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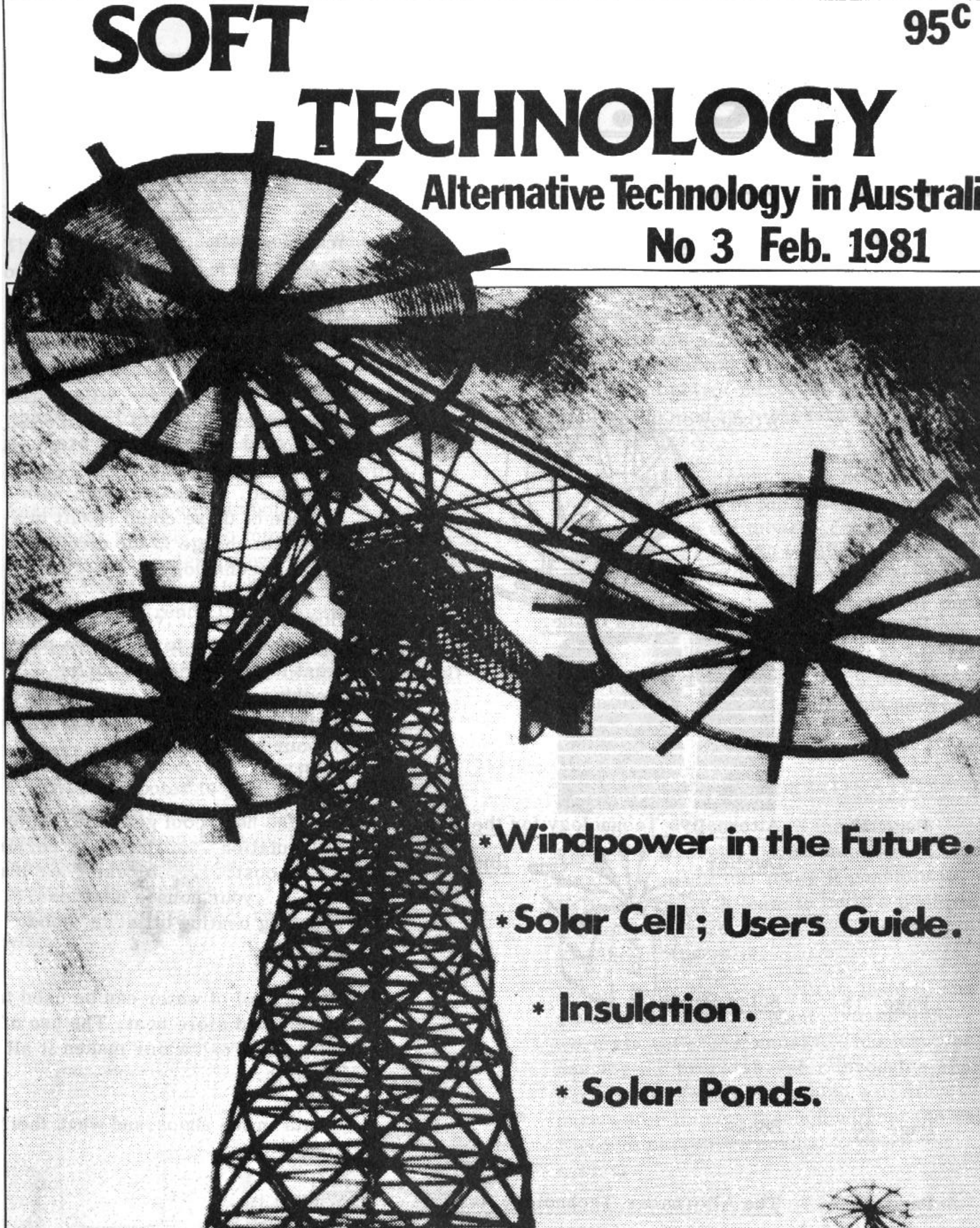
SOFT TECHNOLOGY

Alternative Technology in Australia

No 3 Feb. 1981



*Windpower in the Future.

*Solar Cell ; Users Guide.

* Insulation.

* Solar Ponds.

Registered for posting as a publication : Category B

Content.

This is one of a series of simple magazines on Aternative Technology in Australia, produc- by the Alternative Technology Association, Melbourne. Offers of assistance in writing and production will be welcomed. Address any correspondance to the Alternative Technology Assoc. 366 Smith St. Collingwood. Vic. 3066.

This issue was produced by Mick Harris, Tony Miller, Bob Fuller, Pete of Camberwell, Joane Pike and Myra Jacobs.

Energy Flashes . -

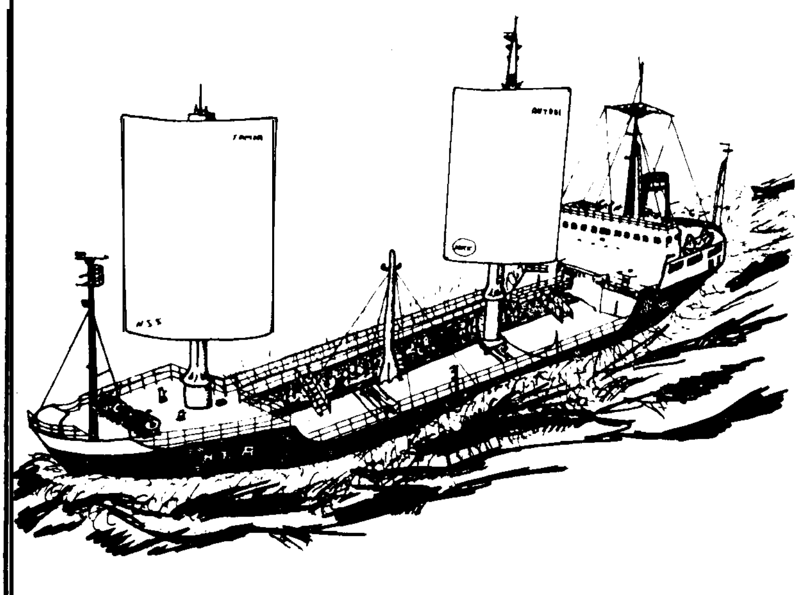
WIND FOR SAIL

The prospect of increasing fuel prices has been enough to prompt one large Japanese company to investigate the use of sail on modern cargo ships. Nippon Kokan, (N.K.K.) in conjunction'with a number of other bodies, undertook research into the use of wind on large ship, which led to the construction and launching of the 1,600 deadweight ton, sail equipped motor tanker Aitoku Maru. The ship is now undergoing testing and evaluation.

Addition of sails added about 10-15% to the cost of the vessel. The minimum fuel saving is put at 10-15% depending on weather conditions. This is likely to be significant considering current trends in fuel costs.

The sails of the vessel are metal framed and supported by masts. In the initial tests metal sheets were used as sails, however it was found the old canvas in metal frames was better.

A micro-computer is used to control the sails. Wind direction and speed are measured and the computer adjusts the sails for maximum wind assistance. When the wind cannot be utilized the sails are turned to an angle which offers least resistance to the wind.



CASSAVA AS A FUEL.

Starch from Cassava could form the basis of an alcohol production industry in Papua New-Guinea. Their Department of Minerals and Energy is building a 1.2 million pound plant near the town of Hagen, whose inhabitants will run their cars on the alcohol petrol mix. The alcohol plant will be supplied by a cassava plantation of about 500 acres.

Alcohol will be produced by hydrolysis and fermentation of the cassava starch produced from the tubers of the plant. These tubers have 30 to 40% starch. The decomposition of the other parts of the plants will supply the heat needed for the fermentation process. At the same time the cassava leaves can be used as pig food, while the waste material from the process can be used as fertillizer for the new cassava crop.

SOLAR-ELECTRIC DESALINATION

A grant of $72,800 from the National Energy Research, Development and Demonstration Council has made it possible for a B .H .P. research team to build a photovoltaic cell array which will be the largest of its kind in Australia.

Power from the array will be used to run a water desalination plant, which will work via reverse osmosis. This involves passing the brackish water through a semi-permeable membrane, which will allow pure water to pass through without the salt, Electric current is needed to drive the system.

The solar cell array will generate thing like 75 kilowatts of electric power. The project will also involve a review of electricity production from photovoltaics and methods of energy storage.

Energy Flashes.......

ENERGY SAVER

A little black box with two rows of numbers and a few buttons has been installed in 100 United States and Canadian houses. The device which could best be described as an energy meter, supplies information to the householder about the amount of energy being used in terms of what it costs in dollars and cents.

The top row of numbers on the little black box give the time while the bottom row shows the cost of gas and electricity used since the previous midnight. By pressing a button labelled "next hour" the meter displays the cost of energy over an hour period assuming electricity use remains constant. Another switch labelled "yesterday" shows the cost of energy consumed on the previous day, while yet another button for "this month" shows a cumulative total.

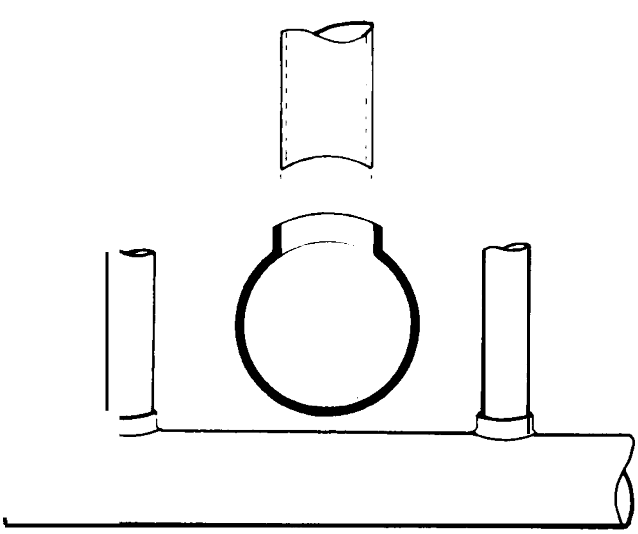
The energy of the 100 metered houses will be compared with 100 control (unmetered) houses. It is expected that the energy use in the metered houses will be lower due to the occupants being constantly aware of the cost of their energy use. If the experiment proves successful the next step will be to reduce the cost of the meters to between $50 and $100, so they can be cheap enough to find widespread use.

New Products *

NEW SOLAR TOOL

A new tool has been developed to make the fitting of riser tubes to header tubes in solar flat plate water heating panels easier and stronger. The tool is for extruding the wall of the copper tube to form a socket into which the branch tubes of a smaller diameter can be fitted ready for brazing or silver soldering.

The advantages of using this tool include the riser tubes are held firmly in place during brazing preventing undesirable movement, and the riser ends need not penetrate the header pipes where they could obstruct the flow of water.



The tool sells for about $9.00 including postage. People interested should write to G.E. Vaughan, P.O. Box 211, Strathfield, N.S.W., 2135

SOLAR WINDOW FILM.

A new solar window film called "Flow Tint" is now available in Australia. Unlike currently available films this product is not sprayed or stuck onto the glass but actually flowed giving an appearance exactly like factory tinted glass.

The manufacturers claim that "Flow Tint", depending on the colour, reduces up to 98% of the suns ultra-violet rays; up to 61% of the infra red rays and up to 79% of the sun's glare. These characteristics are also claimed to make Flow Tint an excellent insulator.

Other advantages are said to include; better appearance, (available with a reflective or purple hue); better adhesion and longer life, (could be expected to last 20 years); no joins as with currently available films; no waste and lower cost.

Furthur information on Flow Tint can be obtained from; Flow Tint, P.O. Box 1103 Southport, Qld, 4215. Phone (075) 327933.

WINDPOWER ; in the future

Recent years have seen a revival of interest in wind as a source of energy; especially electrical energy. This interest has led to the development of a new breed of huge wind turbines such as the NASA, MOD Wind Generators. The MOD 1 now in operation in Boone, North Carolina is capable of generating 2000 kilowatts and sits on a tower 140ft high with two 100ft blades, On the other side of the world in Denmark is the Tvind Windmill which uses 3 blades to generate 2000 kilowatts.

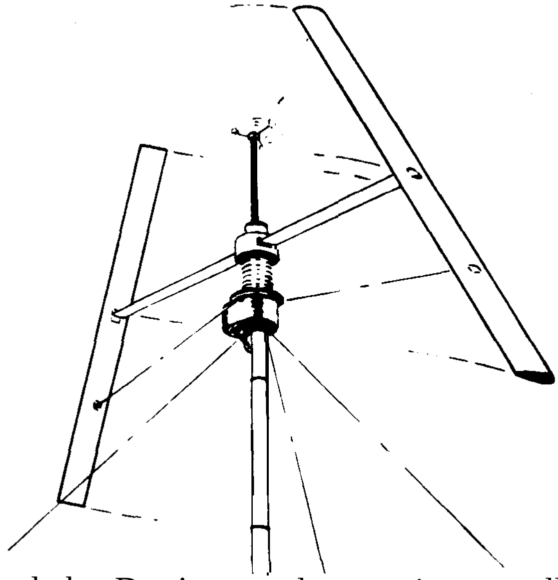
While machines such as these have stolen the lime light in wind developments another group of wind machines of all shapes and sizes are undergoing ongoing research, A breakthrough with any one of these machines could see a rapid change in the direction of wind technology.

VERTICAL AXIS WIND MACHINES

Vertical axis windmills have the advantage that they do not have to turn into and face the wind, If used for generating electricity no slip rings are required. With smaller machines the tower is often much simpler and lees expensive than the tower with conventional wind generators, These machines are now gradually becoming commercially available. One machine available in Britian uses two 3 metre blades of khoya mahogany, The rotor diameter is 4.5 metres with the turbine wieghing 90kg. The turbine will generate 1000 watts and has a built in starter motor. Cost Approx. 5,000 pounds.

DARRIUS

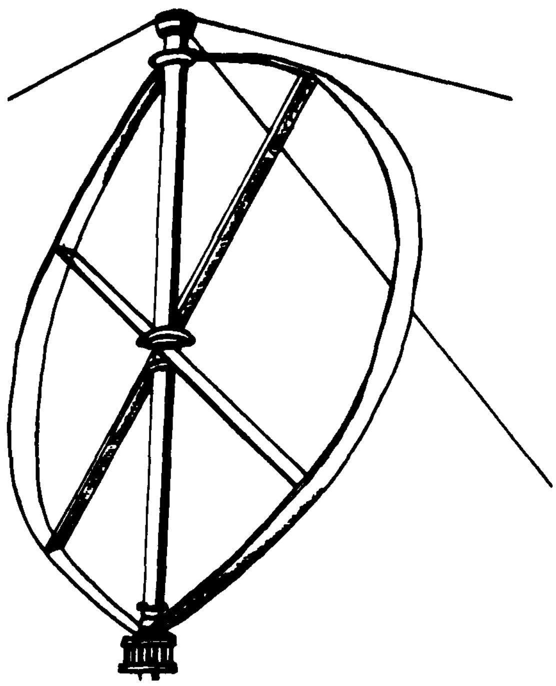
With this vertical axis machine the blade is shaped like an aircraft wing with the leading edge slightly thicker than the trailing edge. Its major advantage is the blades do not require a variable pitch mechanism to protect them from damage in high winds,



Instead the Darrieus tends to go into a stall in high winds.

A disadvantage is the turbine will pot start turning by itself when the wind starts to blow; an independent starter motor is needed. Sometimes the starter can double as the generator.

Another disadvantage is because the Darriaus runs at lower speeds than conventional machines; gearing is needed.

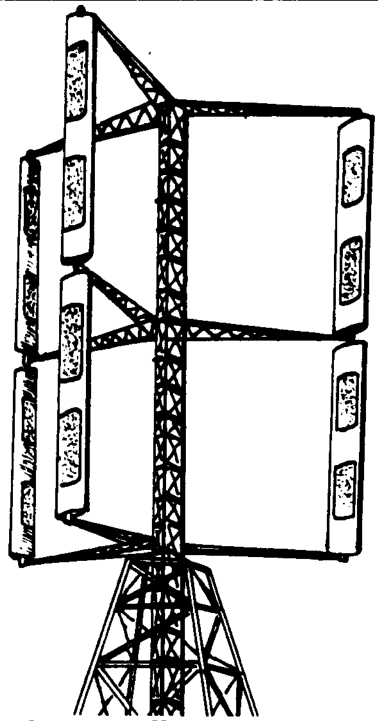


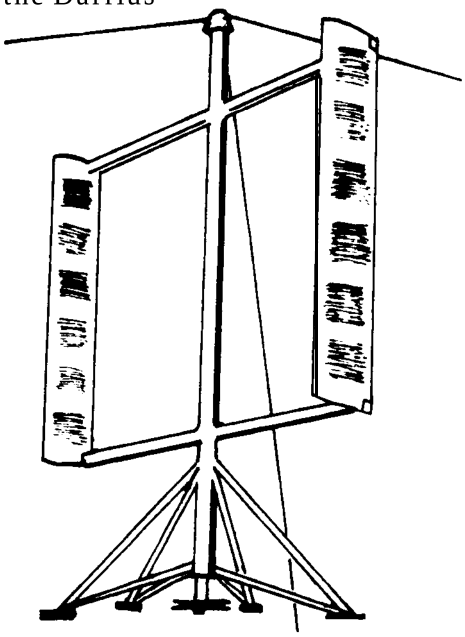
C.V.A.W.T.

Circulation Controlled Vertical Axis Wind Turbine (C.V.A.W.T.) is a design being funded by the U.S. Department of Energy It uses blades based on the wings of short take-off and landing aircraft.

With this machine the trailing edge is rounded instead of having a sharp edge as with conventional blades. High pressure air is blown over this trailing edge. The air adheres to this trailing edge and then shoots off sideways. In the case of an aircraft this acts like a flap causing air to flow downwards, increasing lift. The use of this configuration is expected to increase both torque and speed and allow the turbine to run at lower wind speeds.

Thus with this machine efficiencies of between 40 and 60 percent are expected compared to an efficiency of 20 to 40 percent with the Darrius





CYCLOGYRO

This machine has straight variable pitch blades, that result in a number of advantages. The machine will start itself when the wind starts to blow. The variable pitch blades result in the extraction of more power from the wind. The turbine seems to have a greater efficiency at lower wind speed compared to the Darriaus. Simpler blades also lower manufacturing costs.

One unit recently available in the U . S . has three 8ft tall blades, a diameter of 12 feet can produce four k ilowatts in a 30 m. p. h. wind and two in a 24 m.p.h. wind, Its cost was about $6,500 U.S. including the tower.

AUGMENTER WINDMILLS

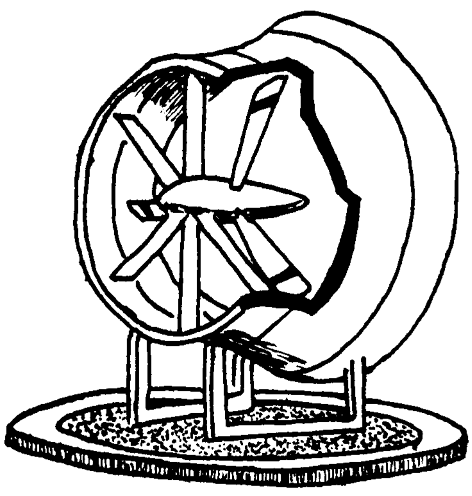
What these machines have in common is some form of static structure which directs more wind into the propellor. Thus you can get more energy out of the propellor and use a smaller propellor.

DIFFUSER AUGMENTER

With this design a shroud is placed around a relatively conventional rotor. The shroud is narrower at the side that faces into the wind and expands as it goes back. This causes a pressure drop behind the resulting in greater airflow through the machine.

However problems have occured with the airstream breaking up as it passes t hrough the shroud (diffuser). To counter this problem the divergence angles of the diffuser have to be quite small, requiring a costly shroud.

Researchers at Gruman Aerospace Corp. New York. are attempting to solve the problems by putting slots in the diffuser that introduce external air into the internal wall of the diffuser.



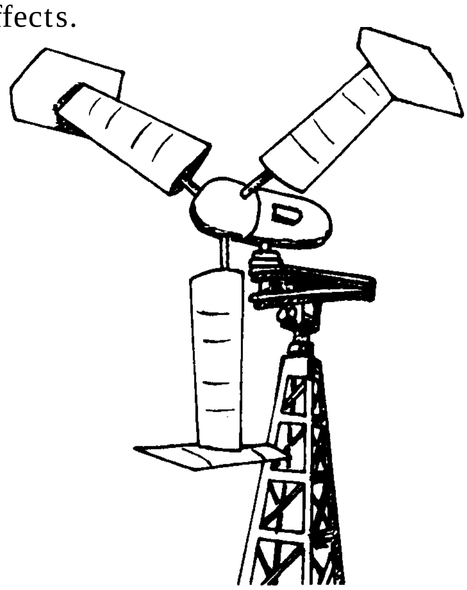
Windpower

It is hoped this will counter the tendancy towards stalling. If the problems can be solved it could be possible to obtain about 34 times the power out of the diffuser turbine than can be obtained with a conventional wind machine.

DYNAMIC INDUCER

Despite the different appearance of this turbine it is very similar to the Diffuser Augmenter. This design aims at the same effect as the previous design but without the high cost of the shroud. The T-shaped device on the tips of the blades push air out and away from the propellor causing an area of low pressure and thus more air is drawn in, resulting in higher efficiency.

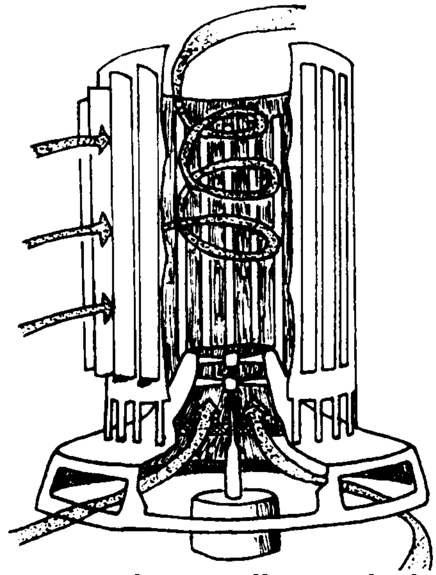
Because the T-pieces are spinning at such a high speed they have the same effect as a complete shroud. However at the same time there is additional wind resistance created by the T-pieces. The problem is to minimize drag while maximizing the positive effects.



TORNADO WIND TURBINE

It is anticipated that this design could augment the power of the wind by up to 1000 times. The system involves a tower with vertical vents. Only the vents on the side towards the wind are open while the machine is in operation.

As the wind enters the tower, the air spirals around up and out creating an area of low pressure at the base. Thus air is



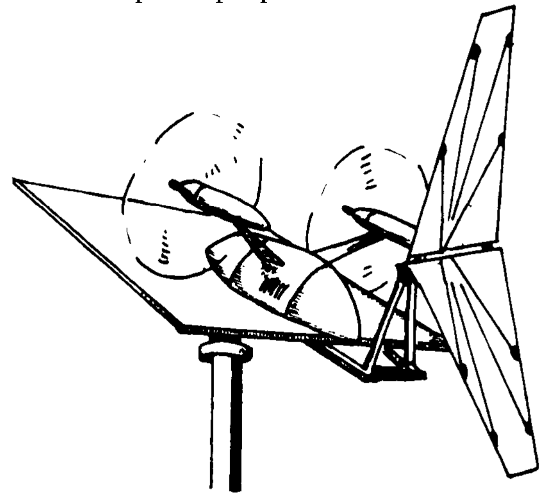
sucked in past the propeller at the bottom of the tower.

The problem with this design is whether the tower of this size can be constructed at a low enough cost to make the turbine economic.

VORTEX AUGMENTER

This rather innovative design aims at catching the whirlwinds (vortices) which occur when air passes over a wing. The idea was to construct a delta wing on which 2 rotors are mounted. As the wind passes over the wind vortices are formed which concentrate the wind's energy; leading to almost double the wind velocity.

An 18 foot long, 10 foot wide operating model with two 3 foot diameter rotor blades has been built to test the principle. Advantages include:- more energy from smaller rotors, (which in turn reduces costs) Wind speed can be varied by altering the angle of attack of the wing surface or by controlling a small flap on the back of the wings surface. Thus there is no need for a variable pitch propellor .



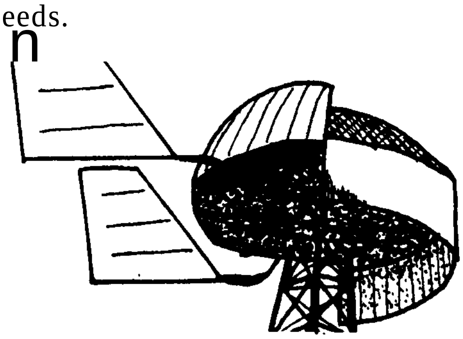
Windpower

NYU URBAN TURBINE

New York Universities Department of Applied Science has been researching a design of the augmenter type. Not so much because of a potential greater output but more because of the greater safety for urban locations.

The device consists of a silver domed shell, 21 feet in diameter, housing four dynamically curved blades that rotate on a fixed vertical axis.

The dome swivels to catch the wind and upon catching it, its force is magnified some four times by the wind shield. Instead of the energy being used to generate electricity or produce mechanical power the rotor will drive a paddle wheel or heat brake - heating water via friction and conducting it to a hot water storage tank. An advantage of the heat brake is it can be driven at peak turbine efficiency at all wind speeds.



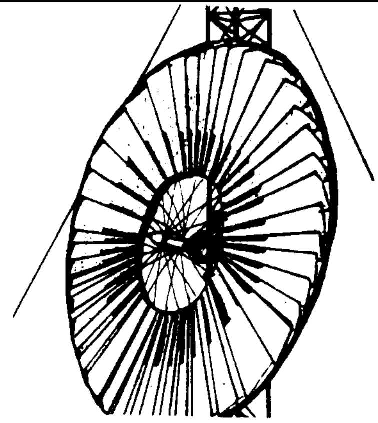
LOW COST DESIGNS

One approach to developing a wind machine which produces cheap electricity is to reduce the cost of the machine itself.

BICYCLE WHEEL

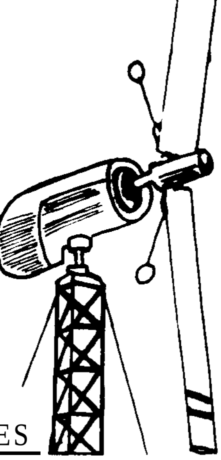
The bicycle wheel turbine is similar to the well proven wind pump which is widespread in rural Australia. However, success with a prototype has been limited. **A** 30 foot diameter machine was built with 36 stainless steel wire spokes which support 48 airfoils, each about 10 feet long.

When construction cost and efficiencies were taken into consideration the results were not promising. One problem encountered was the large area of the blades which made protection from high winds difficult,



BEARINGLESS **ROTOR**

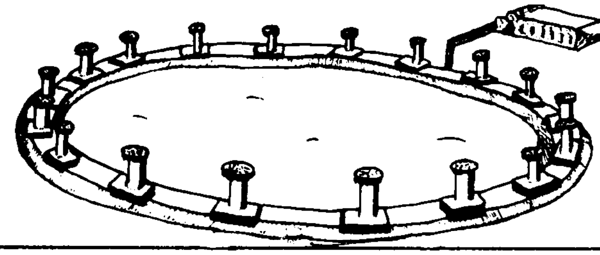
This design could prove to be more promising than the bicycle wheel design. The bearingless rotor design involves propellor blades which are flexible enough between the hub and propellor to bend to a desirable pitch. This is achieved by making the material connecting the hub and pellor from a highly flexible carbon epoxy. The pendulum attached to each blade helps it bend to the appropriate pitch. Eliminating the need for mechanical pitch control could significantly reduce the cost of a wind turbine.



OTHER POSSIBILITIES

MADARAS ROTOR

The Madaras Rotor involves a circular track similar to a railway track. A series of flatcars, each with one revolving vertical cylinder mounted on top are driven around the track by the interaction of the wind and the turning cylinder which is driven by a motor. Generators attached to the wheels of the cars produce power which is taken off by a third rail. Thus the system is something like an electric train in reverse.



Windpower

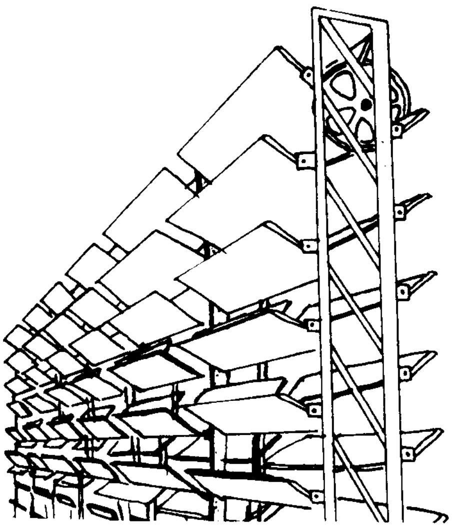
LIFT TRANSLATOR

The Lift Translator is like a cyclogyro vertical axis wind machine laid on its side. In principle it should work in either wind or water.

The machine consists of a series of paddles or "aircraft wing-like" airfoils attached to an endless belt. The foils on one side of the belt are pushed up by the wind while those on the other side are also supplying energy by being pushed down by the wind.

Advantages of this design are that is can accept winds from a variety of directions and speeds and its size is not limited in the way of conventional turbines.

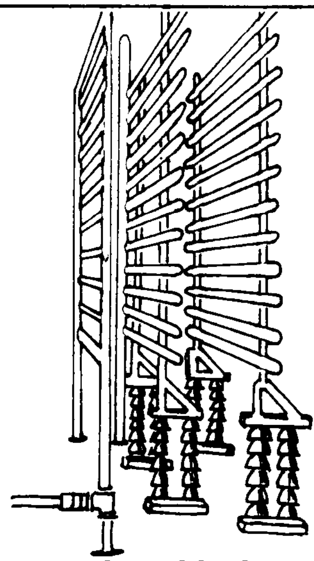
A 45 foot high working model was built to test the idea. It ran successfully for 9 months generating up to 15 kilowatts.



ELECTROFLUID DYNAMICS

This design uses wind to blow water droplets through a highly charged grid The water droplets become charged and are blown towards another charged grid. The charged droplets of water are carried by the wind to electrical groun but in doing so they have to climb a potential hill to get them to ground. Thus energy is gained. The mechanical energy of the wind does work in overcoming electrostatic repulsion and the energy is translated into electrical current.

One problem is producing the charged water droplets. One method of doing this



could be to use liquid hydrogen for cooling moist air to produce small droplets that can then be passed through a corona discharge. Another method would be tc shoot water through small jets into an electrical field.

The future impact of wind as a source of energy will be determined by two factors. The cost of energy from other sources and the cost of energy from the actual wind machines. In other words what it boils down to is a question of economics.

Many of the machines mentioned have been shown to be viable working methods of producing energy and with further research they can be made more efficient than they are today. However that research will cost money and the designs will never be developed to their full potential if they fail to be economically competitive with other sources of energy.

Although current trends with the "conventional" sources of energy show a continuous rise in energy costs, wind does not undergo an increase in cost the way something like oil does. After all, wind never runs out. With this advantage in mind and with a breakthrough in any one of the designs mentioned a possibility, the day when wind will make a real and significant impact on our daily lives could be closer than many of us imagine.

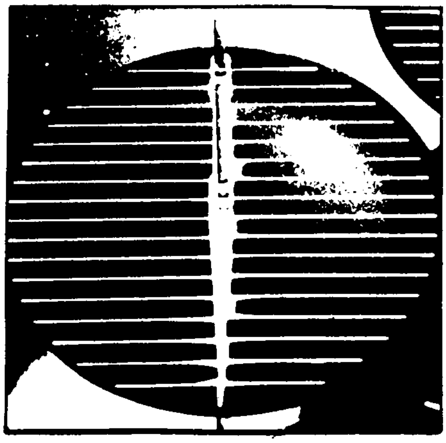
MICK HARRIS

Refs: --Alternative Sources of Energy , No. 38 July/August 19 79.

--13 Wind Machines, Victor Chase, Popular Science, September 19 78.

--Windmills Change Direction, Dr Peter Musgrove, New Scientist, 9 December 1976

Solar Cell Users Guide



By Jim Kuswadi

The idea of getting something for free has always appealed to people. Getting free electrcity from the sun is no exception. Add to it the fact that the sun is a source of non-exhaustible energy, that the process is non-polluting, silent, has no moving parts to wear out and does not consume any raw material, and you have a truly attractive source of energy.

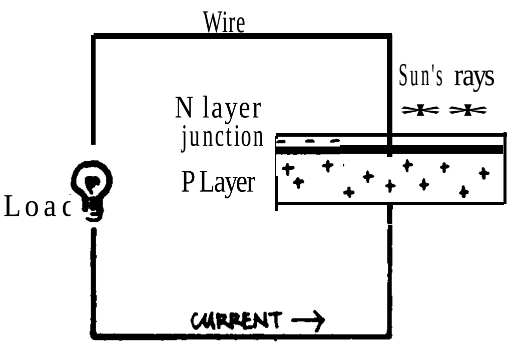
This article concentrates on the practical aspects and tries to assist the first time user of solar electricity.

THE SOLAR CELL

Basically, a photovoltaic (solar) cell is a thin wafer of silicon to which has been added a controlled amount of boron during the crystal formation. This material is called a P-type silicon wafer, On top of this wafer, a thin layer of N-type material is formed by adding phosphorous instead of boron.

The N-type material now becomes the negative pole and the P-type material now becomes the positive pole of the solar cell. Sunlight falling on the solar cell will cause current to flow through a load.

The voltage of each solar cell is always between 0.4 to 0.45V, which is the voltage of a silicon P-N junction. Increased cell size or greater light intensity will give greater current output.



The output of solar cells and panels are measured at a standard light intensity of 1 Sun which is 100 m W/cm.

The solar cell will continue to function on hazy, overcast day, but at a reduced output.

Quite unlike solar hot water systems, high temperatures affect the power output adversely.

SOLAR PANELS

To be of any practical use, solar cells have to be connected in series to get a higher output voltage. 12V rechargeable lead acid batteries as used in cars are the most common form of energy storage used with solar panels When fully charged, the terminal voltage is around 13.5 V. The output of the solar panel has to be sufficiently high to overcome this voltage. 36 cells are usually connected in series to produce between 14.4 and 16 volts.

The exception is the new, large solar cells of 100mm diameter. These cells have a higher voltage output and 34 or 33 of these in series is still adequate.

Battery manufacturers have different battery types for different applications -consult them before you buy new ones.

Since the voltage output of a cell panel is determined by the number of cells connected in series, the output power is determined by the current output of each cell. As a rule of thumb, a 50mm diametre cell will produce about 500mA, a 75mm diametre cell 1 Amp and a 100mm diameter cell 2 amp or more.

WHAT TO LOOK FOR WHEN BUYING A SOLAR PANEL.

Electrical Considerations

How many cells does it have connected in series? Since solar cells are the most expensive component of a solar panel, some

Solar Cells

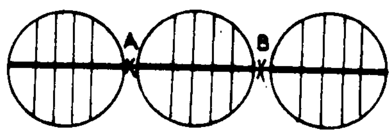
manufacturers try to cut cost by using only 34 or even 30 cells.

If a solar panel is required to operate in hot climates, 40 or even 44 cells in series would be required. This naturally increases its price.

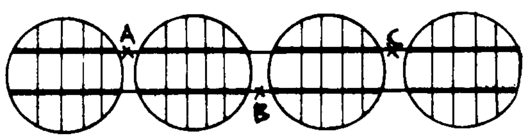
How are the cells interconnected ?

Solar cells of 50mm diameter upwards should ideally have two interconnections between each cell for extra reliability.

Remember, the solar cells are connected in series like links in a chain; cut one link and the whole chain is useless.



One bad joint anywhere would render the panel useless.



Panel would still function even if there were bad joints at A, B and C simultaneously.

Blocking Diodes

In smaller panels, a blocking diode is usually built in. It acts as a one-way valve and prevents the battery discharging through the panel at night time.

In larger panels, diodes are usually not built in but have to be added externally.

Two diodes can be used in parallel for extra reliability.

Mechanical Considerations

Solar cells are very fragile and need to be protected. Most solar panels these days have the cells completely encapsulated in a clear silicone rubber. This prevents moisture, dust and salt water from getting near the cell. It also acts as a cushion against shock and vibration.

Next comes the "container" to hold the solar cells. Since high temperatures adversely affect solar cell performance, a heat dissipating base is the best. Anodised aluminium extrusion with fins is ideal. It also gives a very rigid, solid structure which is easy to mount and group into arrays.

The final component is the top cover. The requirement here is for a tough, strong, durable cover which still allows the maximum amount of solar energy through. Low-iron oxide, tempered glass fulfills all these requirements;it transmits up to 91.6%, of solar energy for a thickness of 3mm. To determine if the glass has a low iron oxide content, look at it edgewise: it should be clear, not green.

Environmental Considerations

Depending on your application, check the performance of the panel in the environment you want to use it in. eg; What wind loading will it stand? Will it stand hail storms ? What maximum or minimum temperature will it cope with ? Are the terminals rust-proof? How easy is it to mount at the angle you need ?

CALCULATING THE REQUIRED SIZE OF YOUR SOLAR INSTALLATION

This guide will give you a rule of thumb which is adequate for most installations.

STEP 1 What is your load requirement each day ?

Assume you want a solar installation to run the following:

2 Fluorescent lights@8 Watts, 3 hours each = 48 Watt hours
1 Transistor radio@ 1 Watt, 5 hours = 5 Watt hours
1 Portable Television @25 Watts, 3 hours = 75 Watt hours

Total =128 Watt hours

STEP 2 Convert your power requirement to Amp hours per day.

Assume you use a 12Y lead acid battery. The Amp hour required per day is: 128/ 10.7 Amp hours per day.

This gives a total of 12.8 Amp hours per day, which has to be recouped in one day from

Solar Cells

The solar installation. Using a rule of thumb again one can expect an equivalent of 5 hours of sunshine each day which has an intensity of 1 Sun, along the Eastern and Southern sea-board of Australia.

The solar installation then has to produce 12.8/5 = 2.6 Amps. An 80 Amp. hour battery would be suitable for this installation.

What you now have is an installation with an abundance of power during the summer, but insufficient to cope during winter months. There are several ways of overcoming this Winter-summer discrepancy:

a) add more solar panels to cope in winter.

b) add more batteries to store the summer excess

c) add a small wind generator to the system, s these give highest output during winter.

d) cut your power consumption during the lean months.

STEP 3

The next question is whether to buy a few large panels or several smaller ones.

The larger the panel, the lower is the cost-per-watt. There is also less work involved in joining them together on a mounting frame, and less electrical interconnections which reduces the potential trouble spots.

The smaller panels, on the other hand, are more modular and should one get damaged, the replacement cost would be lower.

Note the fins on this aluminium extrusion. Do not mount solar panels directly on top of hot objects but allow air to circulate and cool these fins.

This article originally appeared in Chain Reaction , issue number 22.

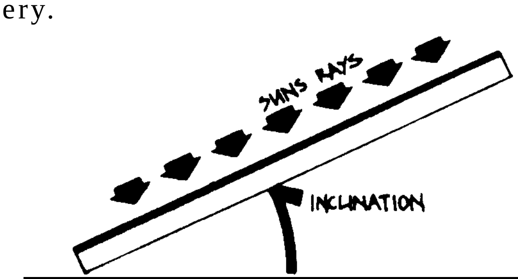
INSTALLATION AND MAINTENANCE

To get the maximum output, solar panels have to face the Sun directly. Since there is usually an abundance of sunshine in summer but a shortage in winter, incline the panels for maximum output in winter. We suggest the following inclination angles relative to horizontal:

OPTIMUM INCLINATION FOR SOLAR PANELS

Darwin	27°
Cairns, Broome	32°
Rockhampton, Townsville	34°
Mt. Isa, Mackay	36°
Alice Springs	38°
Brisbane, Geraldton	42°
Broken Hill, Perth	47°
Newcastle	48°
Sydney	49°
Canberra, Adelaide	50°
Melbourne	53°
Hobart	58°

Fix the installation to face true North on a bracket arrangement to obtain the desired angle of inclination If desired, the brackets could be made adjustable to allow for a winter and summer position. This would increase the installation output noticeably provided there is sufficient battery capacity to store the excess summer output, and reduce the risk of overcharging and damaging a lead acid battery.



Do not mount the solar panels directly on top of hot objects like roofs, etc. Allot space for air to circulate and cool the panel fins.

Disign the installation so that the cable from solar panel to battery is as short as possible to reduce losses. Connect the solar panels to the batteries mains electrical cable with a current rating of at least twice the output of the solar installation.

LOOKS AT........... INSULATION

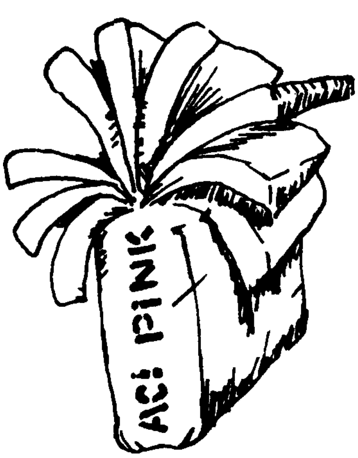
One normally associates insulating one's home with reducing those ever escalating winter fuel bills and therefore perhaps it might seem that now was not an appropriate time to consider such a move. A couple of good reasons, however, immediately spring to mind which counteract that idea.

Firstly, in order to keep sales from flagging during the summer some retailers will be offering special discounts on insulation materials. To take advantage of these offers would improve that all important figure - the payback period.

Bear in mind, also, that with manufacturing costs rising all the time, these products aren't going to be any cheaper next winter.

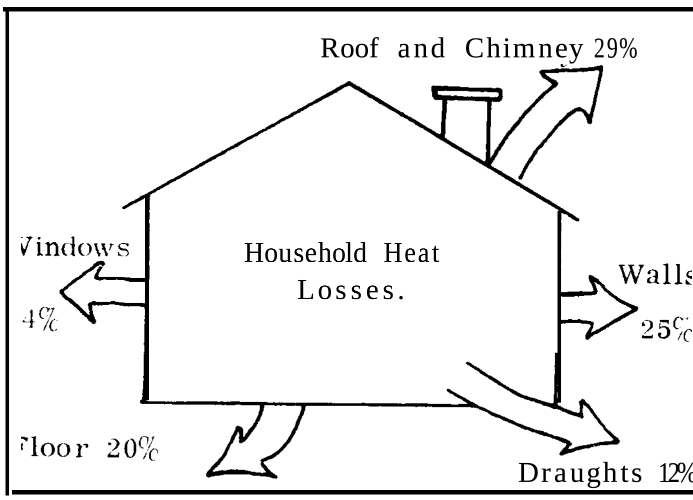
The other reason, of course, is a thermal one since insulation not only helps to keep winter heat in, but also can keep some of the summer heat out. Having already experienced the first of those high summer temperatures, why not help create a more comfortable environment in your home this summer.

Calculations made by the C. S. I. R. O. Division of Building Research, indicate that with 50mm thickness of, say mineral wool in the ceiling a house in Melbourne could be kept up to 3°C cooler than its uninsulated equivalent. Since we do not normaly actively cool our houses - most people do not have air conditioning - cost savings aren't made during the summer months and therefore to recoup the financial outlay of insulating you have to look at what kind of reduction in heating bills you can realistically expect. Of course, if you do use fans or air conditioners during the summer, then you can expect to use them less and that reduction in usage will also reduce you annual energy demand.



The diagram below shows how heat escapes out of your house. The proportions given are estimated averages. They will vary for different constructions but serve to give an idea of the relative magnitudes.

It can be seen from the above that ceiling walls and floors are the most vulnerable areas and in that order.



A little theory may help to appreciate in energy terms and ultimately in dollar terms what we are doing when we insulate.

Suppose we have a ceiling are of 110m² (12 squares) and that there is a difference of 8°C between the temperature inside the house and that outside.

If the roof construction was as shown then on average during winter every square metre of ceiling area would conduct heat to

Insulation

the outside at the rate of about 3.4 watts for every degree difference between the inside and outside temperatures. This rate of conductance is known as the U-value and would normally be written as 3.4 w/m² °C. It doesn't look much when we think in terms of a 100 watt light globe but the heat loss calculation below shows how significant its value is.

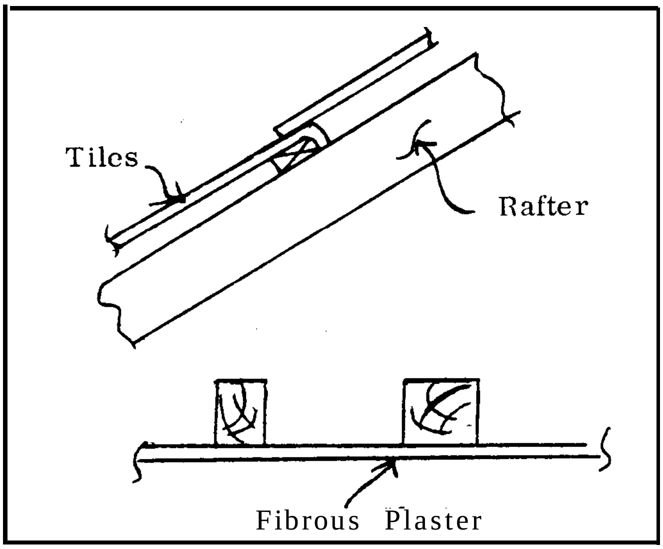
Rate of heat loss = U x area x temp.difference

= 3.4 x 110 x 8

= 2,992 Watts

Now if these conditions existed for the whole day, then approx. 72 **kwhr** of heat pass upwards to the outside air.

If on the other hand, we can reduce the U-value by insulating, say with 50mm of glass fibre, then considerable savings can be made. The new U-value achieved by insulating as indicated will be 0.69 so now the rate of heat loss is 607 watts or approx. 14.6 kwhr over the 24 hour period. The heat loss through the ceiling has been reduced to about 20% of its previous value.



How this reduction translates into cash savings depends on what kind of energy you use to heat your house and how much you have to pay for it.Remember we are also only talking about a reduction in the heat loss hrough the ceiling which may only be 29% of the otal.

Having demonstrated some of the theory behind insulating, lets take a look 'at what is currently available and some of the advantages and disadvantages associated with each.

Insulating materials can be divided into 3 main types.

1. Bulk materials ie. Batts and Loose fills
2. Rigid boards
3. Reflective foils

1. Bulk Materials

These are the materials most commonly used by the homeowner - installer

Mineral Wool

Available as batts , blankets or loose fill, there are 2 materials use. Fibreglass which is as you would expect made from glass fibres, and rockwool which is supun from molten slag rock. Both these materials can irritate the skin and when handling, gloves should be worn. In fact, it is advisable to cover as much exposed skin as possible.

The granuiated form is suitable for hand Pouring or blowing while in batt and blanket form the material is readily cut with a sharp knife or even big scissors to fit in and around the ceiling joists, chimneys or exhaust vents.

Cellulose Fibre

This is made from recycled paper products in a shredded form and can be blown or hand distributed into the attic space. It is mixed with a fire retardant and is also normally treated to resist rodent infestation.

Sea Grass

This is a natural product made from dried sea grass. It is again fire proofed and made resistant to vermin. It comes in a loose form and is simply spread between the ceiling joists to the required thickness just as the other loose fill materials. According to the suppliers, 75m is required to produce an R value (see later in this article for an explanation of R values) of 1.8. At this thickness, one bag of the material will cover approx. 1 square. The suppliers also claim that even if the material becomes wet, no smell is given off.

Vermiculite

This is a material which is not so commonly available. It is made from expanded mica. It

Insulation

is sold as loose fill granules and again is suitable for hand pouring.

A point that should be remembered with all loose fill materials is that some settlement is bound to take place and to achieve an adequate value of resistance to heat flow, this must be allowed for. Contractors usually fill to the top of the ceiling joists and this is regarded as an adequate allowance.

Urea Formaldehyde

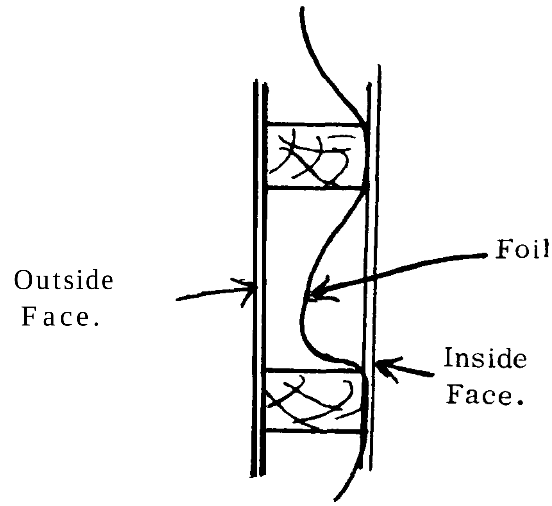
This form of insulation is sprayed into cavities both in the ceiling and walls, and requires specialist equipment to do so. It is the only really practicable way of insulating the walls of an existing house. There may be some outgassing of formaldehyde particularly in the weeks soon after installation and it has been reported that in the US health problems have resulted when the material has not been properly cured.It is also expensive costing about $700 to insulate the ceiling and walls on an average sized brick veneer house. Marketers however, claim that cooking and heating costs may be reduced by up to 50%.

2. Rigid Light weight Boards

These are commonly made of expanded polystyrene combined with a fire retardant and then enclosed in non-combustible materials like asbestos cement. Another material is compressed straw but for an equivalent size, say 50mm, these have only about half the thermal resistance of the other common materials.

3. Reflective foils

Reflective foil does not use the principle of small pockets of trapped air to slow sown the flow of heat. It insulated by enclosing an air space with a reflective surface. Heat trying to escape is radiated back across the air space. To perform best a space of at least 25mm is required and there must be no movement of air in the enclosed space. Overlapping between adjacent sheets can overcome this. There should also be no rips or tears in an installed sheet. It should be noted that if the foil is flat up against a surface with no airspace then it has no insulating effect on that side. This is



often overcome by dishing the foil as shown.

When used in a ceiling, although the top surface will eventually get covered by dust, it will still offer an insulting effect equivalent to 50mm of mineral wool in summer and 12mm in winter. It is easy to install using a heavy duty st apler. Reflective foil laminates also provide and effective vapour barrier. An added bonus.

The 'R' Rating

When choosing an insulating material the prospective buyer will be confronted with an 'R' value displayed on the material. Nowadays be suspicious of any material which does not quote an R value.

The R value is the international system of rating the thermal resistance of the material, or how well it slows down the heat passing through it. The higher the R value, the better the material is at doing this job. For Melbourne however, an R value of 2 is considered adequate.

Costs

Costs vary so much from material to material and from installer to installer that it is imposible to generalise, Loose fill materials may be cheaper than batts but they have the associated disadvantage of being more difficult to move once positioned. Batts on the other need cutting to fit awkward shapes.

The safest thing to do is to shop around. If you are planning to instal yourself, then your

Insulation

choice is limited to thosematerials which can be layed or poured without specialist equipment. The best course or action is to get a number of quotes for both batts and loose fill materials and then choose the cheapest material which will give the right R value. If you prefer to use natural rather than man-made materials your choice is again narrowed.

Expected Savings

Savings will vary from house to house. Not only will different types of house construction perform differently but other factors such as sheltering and terrain, orientation and aspect ratio will influence the thermal behavior of your house. Manufacturers and installers will naturally make all sorts of claims aimed at making their product seem the best, and it would be prudent to take these claims with a large grain of salt. However their are some figures available from good sources which enable reasonable estimates to be made of the savings possible.

Based on the figure of approximatly 29% of total heat being lost through the ceiling and that by installing 50mm of fiberglass in the roof we may reduce this by 80%. Then savings possible are 80% of 29%, ie 23% of the total heat required by the house.

Now to translate this into dollars, you must know the cost of heating your home. The following figures were published in the Melbourne Age in August , 1980. They are said to represent the cost per week to heat the average sized home.

Oil. . . . . $ 8.00 a week.

Electricity. . . . .$6-9.00 a week.
(assuming the most efficient form of heating)

Solid Fuel.. ....$ 5.00 a week.
(eg Briquettes)

Gas . . . .$ 3.50 a week.

Now assuming a 6 month heating season the annual savings may be calculated as:-

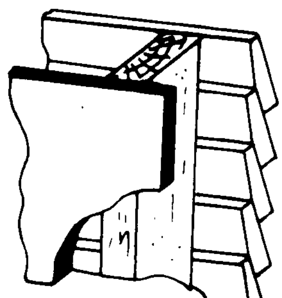
26 x $8 (for oil) x .23 percent of total heat) = $48.

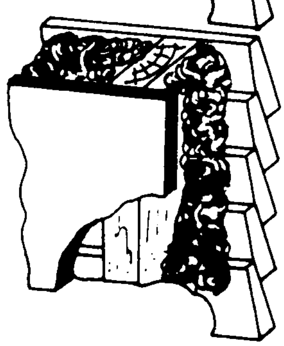
Now if the cost of insulating was say $180, then the payback period assuming no increases in oil prices, (highly unlikely) will be

$\frac{180}{48}$ = 3.75 years.

The above calculation indicates the theoretical amount that one could save in a situation as described. It should be borne in mind that in real life things are not quite as simple. Many heaters are not controlled to maintain a room or rooms at a fixed temperature and it may well be that the heated area is raised by 3 or 4 degrees C above its previously uninsulated temperature. The occupants may not even notice this or merely open a door to adjust the temperature. It can be seen that in that situation the same amount of energy has been consumed and has given either a higher overall temperature or has increased the heated area. No energy savings result.

A more realistic estimate of the amount of the total heat saved may be of the order of 15%. The payback period determined in the above calculation would then be 5.75 years. The amount saved, therefore will to a large extent depend on the user.





Some Tips

If you are lucky enough to be building a new house or an extension, then you have the opportunity to do a thorough job of insulating

Insulation

the walls, floor and ceiling. If you can afford to do only part of this, then do thoseareas which will be most difficult if not impossible to do at a later stage, ie walls and floor. Insulate the ceiling at a later stage when you have funds again.

Insulating a house is definitly a worthwhile proposition, but if your home is inadequatly weather sealed then you are not exactly wasting your time, but stopping draughts and unwanted air movements through holes and gaps under doors should be your first priority. This can be done with weatherstripping tape for windo ws and internal and external weatherstripping for doors.

Reducing the heat loss from windows is also an area which should receive attention. The best way is with curtains of a heavy close weavs material which fit tightly around the window frame and hang down from an enclosing pelmet right to the floor. This will provide an effective barrier between the warm air in the room and the colder air outside.

Further Information.

1. C.S.I.R.O.

The Division of Building Research has now a 24 hour recorded telephone message service giving information on a number of topics. The number to ring for the message on insulation is 03-555-7544. Further information on the subject may be obtained by writing direct to the Division .

2. En ergy Information Centre.

Run by the Victorian Gas and Fuel Corporation, at 151 Flinders Street. Telephone is 03-63-1986.

According to the Gas and Fuel Corporation, about 50% of Melbourne's houses have some form of insulation. It can be seen, therefore, that there is still lots of scope left for city dwellers to save energy. Not only does consuming less energy in the home stretch the resources further, but it cuts down on those quarterly heating bills and surely thats got to be worthwhile.

BOB FULLER

AUSTRALIAN WIND ENERGY ASSOCIATION

The inaugural meeting of the Australian Wind Energy Association was held at the Australian National University, Canberra, on Saturday the 6th of December, 1980. Mr Neville Jones, Department of Mechanical Engineering, University of Queensland was elected as president. The vice presidents are Dr Paul Edwards from the University of Otago, New Zealand and Dr Graham Bowden from the University of New South Wales. Dr Mark Diesendorf of C. S. I. R. O. is the secretary.

The meeting resolved to continue to allocate the main proportion of the Associations income to the dissemination of information through the newsletter "Southwind". If possible four issues will be produced each year.

For 1981 it was decided the following activities would take high priority:

1. Compilation of a file of all wind energy R & D past and present and of all existing aerogenerators in Australia and New Zealand and surrounding islands.
2. Compilation of a file of technical information on aerogenerators and windmills.
3. Compilation of plans for building small, low-cost aerogenerators and windmills
4. Sponsoship of wind energy workshops in as many regions of Australia as possible.
5. Production of a leaflet about AUSWEA and visual aids about wind energy

The annual subscriptions are:

$12.00	Institutional.
$ 8.00	Employed individual
$4.00	Unemployed, pensioner Undergraduate student

Please send subscriptions to The Australian Wind Energy Association, P.O. BOX 1965, Canberra City ACT 2601.

More information from Pratish Bandopadhayay (03) 556 2257 A .H. (03) 557 6648.

Solar Ponds

What is a Solar Pond?

Salt water is denser than fresh water. Right?.... Cold water is denser than hot water. Right? This much we know. But a less known fact is that hot water can be salty enough to be denser than cold fresh water. And in the absence of turbulant mixing, salt takes a very long time to diffuse from Salty to less salty solutions. . . . so slow in fact that it easy to set up a stable pond with heavy salty water at the bottom and light fresh water at the top; and you can keep it that way.

Now if you put such a pond in the sun the solar energy would penetrate and heat the salty bottom (especially if it was coloured black). The salt water would get hotter and ‘at the same time get less dense. But if we made it salty enough it would never get light enough to convect to the surface and dissapate its heat to the atmosphere.

It will be a heat trap. . . . . . a “solar pond”.

What do we know about their problems and performance?

Investigation of “solar ponds " began in earnest in the 1960’s when Israeli scientists ‘studied some naturally occuring examples and succeeded in reproducing the physics artificially. They achieved a temperature of 96°C and showed that their pond was capable of boiling.

Building larger ponds, however, soon pointed out a few difficulties for practical applications . . . . .but these were overcome. Wind-blown dust and vegetable matter sullied ‘the pond and fostered algal growth which tended to shade lower layers. This can be controlled by dosing the pond with herbicide and setting a clear vinyl membrane just below the surface and flushing the fresh water above it periodically. Wind also creates wave action which tends to mix the salty and fresh water layers. That membrane ,and perhaps floating baffles are adequate to contol this problem.

Once perfected we can expect an impressive performance from a tropicle solar pond. In a Melbourne summer such a pond peaks at about 25% efficiency, collecting an average of 63 W/m incident. In Townsville (whose radiation climate is very similar to Darwins) a peak efficiency of 32% (92 W/m’) is predicted.

Extrapolating from these C. S. I. R. O. figures I get the following results as estimates of the territory's potential:

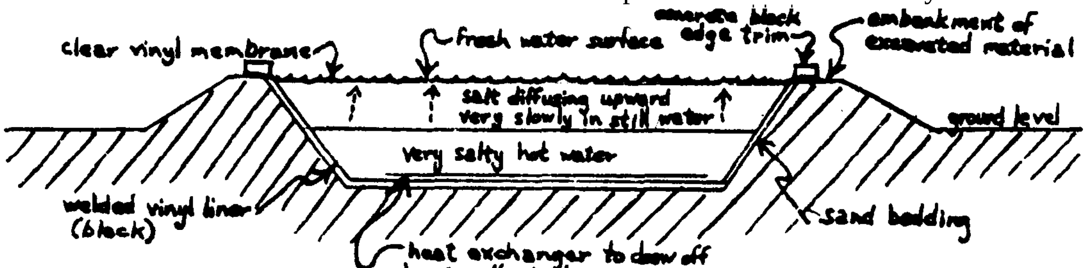
	Peak W/m^2	Ave W/m^2	Min W/m^2
Darwin	66	60	55
Daly Waters	‘70	60	52
Alice springs	75	63	15

(assumes 25% average efficiency, year round These outputs are all in the form of heat at 80-95 c.

Solar Pond Size.

The size of a solar pond effects both its performance and cost. The edge of the pond will shade the pond and conduct away some of the heat gained from the sun. To minimise these detrimental effects we can increase the size of the pond. This will reduce the lenght of edge per collecting square meter. In a really large pond we would expect the edge losses to be negligible and this is borne out by research results.

Also, because the edges or walls are a significant fraction of the cost of a “solar pond”, the bigger is the pond, the lower is the cost per square metre. And there is no reason why such an expanded “solar pond” should look any different from an



Solar Ponds

ornamental lake. There is no theoretical limit to its size either, (a plan has actually been put forward to convert the Dead Sea).

<u>Is it Economically Feasible?</u>

To assess thi s crucial point we need to look at three possible scales on which it mightbe applied to a Northern Territory location. First a communal pond suitable for say 20 families.

A pond 10 metres square at the base and about three metres deep (1.5 metres of still and stable salinity grdient from fresh top to salty bottom which insulates the 1.5 metres of very salty hot water below). This would cost as follows:

1. Earth Moving (100m^3)......	$ 350
2. Concrete Blocks (65m)......	$ 420
3. Sand (12m^3),......................	$ 100
4. Welded vinyl liner............	$ 550
5. Vinyl membrane................	$ 250
6. Salt (47,000 kg)..................	$2100
7. Piping and contols............	$ 650
	$4420

This pond could deliver six kilowatts average in the form of hot water at 80-95°C, that is 52,000 kilowatt hours per year. Now if we assume an investment life of 20 years and a projected real interest rate (market rate less inflation rate) of 4%, $50/year running cost for salt and water and value 150m of land at $2000, we get an effective annual cost of $472 + $50 = $522 per year. Thats about one cent per kilowatt hour.

But don't be to eager to compare that directly with your electricity bill. If you want to use that energy for anything but heat below boiling point you will be up for extra costs and lower system efficiencies. Lets look at other scales of "solar ponds" first.

A solar pond of similar construction to the previous one mentioned but 20 times the size would cost out as follows:

1. Earth moving (2000m^3).........	$7000
2. Concrete blocks (290m).........	$1900
3. Sand (240m^3).........................	$2000
4. Liner......................................	$11000
5. Membrane..............................	$5000
6. Salt (240,000kg).....................	$42000
7. Piping and control.................	$5500
	$74400.

Factoring up land and salt and water costs we get an effective annual cost of about $9400 to deliver 1,040,000 kilowatt hours per year. That's 0.9 cents per kilowatt hour.

Once the heat energy has been collected it can be used to produce electricity or for some other purpose such as air conditioning. Electricity is produc ed by low temperature turbo-generators which have an efficiency of something like 15% and a peak output of 5-10 kilowatts.

If heat is to be used for air conditioning the cost of the energy from a "solar pond" as compared to energy from the electricity utilities are as follows:

	Electric	SolarPond
Cooling	17500 kWh	17500 kWh
C.O.P.	2.5	0.5
Energy Used	7000 kWh	3500 kWh
Price	.06	.06
“Fuel” cost	$420	$350
Total Annual Effective cost:	$640	$637

Although the initial cost of the electric reciprocating air conditioner is lower than the cost of the solar pond/absorption air chiller the lower cost of the energy makes the ‘solar pond’ air chiller option cheaper in the long term.

Due to a number of factors solar ponds are in most cases only marginally cheaper as a source of energy than utility power.
They certainly warrant further investigation.

This item is based on an article written by Trevor Lee in “Solarwise” June 21st issue. Back copies,including the issue on which this article is based are available from the Northern Territory Environment Council, P.O. Box 2120, Darwin, N.T. 5794.

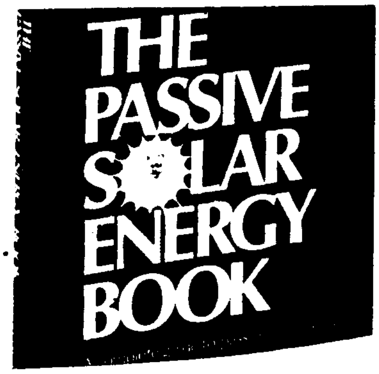
BOOKS.

30 ENERGY EFFICIENT HOUSES...,You Can Build.

By Alex Wade and Neal Ewenstein.

This book tells how to build a house that is energy efficient, solar-heated, and uses space well. Architect Wade discusses proper placement of windows, doors, and skylights; insulation, heating and ventilation; and natural lighting. He shares his experiences with low cost construction using recycled and easy maintenance materials, post and beam framing, and ingenious shortcuts for construction.

PRICE: $11.95.



THE PASSIVE SOLAR ENERGY BOOK

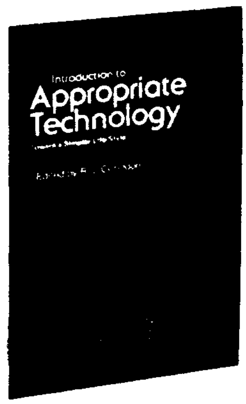
By Edward Mazria.

This book presents a step by step process for choosing and sizing a system suited to ones particular needs.There is information about solar radiation, regional climate variations, and space heat losses and gains so that one can calculate heating/ cooling needs and energy/money savings with a passive solar system.

PRICE: $17.95.

INTRODUCTION TO APPROPRIATE TECHNOLOGY

Edited by R.J. Congdon.



A comprehensive work featuring specific ways in which both developed and developing countries can introduce people orientated technologies to all aspects of society. Written by engineers, scientists,and sociologists, as well as agricultural and educational specialists, this book is a practical and down-to-earth introduction to the alternative technologies.

PRICE : $9.50.

COMPLETE BOOK OF RAISING LIVESTOCK AND POULTRY

By Katie Thear and Dr Alistair Fraser.

This well presented book gives all the basic information needed for the wood be keeper of chickens, ducks,geese, rabbits, goats, sheep, pigs, cattle and horses. Information is included on breeds, what to look for when buying, handling, feeding, breeding and diseases. The book is well illustrated with lots of photographs and diagrams. Most of the information would be suitable for people just entering the field of livestock handling. It does not really go far enough for people who already have a lot of experience. But what is covered, is covered well. The biggest drawback is the price....$19.95

(Copy supplied by A.N.Z. Book Co Pty. Ltd).

ALTERNATIVE TECHNOLOGY ASSOCIATION

The Alternative Technology Association is a group of people interested in the use and promotion of Alternative Technology. Alternative Technology (which can also be thought of as Appropriate Technology), is technology that is ecologically sound and does not conflict with the environment by causing pollution or destruction.

The membership of the Association covers a wide variety of interests and skills. Solar and wind energy are areas of common interest, other important interests include: water power, methane digestion, agriculture, energy efficient houses and other buildings, crop fuels, bicycles, electric vehicles and alternative transport, domes, mudbricks,......etc.

WHAT DOES THE ASSOCIATION DO ?

* We hold regular meetings, with films and guest speakers talking on subjects of interest.
* These meetings are preceeded by a newsletter which provides details of the meetings, and also informs members of any current events of interest.
* We produce this publication, which has Australian based information on Alternative Technology.
* We hold other activities from time to time; such as day trips to energy saving houses and workshops where members can come and work on individual projects.

If you are not a member already, why not fill in the form below and become a member.......

Fill in this form and send it to the Alternative Technology Association: c/o 366 Smith St. Collingwood, 3066.

NAME...............................DATE.......................
ADDRESS..

POSTCODE.............TELEPHONE.............

Please find enclosed my membership fee of
$10.00 normal membership.
$ 5.00 students, unemployed, pensioners, etc.

Areas of interest...
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