be done using either crane, or a temporary jib and turfer winch (turfer winches can be obtained from build-ing equipment hire firms).

Total tower height is 10 metres and the head swings down to a convenient 2 metres above ground for service and repairs. The steel I used was a lucky salvage find, but 100mm x 100mm with a 5mm wall thickness would probably do as well. The best way to appreciate the tower geometry is to study the photographs. Another simpler main hinge arrangement is shown in the accompanying sketch. Note that the furling cable comes down the centre of the tubing, but the power conduit comes down the outside, with flexible conduit at the main hinge.

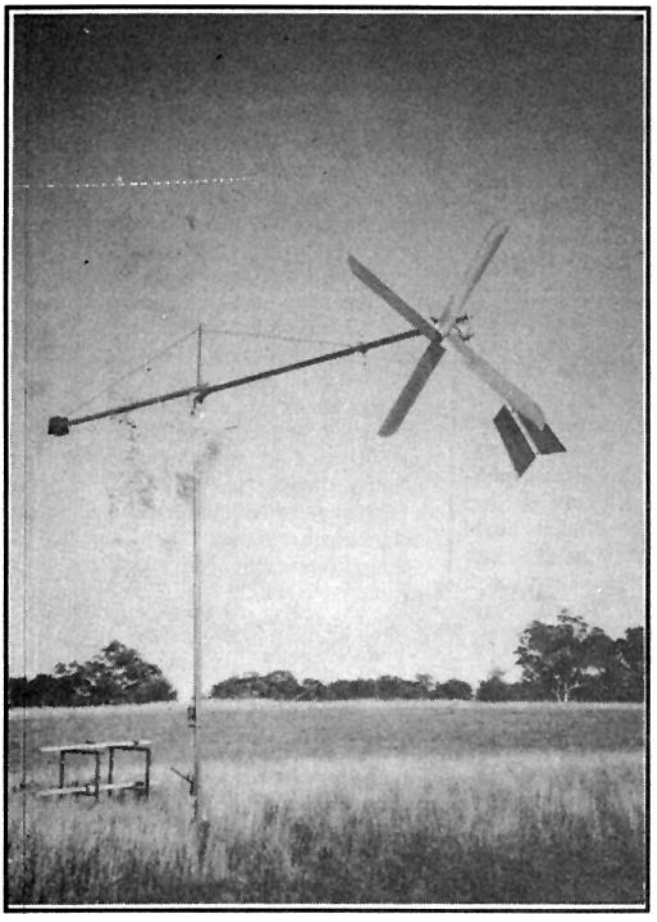
The simplicity of this tower means that it is economical to build and maintain, as well as making repairs and servicing much easier. One limitation of this system is that the head can only be raised or lowered in calm conditions, because the furling does not function unless the tower is in a vertical position So get up early, at least it is only a 5 - 10 minute job before work, and it can be safely kept in a lowered position if the blades are tied stationary.

Remember that if you are going to remove part of the head, chain the head assembly to the base of the tower first! Otherwise the counterweight becomes heavier than the head and will come swinging down un-asked. A similar tower could be made to go to 14 - 16 metres, with not a great deal of change to the design.

Lateral trusses on the see saw part would be advisable to prevent buckling and extra guys should be considered (depending on the tubing section chosen), if the unbraced length of any mast section goes beyond 6 metres. Hoping this helps to make the use and maintaining of your Dunlite a more relaxing pastime.

Postscript

The blades and other parts I make for Dunlite wind generators are distributed by **Natural Technology Systems, 120** Prospect Road, Prospect, South Australia; phone08 344 7298. Having recently bought the Dunlite company's last remaining stock of spare parts, NTS has the best range of spare parts in Australia.



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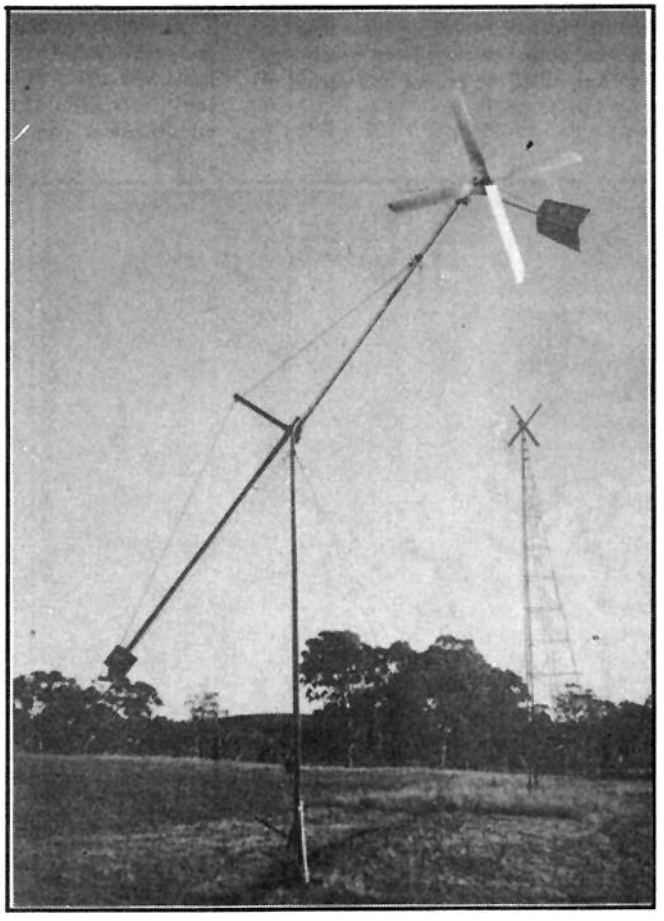


... in action!

Converting a HOOVERMATIC TWIN TUB to 12 Volt operation

by Chris Harkin.

For people with a 12 volt solar electric system, the cost of an inverter large enough to run a washing machine can be enormous - not to mention the inefficiency. Here is the solution - convert your favourite model to run on 12 volts DC!

If your friends ask you "Why?" . . .

Even assuming you want to buy a large inverter anyway, which will cost you well over $1000, it is a waste of your battery-stored energy to run a washing machine on an inverter. This is due to substantial efficiency losses both in the inverter, and in the induction motor used to run the machine. Induction motors have a low efficiency, and use an an enormous current surge to start up - often ten times the rated current. A more suitable system, especially for those of us on a tight budget, is a "low tech" 12 volt washing machine.

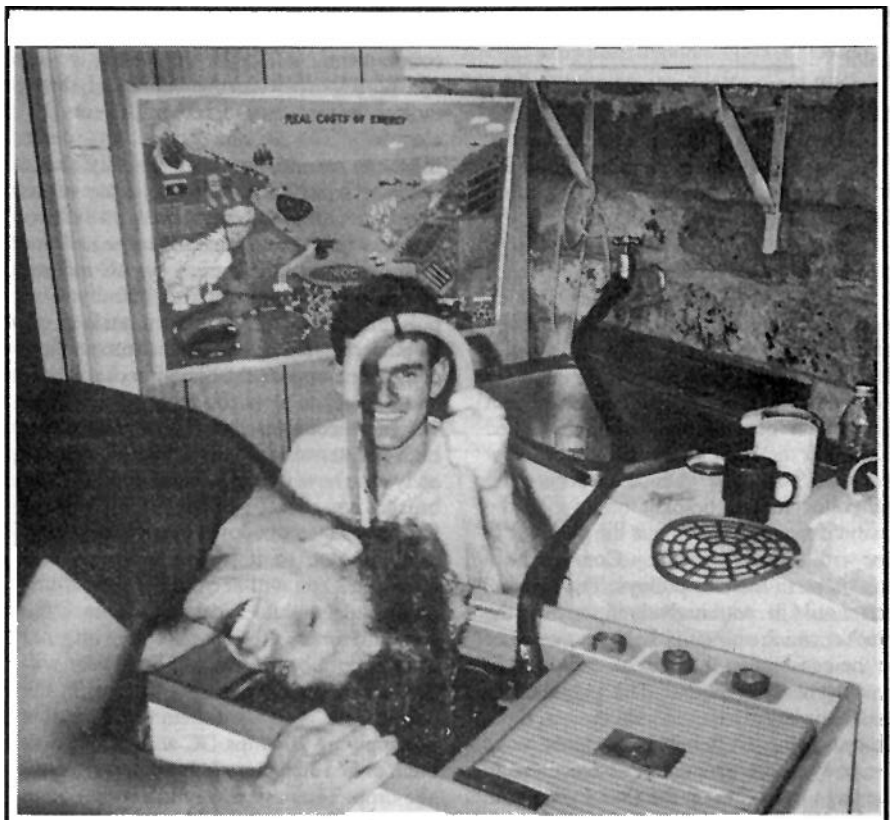
I have chosen the Hoovermatic twin tub for this conversion for a number of reasons:

1. It's easy.
2. They are very economical on water use.
3. They do a good job very quickly.
4. They are extremely popular and so are easy to get cheaply.
5. Parts are cheap and easily available.

The main drawbacks to these machines are that they are manually operated, they have a fairly small capacity, and the wash performance suffers markedly if the machine is overloaded.

There are three main series of Hoovermatic - the earliest, made in the 1950's and early 1960's, has its controls on the front of the machine. The workings of this machine are quite different to those described in this article and this machine cannot be con verted.

The later machines are suitable, though the 1960's machines are getting old now and should be avoided. The machines you are looking for have a rubber valve between the wash tub and the pump, operated by a knob on the top of the machine. The 1960's machine does not have this "pinch valve", its valve is inside the pump housing. If you can get hold of a machine with a plastic wash tub, so much the better. These machines have a better designed pulsator which gives an improved wash action. The alternative has a stainless steel washbowl and still works fine.



Yes it works!! The 12 volt washing machine rinsing a willing volunteers head down at the Solar Workshop.

Checking the machine

It's no good spending hours converting a worn out washing machine. Things to look at before you get stuck into a conversion-

1. Wear in Pulsator Bearings. Rock the pulsator up and down. If it wobbles at all it needs to be replaced.
2. Leaks in hoses.
3. Seized pump. This is very common. Pull it to bits, clean it and put it together again with a bit of grease on the shaft. How to do it is fairly obvious once you look at it.
4. Spin assembly. Check bearing and seal unit in the bottom of the spin tub for wear

and leaking. Check the bottom bearing inside the enormous pulley for wear and roughness. Check the flexible bottom mount for cracks and damage.

If you find problems with any of these, write to me and I will gladly advise you

Converting the wash motor

1. Remove the timer cable from rear of wash motor - (left hand thread).

2. Remove motor from resilient mounting (2 mls), and scrap it.

3. Find a car generator for your new wash motor.

4. Drill into pulley end of its shaft a 3/16 inch hole to depth of 1.5 inches. Tap this hole using l/4" unc left hand thread tap. [The generator turns in the opposite direction to the motor. That's why you are putting the cable into the other end.]

FOR LUCAS GENERATOR: Large spade lug is the +ve input. Use the resistor to join this spade lug to the small one, which is the field connection. SOLDER the resistor to avoid daggy connections. You will need a very big soldering iron for this.

FOR BOSCH GENERATOR: Connect the resistor between the terminal marked "DF" and the body of the generator. Now use your two hose clamps to secure the generator to the bracket on top of the resilient mounts. Watch that the pulley is in line with the pulsator pulley. Connect the V belt between the two pulleys. The original belt should fit. Alternatively if you have the bracket which originally held the generator to the car engine, this can be drilled to fit onto the resilient mounts. The weight of the generator is sufficient to hold the belt tight. To test- using a 12v battery, connect -ve to the body of the generator. Connect +ve to the large spade lug on the Lucas generator, to the "D+" terminal on the Bosch generator.

Spin motor conversion

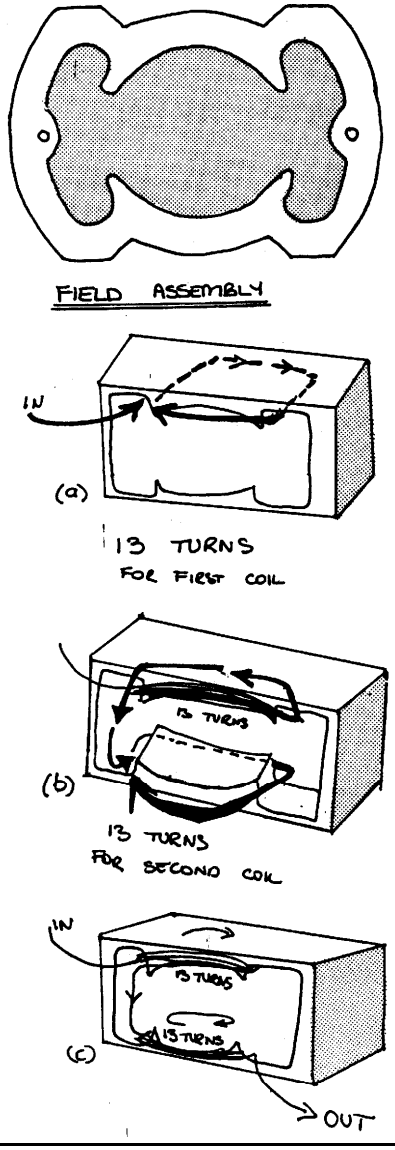
It is very important at this point to understand how DC motors work. I will attempt to give a basic explanation which will probably horrify the purists. We all know that if we have two magnets, and we bring the two LIKE poles together, the magnets will repel each other. If we bring the two DIFFERENT poles together, they will attract. The windings in the motor constitute two electromagnets which attract each other. One winding is the field coils, which are the stationary windings just inside the motor casing. The second winding is the armature, the revolving winding on the shaft of the motor. This is actually a group of windings arranged around the shaft. As the shaft rotates, different windings on the shaft are turned on in sequence so that the best reaction with the field coils is maintained at all times. Along the shaft from the armature windings is a set of copper bars which make up the commutator. The commutator can most simply be described as a rotating switch which feeds power to the correct coils at the appropriate moment. Power is fed to the commutator by carbon brushes, one positive and one negative, which are kept in light spring contact to the commutator.

One important design feature of these motors is that they work on AC or DC electricity. The AC changes polarity many times per second, but as the polarity changes in both the fields and the armature at the same time, the relationship between the two sets of windings remains the same and the motor still turns the same way. AC motors of this type have a design difficulty. The pulsating nature of AC current tends to set up stray magnetic fields in the surrounding coil, which oppose the direction of rotation and so tend to slow the motor down The designers counter this problem by using high-resistance carbon brushes. (I'm not exactly sure how it works, but it does.) These brushes are NOT suitable for low voltage DC use as they cut down the power getting to the motor, so it performs weakly and overheats. You will need to get copper-impregnated graphite brushes to replace the standard ones. If you take the original brushes to a brush manufacturer they will construct a set of matching brushes in the correct mix. You want them to be capable of supplying 20 amps DC at 12 volts. Ask them to fit a 3cm pigtail, this cuts down volt age drop. The easiest way is to order them from me. I have a friend who can make them up in small quantities for $8 each, you need two.

Well, so much for theory.

Tip the Hoovermatic on its top. Holding the motor in place are two screws - remove them. Disentangle the two belts from the pulley. Note which one goes where. Remove the wires and pull the motor out. The cap of the motor is held on by three spring clips. Prise them off. Remove the cap. The two carbon brushes will fall out - throw them away. Inside you will see two screw heads. Undo - there are nuts underneath the motor. Remove the pulley from the motor- right hand thread. When the pulley is off catch the spacer from behind the pulley. Now you can extract the fields and the armature. The fields are likely to be a struggle - use plenty of WD40.

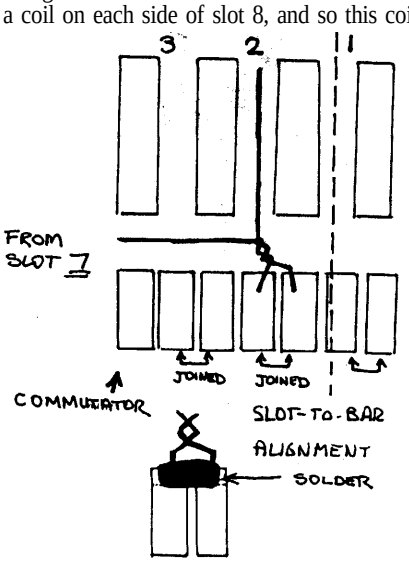
Place the field assembly in a vice and cut through the windings with a hacksaw. Prise them off and discard. Use the insulating paper as a template for new insulating paper. Fit the paper. Wind the new fields using 13 turns per coil of 1.5mm enamel covered winding wire. Tie up the coils using string to stop them unravelling. They should be TIGHT. You will have to bend the exposed parts of the coils back so that they don't foul the armature. Make sure the leads in and out are quite long - give yourself 15cm or so to play with. These will be threaded through the holes in the motor cap upon reassembly. When the windings are in place and tight, spray with dielectric varnish and allow to dry overnight.

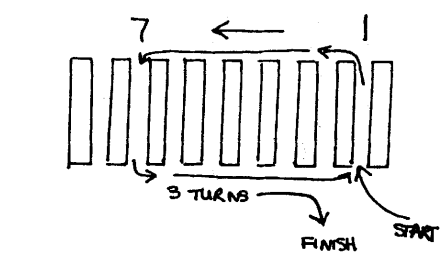


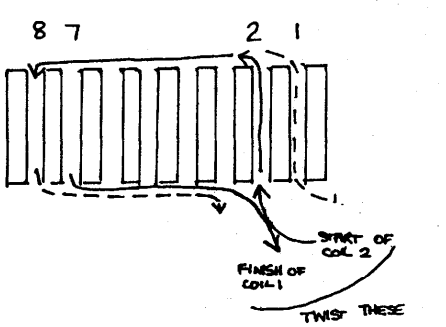
Now for the hard bit, the ARMATURE. First of all cut off the windings where they meet the commutator. Do not leave any "whiskas" sticking up from the "commie". Now cut off the windings as close as possible to each end of the pole pieces. Don't be a dill and hacksaw through the shaft. Now you have to remove the little cardboard wedges in the slots. Use an old hacksaw blade - power hacksaw ones work best. Place the blade along the slot with the teeth on the wedge. Tap it down so that the teeth bite into the cardboard. Now tap it along to slide out the wedge. With all wedges removed, remove all wire from inside the slots. Use a file to tidy up any damage to the slots. By the way - the commutator is NOT removable on this machine so don't try to. Line the slots with insulating paper, use the old bits as a template.

NUMBER the slots. Hold the armature vertically with the commutator DOWN. Using a texta, mark any slot as "1". Then rotate the thing to your RIGHT and mark off 2, 3, 4, and so on up to 14. The numbers are in REVERSE sequence if you have done it correctly - 4, 3, 2, 1, 14, 13, etc. as you go round. THIS IS IMPORTANT. Using 1mm wire wind your first coil, starting with the wire in slot 1, free end down toward the commie, the reel of wire toward the top. Now bring the wire across to your left, and down slot 7. Now cross and back to slot 1. You have just completed the first turn. Now two more of the same. There should be three turns per coil. Now cut the wire, leaving enough of a tail to reach down past the end of the commie. Better too much than not enough. Now wind your second coil, starting in slot 8 and going to slot 14. The third coil goes from slot 2 to slot 8. You now have a coil on each side of slot 8, and so this coil is "full". A strip of insulating paper slid down the slot to close it off will stop wires flying out all over the place.

Now be careful here - do not get your wires crossed or there will be trouble. Look at the diagram to see which wires are joined. The STARTING LEAD from coil 1, which is in slot l, will be connected to the FINISHING LEAD from coil number 14, which comes from slot 6. Look at the diagram and it should be clear. So the starting lead from any coil is connected to the finishing lead from the coil on the RIGHT when viewed with the commutator downwards. The wires to be joined should be twisted together until fairly tight. When all coils are wound in the sequence shown in the chart, you should have no gaps, and a twisted 'double lead' for each slot. There should be a paper wedge in each slot. You can now varnish the armature. Do not get any varnish on the commutator. Protect it with teflon tape covered with masking tape. You should protect the commutator with teflon before using masking tape to keep the glue from the masking tape of the commie. Any goo on the commutator will gum up the brushes and cause sparking. Once done set aside to dry overnight.







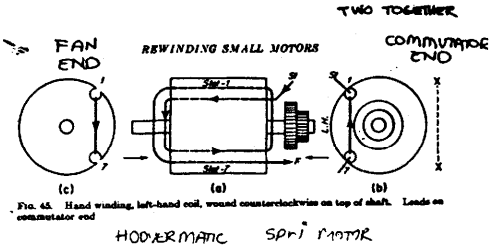


Fig. 45. Hand winding, left-hand coil, wound counterclockwise on top of shaft. Leads on commutator end

Connecting wires to commutator

You should notice that there are twice as many commutator bars as slots. This is because there were two coils per slot in the original motor. Your new winding has only one coil per slot so every second bar is joined together. Look carefully at the diagram to see the correct slot-to-bar alignment. At each slot the bar directly in line with the centre of the slot, and the one to the RIGHT are joined together. It is CRITICAL you get this right.

Using an enormously powerful soldering iron, join the two raised bits of the appropriate corn bars together. Do not get any solder on the lower part of the bars where the brushes run. The raised bits should be clean or the solder won't stick. If you can't solder, get someone to teach you - it's an art. Don't bugger up all your hard work with sloppy soldering.

Once all bar pairs are joined, you can trim the lead pairs so they cover the raised part of the bar but not the lower part. Look at the diagram to see which lead goes to which bar. The alignment is the same for all of the leads. Now scrape back a bit of the enamel on end of each wire. About 3mm is O.K. Now tin the end of each wire with solder.

When all are done you can lay the wires down to the appropriate bars. When soldering them in place you need to make sure that the two wires twisted together for each coil are soldered to each other and to the bar pair underneath. Do NOT let any soldier run onto the lower part of the bar, or contact the adjacent bar pairs. If you do accidentally join to an adjacent bar pair you can either remelt with the soldering iron, and the break should open up again, or cut it away with a sharp implement. I used a steak knife with great success. When all are connected, you've finished! Check very closely you haven't got anything into the gaps between adjacent bar pairs. These gaps are as important as the joins! If so, clean it out with your sharp implement. Now clean up any burrs on the commie with fine glasspaper. The "blobs" of solder at each joint should be as small as possible as there is limited clearance inside the motor. Clean off any mountains with a small file.

You have finished!

Now put it all together - it should be self-explanatory. The two leads from the field coils go up through the holes in the motor cap. When you put the cap on, the spring arms holding in the brushes must be pulled back out of the way. This requires about

three hands. The cap only fits one way - there is a locating lug. Put on the the spring clips. I hope you bolted in the field assembly first! Now fit the special brushes. You have to flick the spring arm out of the way first, slide the brush in [make sure the taper is in the right way] and let the spring arm snap on top. The pigtail can be connected to the lug next to it.

Bolt the motor in place and hook up the belts. Take one of the leads from the field and connect it to one of the brush lugs. You now have one field wire and one brush lug not connected. Connect a battery to these two. The polarity doesn't matter, the motor should go. Performance will only be about 75% until the brushes wear in exactly - usually 2 or 3 weeks of use. It should turn clockwise when viewed from above. [Cabinet now the right way up]. If not, then reverse the FIELD connections. The one connected to the battery, put on the brush lug and the one on the brush lug, connect to the battery. This is important as the pump doesn't work properly in the reverse direction. Re-connect the cable from the lid to the switch/brake assembly on the motor.

Wiring it up permanently

Use 4mm wire for leads in to machine. (Figure 8 cable).

Use 4mm wire for connections from motors to relay, motors to negative and relays to positive.

Use light guage wire - about lmm - for the control wiring. Follow the diagram.

If you don't really want a wash timer, you can dispense with the second relay. Just use a changeover relay so that it spins with the spin lid DOWN, and washes with the spin lid up. This also saves drilling and tapping the wash motor. If you have a "Hoovermatic Deluxe", write to me and I'll explain how to preserve it's auto-rinse function.

How to use it

1. Set pump control to "Fill-Wash-Spin". This is important.

2. Fill the wash tub from the tap. Not too hot- you have to put your hands in to get the clothes out.

3. When the tub is full, add detergent, and start the wash timer with the spin lid open. The pulsator will rotate, this whirling the wash water around. Start feeding in the clothes from the left hand rear of the tub. The moving water should pull the clothes slowly from your hands. The clothes should be moving constantly in the tub. If they stop moving even though the pulsator is still turning, you have overloaded the tub. This machine is designed to wash a SMALL load very quickly- usually 2 to 3 minutes is plenty. This is a characteristic of the 240 volt machine also, though the 12 volt machine tends to slow down more when overloaded. At 150-200 watts compared to 500 watts in the 240 volt machine this is to be expected. The best tactic to maximise load size whilst minimise overloading is to mix the size of garments in a wash - one or two pairs of jeans per load is the most it can handle of these stiff, bulky items. The rest of the load can be small light-weight stuff like t-shirts, socks etc. A wash load should fit comfortably into the spin can.

4. When the first load is washed, and let water drip back into the wash tub, then load them into the spin can. Try to minimise the amount of WATER you load into the spin can, as if you fill the spin tub with water it will sometimes struggle to get under way. Press the rubber mat down onto the load. This is important if you don't want your wash torn to shreds. Now you can add the next load to the wash tub, with the wash timer on. Let the new load agitate for a bit, then close the spin lid to spin dry your first load. The changeover relay will switch off the wash motor when the spin motor is used. This is to save battery drain. The clothes in the tub will soak.

Listen to the tone of the spin motor. When there is no more water being pumped out, you will hear the motor speed up. Lift the lid to stop the spinner. The wash motor will restart [if the timer is on]. Run cold water onto the clothes in the spin can to rinse. A fast trickle is best, too much pressure just wastes water. The clothes in the spin can will soak up water as they have just been spun dry. When they are thoroughly wet, turn off the hose, close the lid and spin away the rinse water. If the spin tub is too full of water it will struggle. Lower the drain hose into a bucket if it can't pump out. You will soon get the hang of how much water is just right.

If you have a "Hoovermatic Deluxe", write to me for details of how to preserve the auto-rinse function.

After 2-3 rinses, let the machine spin for 2-3 minutes to get rid of the rinse water and dry the clothes.

Each time you transfer clothes from the wash tub to the spin can. you transfer the water as well. To put this back into the wash tub, hang the outlet hose back into the wash tub.

To empty the wash tub

When the last load is having it's final spin, turn the pump control to "Empty tub". The pump will now remove water from the wash tub. You should wait until the spin tub is empty before switching over to "Empty tub". Watch the drain hose- when the outlet slows to a trickle, you should hear the motor speed up due to the reduced load. NOW you can empty the tub. Failure to do this will result in the spin motor being overloaded trying to spin a whole tub of water.

When the tub is empty, rinse out the tub with cold water to flush out any detergent deposits. This greatly extends the life of the rubber hoses. When this is done switch the pump control back to "Fill-Wash-Spin" and shut the baby down!

If you have any problems with this, write to me at *8 Hollick St. Richmond 3121 Vic.* I am happy to give advice, solve problems, or I can supply parts, from a set of brushes, a rewound motor to a complete machine.

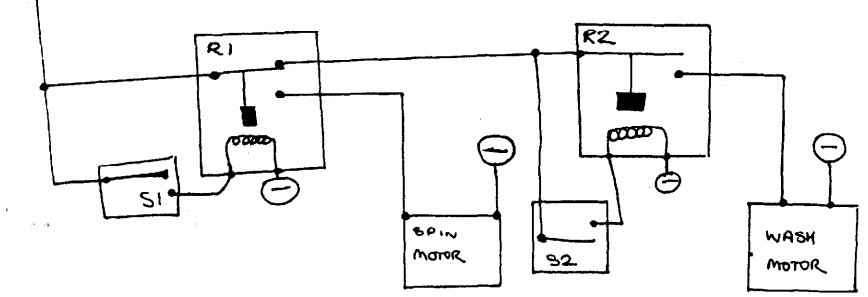
WIRING DIAGRAM

R1 = CHANGEOVER RELAY (12V)

R2 = NORMAL RELAY (12V)

S1 - SPIN SWITCH - OPERATED BY LID CABLE. - LOCATED ON SPIN MOTOR.

S2 = WASH TIMER.



BITS LIST

-HOOVERMATIC Washing Machine in good condition, except wash motor. (not needed).
-large 12 volt car generator, eg LUCAS C45 or BOSCH from an old Holden. (Lucas C40 is too small). Lucas C45 is best if available.
-10 watt, 2.2 ohm wire wound resistor.
-1.5mm dia enamel winding wire, (for fields).
-1.0mm dia enamel winding wire, (for armature).
-Insulating paper - special motor winding paper, available from an electric motor repair shop.
-Winding varnish. It's available from ELECTROLUBE in a spray can.
-Graphite/copper brushes. See text for details.
-4mm insulated wire, -1mm insulated wire.
-1 changeover relay-12 volt.
-1 standard (horn) relay-12 volt.
-2 hose clamps big enough to go around the generator.

ATA REPORT

News and Activities around the ATA

Since the last edition of Soft Technology the ATA has been very active in getting out and Spreading the Good Word.

ConFest

The trailer was a star of the show at the Down to Earth ConFest at Walwa on the Murray River. There was a lot of interest in the trailer and the association from people at the ConFest. Many thanks to Andrew Baker for taking the trailer up and back.

Breamlea

Nick Wardrop from the Victorian Solar Energy Council kindly gave up a Sunday to take us to Breamlea, near Barwon Heads, to see the 360kW

Westwind wind generator. This is a pilot project of the S.E.C. and the Solar Energy Council. The trip included a climb up the tower to look at the internal workings of the machine, including an unplanned demonstration of the emergency brake by Nick's young son!

Also Brendan demonstrated King Kong abilities by climbing a nearby tower to get that elusive perfect photo.

Palm Sunday

Chris Moss and Alan Hutchinson took the mobile display trailer to the Palm Sunday rally. The trailer impressed onlookers despite a lack of sun or wind and facing East instead of North.

Green Home Expo

The A.T.A. stand at the Green Home Expo was voted the most successful stand by an association. What more needs to be said?

The range of interesting moving, working displays ensured a crowd around the stand. The A.T.A. members enjoyed watching countless people tentatively hold a hand out over the frying pan on our solar cooker. It's INDOORS, folks!

The stand also brought in substantial revenue for the A.T.A. and due to the popularity of our display, the organisers have promised us a front line position in next year's Expo.

Trailer

The trailer (otherwise known as the Mobile Educational Display Unit)

is now on the road. Athough in need of a few finishing touches, the trailer is now visiting schools to explain Solar, Wind and Hydro power, recycling, composting, methane digester, you name it! Thanks to Noel for all the time he has put into getting the displays finished.

Workshop

The wind generator at the Solar Workshop at CERES in Brunswick is now up and running. The tower has an ingenious hinged base, which allows it to be lowered for servicing. Brendan has built a device which steps up the output voltage at low speeds. This means even low windspeeds can produce a usable output. As the Workshop is open on Sundays, you can come down and see it in action. See you there..

The prize-winning ATA display at the Green Home Expo

Dear Editor ...

Segner Turbine

I am writing to you concerning the "Segner Turbine" article by Alan Hutchinson in Soft Technology no. 31. There are a couple of errors in the formulae given which would pose problems to anyone attempting to design a turbine for their own application.

In the "calculation example" on page 14, the nozzle pitch diameter is calculated by the formula

$$D=(60/[N_{opt}*pi])* gH ([l/1 - Cf^2] - 1)$$

giving D=1.6 m. This is a misprinted formula. Using it would give D=3.4 m. The correct formula reads

$$D=(60/[N_{opt}*pi])* gH ([l/1 - Cf^2] - 1)$$

which gives D=1.6 m. A similar misprint occurs in the Basic Formulae table. Here the correct relationship is

$$N_{opt}=(60/[D*pi])* gH ([l/1 - Cf^2] - 1)$$

Obviously the omission of the inner square root makes quite a difference to the size of the turbine diameter! The designer would be annoyed and frustrated when his or her turbine runs with an optimum 56rpm rather than the required 120 rpm!

A less significant error occured for N_{max}. It should read:

$$N_{max}=60*Q/(D*pi*Cf*A)$$

which is the result if h becomes zero in the N_{limit} formula.

I did enjoy the magazine and will keep reading it.

Yours faithfully,
Tom Kirchner,
Flemington, Vic.

Z-Axis Drive, 32 volt systems

Received the October 89 issue yesterday (No32/33) and am writing to say what an excellent issue it was. Good, meaty, practical stuff and I thoroughly enjoyed it all!

Question no.1. I would very much like to get in touch with Greg Clitheroe to ask some question about his low voltage modifications and also, if possible, to buy a copy of his book *Backyard Electrical Systems?*

The letters section carried a letter from W. Wadsworth of Northcote, Victoria. The gear system he mentions is called Z - Axis Drive and I enclose photocopies of some relevant information which you may copy for the association's files and forward on to Mr. Wadsworth. I would also like to write to Mr. Wadsworth concerning this matter if you can mange this?

Keep up the great work!
Yours sincerely,
Terry Jameson,
Woodford, N.S.W.

Low-head Hydro

I read with interest the article on John Hutchinson's low-head turbine (Soft Technology 32/33). I have some questions to raise about that article.

1) What range of frequencies does the generator operate between?
2) What controls the frequency?
3) What frequency can you go down to?
4) What is the efficiency of the system, in terms of hydraulic and electric component losses?
5) Am I right in assuming the generator was rated at 2.2 kW because the computer program gave an estimated output of 1.8 kW at 100% efficiency. or was there another reason for using an overrated motor?

I must say I enjoyed the magazine . . I wait in anticipation for more!

Yours faithfully,
Richard Feynman,
Preston, Vic.

Soft-tech October Issue

Thanks very much for the October issue. It not only reminded us to re-subscribe but also featured the very useful "Solar Water Heater Buying Guide". Just what we needed!

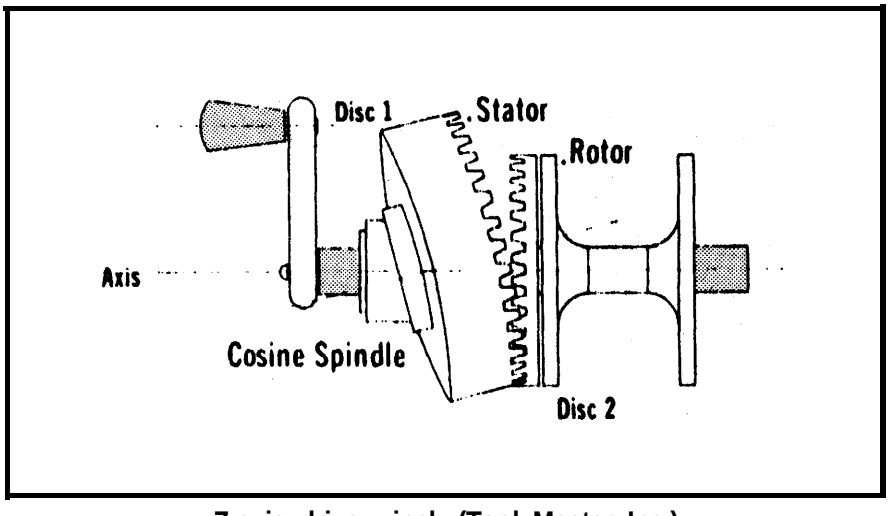
Also good was Bill Keepin's article. Heard him speak at a People for Nuclear Disarmament A.G.M. He presented solid facts against nuclear power and for energy efficiency.

Thanks,
C. Newton
Mt. Hawthorn W.A.

Does anyone know . . .

Would you have any ideas on how to convert a table/bench mounted "mangle" (wooden rollers type) into a grape press/roller please, some descriptive literature would be appreciated.

Thank you,
B. Marschner,
Pt. Pirie Sth, S.A.



Z-axis drive winch (Tool Master Inc.)

Book Reviews

A bevy of books on houses . . .

Reviewed by Ian Scales.

Earth Garden Building Book

Design and build your own house.
Robert Rich and Keith Smith,
Viking Books/Penguin Australia, 1988
260 x 190mm $315pp., illustrated, paperback.

Now that this book has appeared, it is difficult to see how anyone could do without it. It is full of hard-won wisdom of self-building. Well-structured and presented information covers design, materials, construction methods and tool maintenance.

A lot of work and thought has gone into this book; I suspect it is a bit of a labour of love - all the better for the reader. Many of the sections appear to be revised articles originally appearing in Earth Garden magazine. It all adds up to be quite encyclopaediac, although of course some topics still require cross-reference to other sources to get the full story. Some of the sections that caught my eye, mentioned almost at random to show the range of material, were: earth floors, safety on site, cutting corrugated iron, building stone arches - and so on. Nice one.

Owner Builders Companion

Build or renovate your own home in earth, stone or timber.
John, Gerry and Justin Archer
Penguin Australia, 1989
220 x 180mm, 202pp., illustrated, paperback.
Reviewed by Ian Scales.

This book is almost complementary to the recently written Earth Garden Building Book. It tends to favour on low-cost options and creative uses for materials, and as such is almost certain to engage everyone thinking of building on some page or other.

It is written in the style of a series of notes and comments that escape a more formal treatment such as the book mentioned above. Indeed, it is a compendium of articles from Owner Builder magazine. I personally was quite interested in the idea for a homemade skylight, protecting trees during house construction, and kitchen design considerations. Again, a book to know about as a house takes shape in imagination or on ground

The Natural House Book

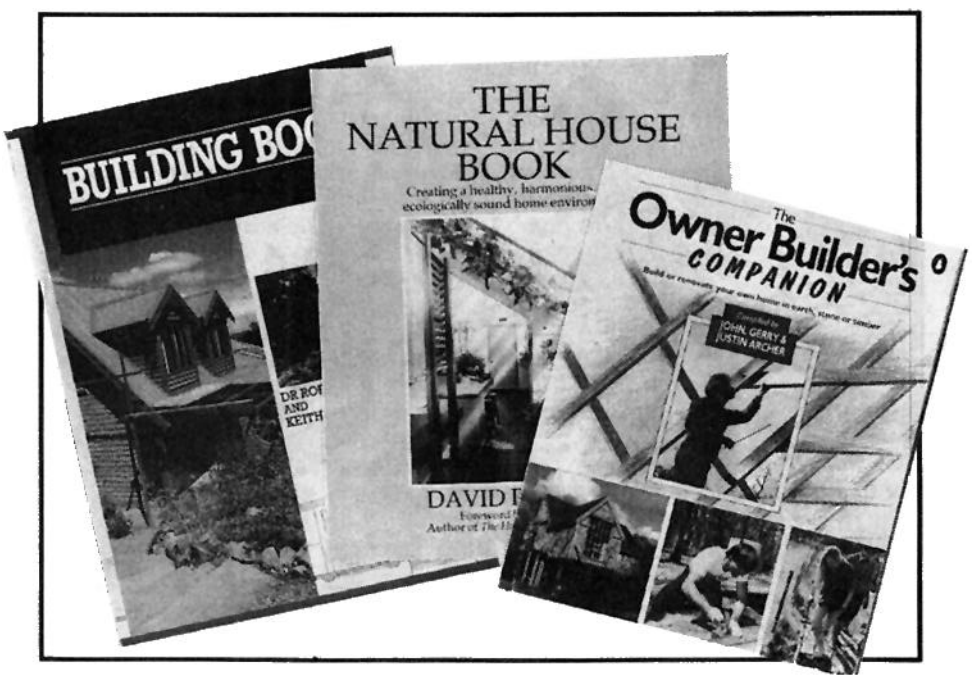
David Pearson
William Collins, 1989
245 x 210 mm, 287 pp., illustrated, paperback.

The first thing that attracted me to this book was the quality and content of illustration - colour photographs of some very interesting architecture from around the world. The second thing I found that made it worth its price was the quality of information - a great deal of good research has been put into this book.

The Natural House book is about all aspects of domestic architecture; materials, spatial arrangements, and equipment that have a bearing on ecology.

Unlike the recent Earth Garden Building Book and Owner Builders Companion, this book has been written overseas and draws on much European material (unfortunately not referenced). It also is a text pitched more at the conceptual level rather than the practical nitty-gritty. The angle of this book is toward ideas relating to the philosophy of ecology and health as applied to architecture and building systems. As such it is definitely thought-provoking: there would be very few who would not learn something new and significant from this book. There is a high degree of inspiration awaiting the reader in the form of the colour photographs, which are of consistent& good quality. Again, a worthy book, but those wanting more academic or practical treatment will have to look to the bibliography and beyond. The topics covered could easily fill a 600 page tract (so I have heard, that is the size of a similar German publication - but then, that culture demands thorough information perhaps more than we do).

This is a ground-breaking book in this country: although the ideas have been floating around for years in publications arcane and obscure, here at last they are presented in a bold manner that is easily accessible to all.



NEW PRODUCTS

Mud brick water repellent

Mud Brick Water Repellent WRC is a water-based impregnant which has been specifically designed for use on all mud brick and rammed earth structures.

Impregnation of earth structures with WRC will prevent water damage such as damp walls, formation of cracks due to expansion and shrinkage, erosion, formation of mildew, moss and lichen, reduced thermal insulation properties and increased heating costs.

The advantages of WRC are:

1. The natural appearance of the mud brick surface is retained with a very slight darkening and no gloss.

2. The final surface is maintenance free as the water repellent of similar structure to the mineral substrate, is impregnated and bound chemically to the mud and is not like a surface coating which will peel off eventually.

3. The water repellent does not seal the surface and the wall can breathe.

4. The product is water-based, eliminating the hazards due to organic solvents.

5. Water clean up.

MINISTER LAUNCHES INSULATION PRODUCT

Australian homeowners now have the opportunity to significantly increase the comfort of their homes and to cut ever-increasing energy bills. Until now wall insulation could only be installed while a home was being built. For the owners of uninsulated homes it was impossible to achieve the benefits of wall insulation - without tearing down the walls.

The Bradford Cavity Wall Insulation system involves filling the wall cavity with natural Rockwool insulation using a high performance blowing machine. Rockwool is manufactured from natural molten rock and has a texture similar to wool. 'The product has excellent thermal and acoustic properties and is the ideal insulation for this purpose.

Used with roof insulation, Cavity Wall Insulation will completely seal the home, and provide an effective barrier against heat and cold. The home will be more comfortable, warmer in winter and cooler in summer.

Energy bills can be reduced by as much as 66 per cent - so the insulation soon pays for itself.

The home will also be a quieter place to live. Cavity Wall Insulation provides a sound barrier against external noise. Vapour permeable, it allows the walls to breathe and reduces condensation inside the wall cavity and on interior walls.

Cavity Wall Insulation was found to have excellent water repellent qualities when tested by the CSIRO. It is inorganic, rotproof, odourless and will not sustain vermin or fungal growth.

It will not burn or sustain fire, and actually provides an effective fire barrier by retarding the spread of flame.

Bradford Cavity Wall Insulation will not deteriorate with age and is guaranteed for loo years. Installation is carried out by trained Bradford Approved Distributors, following installation procedures specified by Bradford.

For more information:

BRADFORD INSULATION
P.O. BOX 1754
NORTH SYDNEY N.S.W. 2059

Software for Solar Design

A system for IBM compatible PCs for the construction of 3-D models of the built environment and the computation and display of shadows and reflections caused by sunlight.

The SR program (derived from Shadow and Reflection) is designed to provide a tool for the study of shadows and sunlight reflections in the built environment, It is therefore aimed at the designers of buildings and the built environment (architects, builders, urban designers and landscape designers). In fact anyone concerned with the effects of sunlight and shade would find SR a valuable tool in their efforts to study and evaluate the impacts of sunlight and shade in their work.

SR may be used at all scales, from the study of shadows cast by an eave's overhang, to those in an urban precinct which might contain many complex buildings.

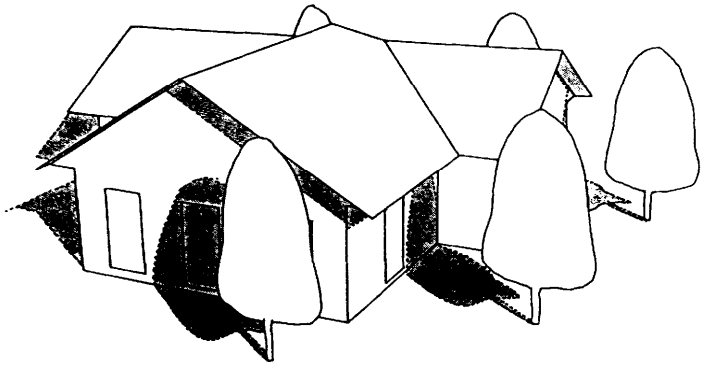
It is possible for inexperienced computer-users to use SR as it can be totally driven by way of a menu system from which user selections are made.

The SR program is available for commercial use, the fee depends on the type of license. The cost of the license to use the

program for your own consulting work is $600. This includes a user manual and tutorial guide, but no real support apart from fixing identified bugs.

The development of SR has been assisted by a grant form the Western Australian Government and is thus made available at a nominal price to cover costs of producing documentation and providing limited user support.

Further information from:
Dr. G. G. Roy,
Department of Computer Science,
The University of Western Australia,
Nedlands, W.A. 6009



New EnergyStore ideal for RAPS

PACIFIC DUNLOP Batteries Industrial has begun production of a battery, boasting a 5 year warranty, specially developed by Australians to meet the unique needs of remote area power systems (RAPS).

The Exide EnergyStore - which is available in 4, 6, 8, 12 and 24V in capacities to 1860 Ah at the 100 hour rate - is quite different to other batteries.

For one thing, the EnergyStore is designed to hold 50% more electrolyte than conventional cycling batteries.

This boosts capacity by about a third at the 100 hour rate, which is the most suitable for RAPS systems designed to utilise solar power, wind power or hybrids of either with diesel generation.

It also means less frequent top-up-as little as once every 7-8 months.

And it makes the battery far more tolerant to the high temperatures of many remote regions of Australia - an important point when you consider that operating at 40°C will chop the life of the average battery in half!

A Photovoltaic Refrigeration System Design Program

Rural health centres, hospitals and clinics in developing countries cannot get access to electricity grids and even when these are available, in most cases the supply is not reliable. As a result, the control of vaccine at optimum potency level is very difficult to attain. The most appropriate and economical system for these medical centres is small-scale photovoltaic refrigeration system (SSPVRS). A proper system components design based on site-specific data is important for good reliability of SSPVRS. The design and performance analysis of SSPVRS can be done in a simple manner using a computer software package PVRS for any location in which meteorological data are available.

PVRS is a comprehensive small-scale photovoltaic refrigeration system analysis and design program for microcomputers. The program provides long-term monthly performance estimates for systems having battery storage. The method employed in the program is based on radiation statistics, utilisability and monthly-average hourly load.

For further information and demonstration disk, please contact:
The Development Technologies Unit
Faculty of Engineering
The University of Melbourne
Parkville, AUSTRALIA 3052.

BREAKTHROUGH IN BORE PUMPS

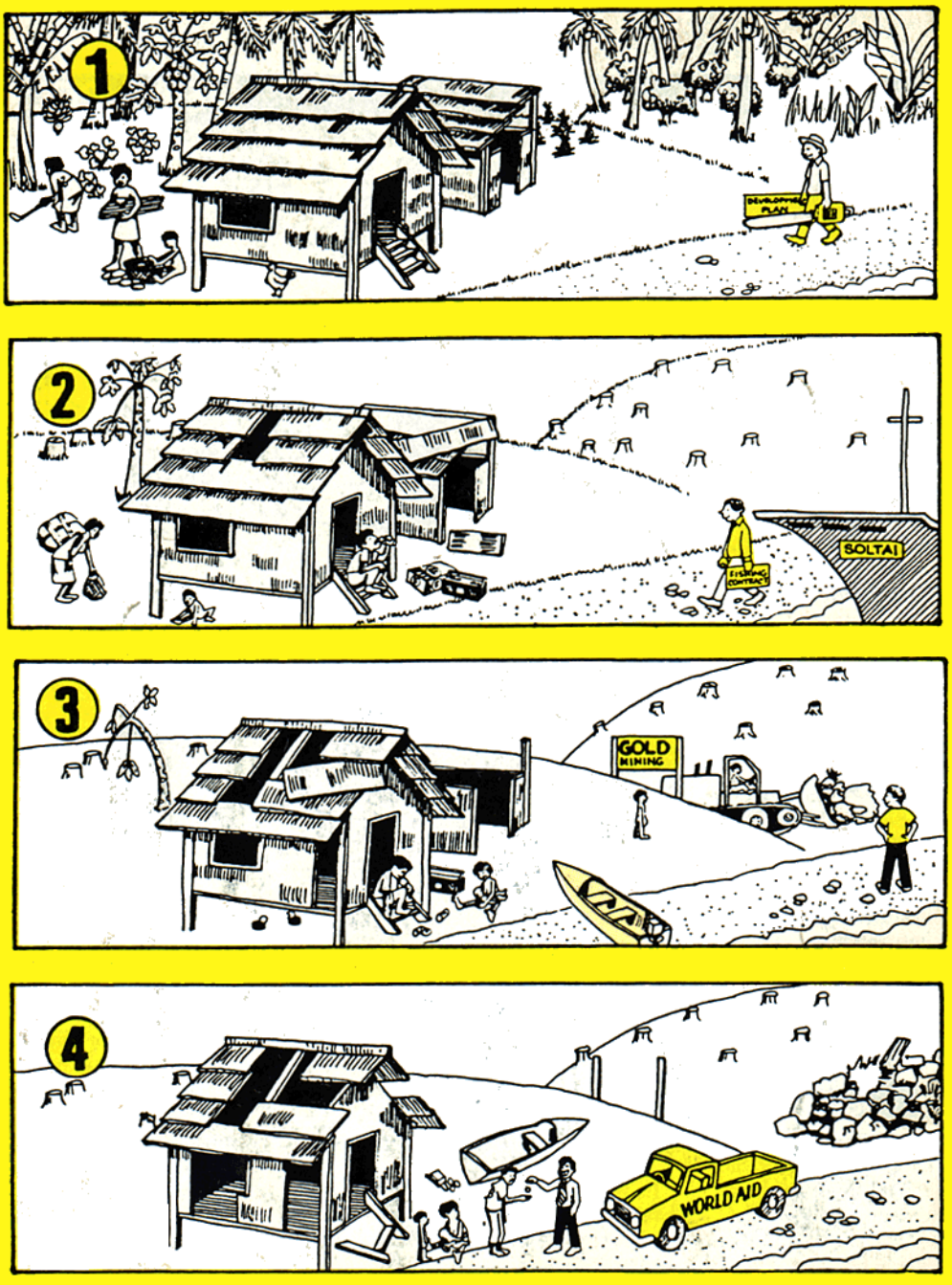
In response to the need for pumping equipment which is able to withstand the ravages of highly damaging bore water, Davey Products Pty Ltd have employed new technology in pump construction. The Davey "D" series deep well pumps have an internal lining which is unaffected by the electrolysis and mineral corrosion common with bore water. The pump body also has exceptional strength and a very smooth internal surface, reducing friction and lowering running costs. Consequently this range of pumps has gained a wide acceptance in the poor quality water areas of Queensland, Western Australia and South Australia which have been notorious for destroying stainless steel and other types of metal pumps in a short time. Each of the Davey deep well models is equipped with an automatic control valve which maintains optimum pressure to ensure maximum performance from the choice of eleven deep well injectors, for suction depths up to 40 m (130 ft).

For more information contact:
Davey Products P/L
2-22 Hargreaves St,
HUNTINGDALE 3166.

BIO-DEGRADABLE FLOWER POTS

The new Bio-Pots are made in Australia using 20 percent recycled newspaper and 80 percent cardboard, instead of being manufactured of compressed peat. The cardboard contains long fibres giving the pot its strength and durability. For the nurseryman home gardener and farmer, Bio-Pots are an environmental and economic revolution. Because the pots will break down to organic compost, planting out is quicker and easier. Simply place the whole pot containing the plant into the soil. The pot needs to be covered completely and will decompose within three months. The roots can easily penetrate the pot walls, thus avoiding that circling of roots around the inside of the pot. The roots are ready to go deep into the soil as soon as it's planted. The product is available in a large range of sizes.

International Reforestation Supplies,
P.O. Box 67,
BRUTHEN, 3885.



WHAT KIND OF DEVELOPMENT?

Soft Technology is produced by the Alternative Technology Association. We are a group of people interested and involved in alternative technology and our activities include meetings, film nights, workshops and field trips.

MEMBERSHIP
Members receive Soft Technology, our newsletter and have access to the Solar Workshop and library.

Rates: $20, $15 Concession

SUBSCRIPTION
Subscribers receive Soft Technology four times a year.

Rates: $12 (everyone)

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