Society has the choice of two approaches to energy

*By BRIAN MARTIN **

WHAT is the solution to the impending 'energy crisis'? Is nuclear power essential in spite of its hazards? Or can human needs be satisfied and a high quality of life be maintained by the alternatives of conservation, and solar and wind power?

Two basic approaches to the supply and use of energy in society may be distinguished.[1]. The first may be called the 'hard energy path'. It relies on massive centralised production of ever-larger supplies of energy, especially electricity.

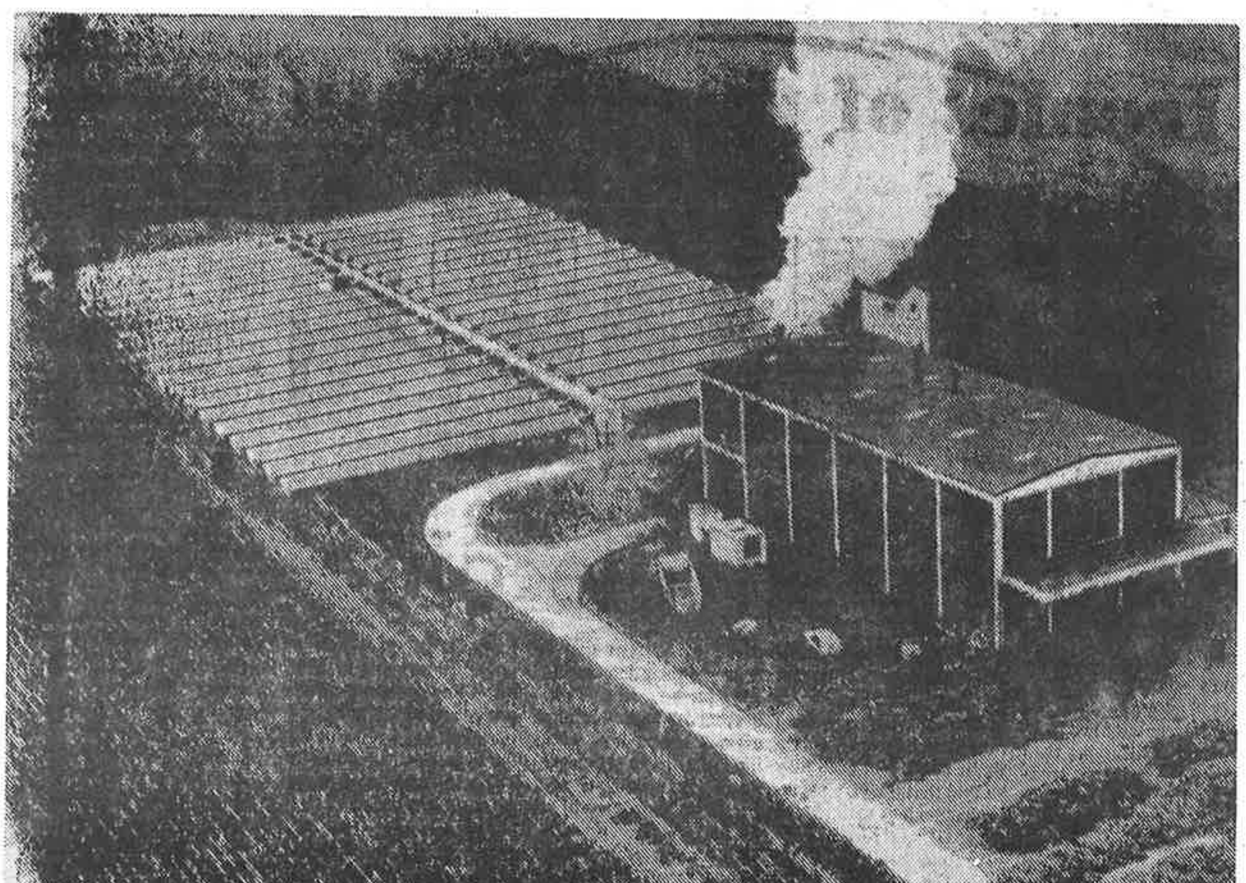
It focuses on the technologies for using coal, nuclear fission, and in the future perhaps fusion, and orbiting solar satellites. This sort of energy future is most strongly promoted by oil and mining companies and related government bureaucracies such as electricity utilities.

The second approach is the 'soft energy path'. It is based on efficient use of energy, the expanded use of renewable energy sources matched in scale and type to the needs of being met, and gradually reduced dependence on fossil fuels.

This type of energy future is advocated by a large number of environmentalists, scientists, planners and growing numbers of the general public.[2]

At present society has the option to move towards either type of energy path. In particular, nuclear power presently provides only about 2 per cent of total energy used in the world and so is not essential to human survival.

Most of the technologies for both the hard and soft paths are presently available. The real issues are not technological, but economic, social and political.



A big solar-energy project on a German farm

THE HARD-ENERGY WAY: NUCLEAR POWER DESPITE THE HAZARDS

The hard path could well result in serious economic dislocations due to the capital and fuel costs of ever expanding energy use. It has been calculated that about 75 per cent of US net private domestic investment would be required to provide the capital for a US hard energy path.[3]

The hard path is also environmentally destructive. Even a major commitment to a nuclear power cannot provide all the rapidly expanding energy supplies needed for this path. Therefore the hard path requires *more* use of coal with its associated environmental hazards and worker deaths.

The environmental impacts of nuclear power include reactor accidents, long-lived radioactive wastes and the release of highly toxic radioactive species such as plutonium into the environment.

Then there are the social and political disadvantages of the hard path. Most importantly, the use of nuclear power increases the chance of nuclear war through the proliferation of nuclear weapons capability.

Nuclear fuel cycle operations are also vulnerable to criminal and terrorist actions. Protection against these possibilities is already leading to restrictions on civil liberties.

Already there are extensive security checks on nuclear employees in many countries, dossiers compiled on anti-nuclear activists in the US, a planned special nuclear armed constabulary in Britain, and police attacks on non-violent demonstrators in France and West Germany.[4]. This is not to mention the punitive laws of the Atomic Energy Act used to give the go-ahead for uranium mining in Australia[5].

Finally, the massive financial investment in centralised power plants entailed by the hard energy path leads to centralised decision-making and control[6], and restriction of the ability of the public to democratically determine the future path of social development.

The yet unproven technologies of nuclear fusion and orbiting solar satellites are subject to many of the same shortcomings as coal and nuclear fission. For example, the intense microwave beam from a solar satellite could cause immense danger if diverted by accident, and therfore could also be used for military or terrorist purposes[7].

These economic, social and political implications of the hard path thus include quite a number of significant life-style changes, most notably a great increase in social and political insecurity.

The soft path looks rather different. Here I will outline some features of a possible soft energy path, to illustrate some of the potentialities.

Let me emphasise that this is not a blueprint. Ideally decision-making about energy futures should involve all concerned and interested citizens in a free and open process of communication, discussion and implementation.

At the moment most of this decision-making power is held by energy interests in corporate and government circles, which have a strong best interest in increasing their political and economic power via the hard energy path[6]. It is an advantage of the soft path that more of this control would be returned to the public which is affected by the decisions.

Some of the soft energy path measures here involve life style changes, others do not. It is quite possible to present a soft path which requires only minor life style changes. For example, the books 'Soft Energy Paths' by Amory Lovins and 'Rays of Hope' by Denis Hayes give comprehensive treatments.

However, there is nothing sacred about present life styles. If a soft energy path can reduce traffic deaths, increase worker satisfaction or help promote world peace as well as provide for human needs which require energy, then surely so much the better.

In discussing energy use in society, several sectors are usefully distinguished: residential, commercial, transport and industry. In each of these areas the major components of the soft energy path are conservation, increased use of renewable energy sources, and changes in policies and procedures to reduce energy requirements.

The treatment here is concerned with the rich industrialised societies. For the poor countries the case for soft path measures, as presented for example by Arjun Makhijani in 'Energy Policy For the Rural Third World', is even more imperative[8].

Over one-third of energy used in most industrialised countries is in the residential and commercial sectors.

In the residential sector, space and water heating require about 75 per cent of energy used at present. Measures such as insulation and reducing air flow through windows can result in perhaps a 50 per cent reduction in space heating requirements in existing buildings. Through careful design, heating requirements in new buildings can be reduced by up to 80 per cent.

One important technique is the positions of buildings so that windows gain maximum solar energy[9]*. Notice that sunlight coming through a window is safer, cleaner and cheaper than nuclear power.

The American Institute of Architects calculated in 1975 that by using energy-efficient systems in old and new buildings the US could save in less than 20 years energy equal to one-third of its current energy use, at half the cost of providing new energy supplies.[10]

The size of this energy saving is thus about 10 times as large as what is now supplied by nuclear power. The added cost of constructing a typical house in the US in accordance with recent government insulation standards is about $500. The savings in fuel bills amounts to about $125 per year.[11]

Conservation in buildings thus can have a very big impact on energy requrements in the near term of a decade or two.

The greatly reduced residential energy requirements left after conservation measures can be met in part by active solar collectors for space and water heating. Designing collector systems and reservoirs for neighbourhood scale operations, such as a group of 10 or so houses, reduces costs and provides adequate supply against sunless periods.[12]

Solar hot water systems and some solar space heating systems are well tested and already economically competitive in many cities.[13] The booming solar collector industry is taking advantage of this situation.

This is in spite of hidden subsidies to conventional fuels and in spite of interest rate barriers to decentralise energy production.[14] Further development and economies of mass production can only increase the attractiveness of solar heating systems.

The world's largest wind generator, which started a year ago at Tvind in Denmark and which was designed and built by teachers, students and helpers at the local school, demonstrates th at the renewable energy technologies can truly be controlled by the people that use them. And compared to present centralised systems, neighbourhood energy systems provide much greater security against threats of major accidents, sabotage, arbitrary rate increases and strikes.

Besides space and water heating, the remaining quarter of energy used in the residential sector is mainly for cooling and cooking. Evaporative cooling, insulation and proper placement of eaves and trees can greatly reduce the energy demand for cooling.

This leaves only a tiny role for electricity, whose use can be further reduced by over 50 per cent through use of efficient appliances and lighting. This holds even assuming access by all households to basic consumer goods such as refrigerators and stereos.

OR THE SOFT-ENERGY WAY: POWER FROM THE WIND AND SUN

The commercial sector has similar energy requirements to the residential sector. Besides the proposals mentioned above, energy savings can be made by reducing unnecessary lighting (including huge lighted advertisements), using 'waste' heat generated within buildings and eliminating throwaway packaging.

The combination of conservation and solar and wind energy for heat thus can begin to replace the bulk of present residential and commercial energy use in the relatively near term of the next few decades. For this interim period there are ample supplies of coal to supply energy requirements not yet eliminated by conservation or taken over by the alternatives.

However, the switch to conservation and renewable energy sources will not occur automatically. There need to be strong measures taken to promote energy efficient building codes, provide loans and incentives for use of solar heating systems and eliminate subsidies now provided to fossil fuels and nuclear power.

Looking forward 10 years or so, electricity supply can be generated increasingly through a combination of small hydro plants, wind power, and solar cells when the price drops sufficiently, with some short term electricity storage provided via flywheels and small reservoirs. Farther in the future there is the possibility of long term electricity storage by chemical means such as decomposing water into hydrogen and oxygen.

These electricity sources combined with improving building and appliance design and improved solar and wind heating systems mean that in the long term conservation and the renewable energy technologies provide a solid basis for satisfying residential and commercial energy requirements while maintaining an improved quality of life and avoiding the environmental and social hazards of a hard energy path.

The much-talked-about 'energy crisis' is not a shortage of energy, because there are supplies of coal for hundreds of years. It is instead an impending shortage of liquid fuels over the coming decades, which is being manifested now as rising prices.

This impending shortage is mainly a problem for the transport sector in industrialised countries, the only sector at present heavily dependent on liquid fuels.

It is important to realise that nuclear power is not a solution to this problem, since it produces only electricity which currently provides only 10 to 15 per cent of end-use energy in rich countries.

The future for transport in a nuclear society is either all-electric requiring new and highly expensive transportation technologies, or based on oil produced from coal requiring coal mining of devastating proportions as well as absorbing scarce water supplies.

The transport sector now consumes about a quarter of energy used in most rich countries — but over 40 per cent in Australia. What approaches does the soft path offer towards satisfying these requirements?

A dramatic short-term impact on energy requirements could be made through a switch to much lighter cars with greatly improved fuel economy. In the US, 1976 model cars obtained 27 per cent better mileage than 1974 models.[16]

Large energy savings can also be made through transport planning. Most important is the provision of greatly improved public transport facilities and sevices along with comprehensive measures to improve conditions for cyclists and pedestrians. In the recent book 'Seeds for Change', by Deborah White and others, a detailed transport model for Melbourne is presented which is based around existing rail lines, shuttle-bus services, walking and cycling.[17] This model aims at transport arrangements which save the most energy while also enriching the quality of life. It demonstrates that this soft energy approach is much better thought out than is the hard path in providing for transport needs.

For transporting freight, a gradual shift of much of the energy expensive air and truck traffic to rail would cut energy use by roughly 40 per cent.[18]

These measures of course do not provide an overnight solution to transport problems. That is why strong measures are needed today to initiate changes intransport modes and patterns before the real crunch comes in a few decades time.

And because it has been government and industrial organisations with vested interests in promoting the present system which is so fragilely dependent on oil and motorcars,[19] it will require citizen efforts and pressure to help promote more efficient vehicles, public transport, cycling and walking.

Over the longer term, transport energy requirements can be greatly reduced by energy-conscious design of communities and essential services. For example, the cities of Runcorn, England, and Port Grimaud, France, were planned to function without cars.[20] Planning for safe cycling and walking in addition would improve physical health and greatly reduce the death and suffering now caused by auto accidents.

The economic costs resulting from traffic accidents alone are roughly equal to all motoring taxes,[21] so obviously the automobile transport mode is receiving enormous subsidies ranging from road building to sacrifice of urban land to lack of compensation for the effects of pollution.

When settlements are redesigned to reduce most trips to two to five kilometres, with efficient public transport, safe walking and cycling routes and special facilities for those with special needs such as the handicapped, the present motorised society with its attendant violence and human suffering may seem more than just a little irrational.

Transportation fuels in a soft energy path will include a declining proportion of petroleum, increased use of liquid fuels produced from crops such as cassava and sugar cane, and perhaps synthetic fuels and hydrogen generated using solar and wind energy. Extensive use will also be made of electricity for trams and rail freight.

Finally, changes in patterns of work and production could greatly affect energy requirements for transportation. For example, decentralised offices would reduce commuting requirements, and greater use could be made of telecommunications.

The industrial sector consumes somewhat more than one-third of energy used in industrialised societies.

As in the case of residential, commercial and transport energy requirements, conservation can almost immediately have a big impact on energy requirements in industry. Major savings can be made through such measures as plugging leaks, cogeneration of electricity and process steam, and heat recovery in direct heat applications.[22]

Energy supplies for industry in the intermediate terms can be covered in part by coal and oil. But since 85 per cent of energy used in industry is in the form of low- or high-temperature heat, solar and wind heating systems are quite capable of taking over much of the load.

Industrial production can be rationalised in several ways with energy savings as well as benefits in materials, expense, labour and time. First would be the elimination of planned obsolescence whereby goods are designed to break down prematurely or to be hard to fix.[23]

For example, building cars to last 30 years would require more energy initially, but total energy savings in manufacture and fuel over the lifetime of the car would result.

Second, getting rid of obsolescence through planned fashion changes would reduce energy needs and also reduce the pressure to compete for symbolic status via the latest models.

Third, industrial production could be re-oriented towards energy-thrifty products. The switch from soap to detergents increased profits for manufacturers, increased water pollution and increased the energy

The outcome depends on social and political factors

required for production by a factor of three, but did little for the consumer.[24] For construction materials, a switch from energy-expensive aluminium to concrete and timber would save energy as well as release investment capital.

Fourth, comprehensive recycling would conserve energy and materials as well as reducing litter and pollution.[25] For example, use of organic waste as fertiliser (after extracting energy through a biogas digester) reduces the need for energy-expensive artificial fertiliser, reduces the need for water purification and avoids contamination of water supplies-with dangerous nitrites.

Another big drain on worldwide resources and energy is military production, which consumes something like 10 per cent of energy used in the US. A program of conversion of military production to production for human needs would also promote world peace.

Roughly one-third of the several million scientists and engineers involved in research and development around the world are engaged in military work.[26] If this effort were redirected towards the problems of energy conservation, safe energy technologies, safe production processes and appropriate technologies for poor countries, the results almost certainly would be impressive.

Energy also can be saved by producing more things where and when they are needed. For example, more local production of food in family and community garden plots would reduce energy needs for transport and processing and also facilitate recycling. Gardening is considered a pleasurable activity by many people even with out the benefits of food production.

Finally, the changed modes of residential energy use and transportation would also reduce the needed industrial capacity: bicycles are cheaper and less energy-expensive to produce than automobiles.

The soft energy path sounds nice, but how do we get there? This has been looked at in detail in a number of studies. For example, John Steinhart and colleagues at the University of Wisconsin have outlined a series of measures designed to reduce US energy use to one third of its present level while using no nuclear power and greatly increased use of solar and wind power.[27]

Their list of policy directions includes such measures as mandated fuel economy standards for vehicles, redirection of funds from highway building to mass transit, solar and wind energy incentive programs, energy efficient building codes, requirements for comprehensive recycling, change in laws concerning generation and sale of electricity by industry, and effective anti-trust regulations.

These measures are immediately feasible. It is political and economic factors, notably the opposition of vested interests, that stand in their way.

In summary, nuclear power now provides only about 2 per cent of the world's energy. Expansion of energy supplies via coal and nuclear power would be expensive and would entail vast social changes due to assaults on the environment, increased proliferation of nuclear weapons, terrorist and criminal threats, reduction in civil liberties to counter these threats, and a massive complex of political and economic power based around energy supply and control.

One alternative is a soft-energy future based on conservation, the renewable energy technologies using sun, wind and organic matter, and possibly changes in community design, production patterns and allocation of resources.

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References:

1 Amory Lovins, *'Soft Energy Paths: Toward A Durable Peace'* Harmondsworth: Penguin, 1977).

2 Besides Lovins, op. cit., see for example Wilson Clark, *'Energy For Survival: The Alternative to Extinction'* (Garden City, NY: Anchor Press/Doubleday, 1974), Godfrey Boyle, *'Living On The Sun: Harnessing Renewable Energy For An Equitable Society'* (London: Calder and Boyars, 1975), Peter Harper and Godfrey Boyle (eds), *'Radical Technology'* (Harmondsworth: Penguin, 1976), Denis Hayes, *'Rays of Hope: The Transition To A post-Petroleum World'* (New York: W. W. Norton, 1977), Stephen Lyons (ed), *'Sun! A Handbook For The Solar Decade'*. (San Francisco: Friends of the Earth, 1978).

3 Lovins, op. cit. note 1, p.30.

4 John Ball, 'Plutonium Economy' A Threat To Liberty' *Canberra Times*, March 31, 1978, p.7.

5 Kevin O'Connor, 'Uranium And Civil Liberties', *Dissent*, No. 37, August 1978, pp.4-7, 39-40.

6 James Ridgeway, *'The Last Play: The Struggle to Monopolise The World's Energy Resources* (New York: E. P. Dutton, 1973).

7 David Dickson, 'Congress Approves Solar Power Satellites —And Asteroid Mining', *Nature, 274* (July 6, 1978), p.3.

8 Leon N. Lindberg (ed), *'The Energy Syndrome: Comparing National Responses To The Energy Crisis'* (Lexington, Massachusetts: D. C. Heath, 1977).

9 Arjun Makhijani, *'Energy Policy For The Rural Third World'* (International Institute for Environment and Development, 1976); see also Neil Barrett, Peter Hayes and Jeff Nicholls (eds), 'Atoms For The Poor? Nuclear Power and The Third World' (1977).

9* 'Energy Conservation In The Built Environment', papers from a conference in Sydney on 15-16 March, 1978 (Department of Environment, Housing and Community Development).

10 American Institute of Architexts, 'Energy And The Built Environment: A Gap In Current Strategies' and 'A Nation Of Energy-Efficient Buildings by 1990' (Washington, D. C., 1975).

11 Eric Hurst and Linda Pearlstein, 'Residential Energy Use: How Much Can We save?', *Sierra* (FEbruary/March 1978), pp. 15-16.

12 Martin Ryle, 'Economics of Alternative Energy Sources', *Nature, 267* (12 May 1977), pp. 111-117.

13 Energy Research and Development Administration, *'Solar Energy Report'* (Washington, D.C ., February 3 1977).

14 Brian Martin, 'The Built-In Barriers To More Widespread Use Of Solar Energy'. *Canberra Times*, December 20 1977, p.2.

15 Andrew Jamison, 'Democratizing Technology', *Environment, 20* (January/February 1978), pp. 25-28.

16 Federal Endergy Administration, *Energy reporter* (Washington, D.C., February 1976).

17 Deborah White at al., *'Seeds For Change: Creatively Confronting The energy Crisis'* (North Melbourne: Patchwork Press, 1978), pp., 143-249.

18 John Steinhart at al., *'A Low-Energy Scenario For The United States:* 19 75-2050'.

19 On the dismantling of US tram systems by automobile interests, see Barry Commoner, *'The Poverty Of Power: Energy And The Economic Crisis'* (London: Jonathan Cape, 1976), pp. 189-190.

20 Steinhart et al., op. cit. note 18, pp. 565-566.

21 For the Australian situation see *'Getting On The Right Track: The Public Transport Crisis In Australia'* (National Action for Public Transport, 1976), pp. 44, 47.

22 marc H. Ross and Robert M. Williams, 'Energy Efficiency: Our Most Underrated Energy Resource', *Bulletin of the atomic scientists, 32* (1976), pp. 30-38.

23 Vance Packard, *'The Waste Makers'* (London: Longmans, 1961).

24 Barry Commoner, *'The Closing Circle: Nature, Man, and Techology'* (New York: Alfred A. Knopf, 1971).

25 Ian Pausacker, *'Is recycling The Solution?'* (Monbulk: Patchwork Press, 1975).

26 Randall Forsberg, *'Resources Devoted To Military Research And Development'* (Stockholm: Almquist and Wiksell, 1972).

27 Steinhart et al., op. cit. note 18, p. 576.

28 Richard Grossman and Gail Dancker, 'Jobs and Energy'(WAshington, D.C.: Environmentalists for Full Employment, 1977).