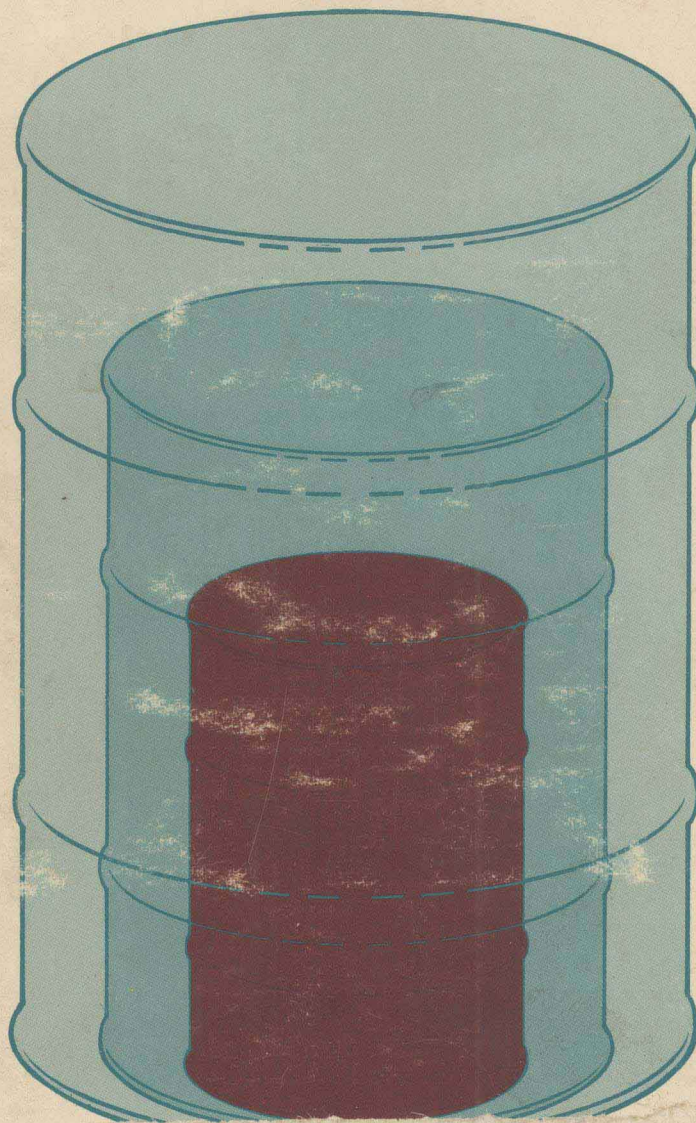SENATE STANDING COMMITTEE ON NATIONAL RESOURCES
REPORT ON

THE REPLACEMENT OF PETROLEUM BASED FUELS BY ALTERNATIVE SOURCES OF ENERGY

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA

THE REPLACEMENT OF PETROLEUM-BASED FUELS
BY ALTERNATIVE SOURCES OF ENERGY

with regard to
research into alternative fuels
development and demonstration of practical alternatives
fiscal and other measures required to encourage their adoption

Report from the

Senate Standing Committee on National Resources

Membership of the Committee

Senator A.M. Thomas (Western Australia) – Chairman
Senator G.T. McLaren (South Australia)
Senator C.R. Maunsell (Queensland)
Senator E.A. Robertson (Northern Territory)
Senator M.C. Tate (Tasmania)
Senator B.C. Teague (South Australia)

GLOSSARY OF TERMS

AAA	–	Australian Automobile Association
AAEC	–	Australian Atomic Energy Commission
ADR	–	Australian Design Rule
AMEC	–	Australian Minerals and Energy Council
AMIRA	–	Australian Mining Industry Research Association
ASTEC	–	Australian Science and Technology Council
BAE	–	Bureau of Agricultural Economics
BTE	–	Bureau of Transport Economics
CAE	–	Colleges of Advanced Education
CBD	–	Central Business District
CNG	–	compressed natural gas
CSIRO	–	Commonwealth Scientific and Industrial Research Organisation
FCAI	–	Federal Chamber of Automotive Industries
IC	–	internal combustion engine
IEA	–	International Energy Agency
LNG	–	liquid natural gas
LPG	–	liquid petroleum gas
MHD	–	magneto hydro-dynamics
NCIRL	–	National Coal Industry Research Laboratory
NEAC	–	National Energy Advisory Committee
NERDDC	–	National Energy Research Development and Demonstration Council
OPEC	–	Organisation of Petroleum Exporting Countries
psi	–	pounds per square inch
RD & D	–	research, development and demonstration
RON	–	Research Octane Number
SAE	–	Society of Automotive Engineers - Australia

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CHAPTER 1

OVERVIEW

By the standards of other industrialised western nations Australia is richly endowed with energy resources. Considering only fuels capable of being utilised with existing technology at current prices, demonstrated and inferred recoverable reserves of non-renewable energy resources clearly show that Australia does not face any general energy shortage or crisis.

The problem facing Australia is that the available resources do not match the pattern of energy demand. Crude oil constitutes less than one per cent of Australia's energy reserves but meets almost half of the country's energy demand. Currently Australia consumes around 600,000 barrels of oil per day, approximately two-thirds of which come from indigenous sources. This oil is of a high quality and is particularly suitable for the manufacture of motor spirit and aviation fuel. The major source of oil is the Bass Strait and the output from these fields is expected to decline within five years. With significant new discoveries, total oil production in Australia could be maintained at 400,000 barrels per day in the 1990-2000 period. Even with this assumption, anticipated demand for transport fuel in particular will require a large volume of imports.

The following table illustrates the pattern of primary energy use in Australia over the last two decades.

Consumption of primary energy, Australia[a]

Year	Black coal		Brown coal		Petroleum products		Natural gas		Other[b]		Total
	Peta-joules	%	Peta-joules	%	Peta-joules	%	Peta-joules	%	Peta-joules	%	Peta-joules
1960-61	531	42	146	12	483	38	-	-	106	8	1 266
1965-66	592	36	202	12	740	45	-	-	116	7	1 651
1970-71	654	30	228	11	1 066	50	74	3	132	6	2 164
1975-76	750	28	290	11	1 255	47	213	8	150	5	2 658
1977-78[c]	853	30	295	10	1 305	46	259	9	148	5	2 860

Department of National Development and Energy

a A petajoule is 10^{15} joules
b Includes wood, bagasse, and hydro-electricity
c Provisional

This usage pattern contrasts with the resource situation in that coal represents 84 per cent of Australia's identified economically recoverable energy resources, but only 40 per cent of consumption; whereas oil and gas amount to only about 2 per cent of identified economically recoverable resources.

Australia's dependence on petroleum products is more clearly illustrated in the following table which shows energy consumption by industry sector for the period 1976-77.

Energy consumption by industry sector,
Australia 1976-77

Sector	Oil consumption by sector, as proportion of total	Degree of dependence on primary energy sources[a]				
		Oil	Natural gas	Coal	Wood, bagasse	Total
	%	%	%	%	%	%
Transport	56	100	–	–	–	100
Manufacturing industry	17	29	15	46[b]	10	100
Domestic/commercial	8	60	28	2	10	100
Agriculture	5	100	–	–	–	100
Energy sector[c]	11	14	6	75	5[d]	100
Mining	3	59	41	–	–	100
All sectors	100	46	9	40	5[d]	100

a Use of electricity is not allocated to final consumption sectors.
b Includes coking coal.
c Includes generation of electricity, processing of natural gas, and petroleum refining.
d Includes hydro-electricity.

The Committee notes with concern that more recent statistical information is not available in respect of energy consumption in Australia.

These figures demonstrate that the paramount issue for Australia is that the transport and agriculture sectors are virtually totally dependent on petroleum fuels and that, for those sectors, there are no readily available, commercially competitive alternative fuels or technologies that can be substituted. In many discussions of energy matters this point is lost amongst references to Australia's resources of black and brown coal, natural gas, shale and uranium.

In Australia's case the 'energy crisis' has resolved itself into the need to meet its demand for petroleum products particularly transport fuels, without becoming excessively dependent on crude oil imported from OPEC countries. Currently 74 per cent of Australia's imports of crude oil are derived from Persian Gulf countries (Saudi Arabia, Bahrain, Iran, Iraq, Kuwait and the United Arab Eminates) and Saudi Arabia alone supplies almost half of Australia's import requirements. Significant increases in oil production are expected in the future from non-Middle Eastern areas - the North Sea, Central and South America (particularly Mexico) and China. However, even when taken together the amounts available are not large enough to challenge the Middle East dominance of the world's oil export trade. Thus as Australia's self-sufficiency in crude oil falls it will probably be dependent upon the ability and willingness of OPEC oil producers to make up the shortfall. While dependence on an imported commodity is not necessarily a problem, dependence on OPEC is considered inadvisable because experience with that organisation suggests that arbitrary restrictions of supply and further price increases are likely to continue. The Iranian revolution clearly demonstrated the vulnerability of crude oil production to politically based disruption. The Committee believes that in this decade conservation, reduction of demand for oil through substitution and increased exploration for crude oil offer the only way to restrict dependence on imported oil.

Conservation of all non-renewable sources of energy is the foundation upon which future energy policy must be built. Conservation as espoused by this Committee refers to what has been described elsewhere as productive conservation

> 'which encourages changes in capital stock and daily behavior that promote energy savings in a manner that is economically and socially non-disruptive. Its aim is to use less energy ... to accomplish some task ... in order to prevent disruption later.'[1]

All non-renewable energy sources will continue to rise in price in the long-term as increasing use diminishes reserves. (This should be qualified by acknowledging that rising resource prices automatically increase economically recoverable reserves within finite limits.) This energy must be used with the maximum efficiency obtainable both to contain costs, which are ultimately borne by the community and to minimise the rate at which reserves are depleted. The environmental and public health risks posed by the continuing large-scale combustion of hydro-carbon fuels – particularly photochemical smog, particulate air pollution and carbon dioxide accumulation in the atmosphere – are well known and have to be faced irrespective of problems of energy supply.

The major readjustments which energy supply requirements are forcing on the community should be seen as an opportunity to confront these environmental problems as part of an integrated response to future energy requirements. Renewable and/or non-polluting resources must be favoured in planning Australia's long-term energy future. In accepting the need for conservation it must be recognised that conservation does not consist of a single measure but of a wide range of continuing small measures. The policy of world parity pricing for crude oil is already having a discernable effect in restricting demand but the real impact of parity pricing for oil will be obtained in future years as decisions taken within the context of escalating energy costs begin to influence the shape of the economy and society.

In the short to medium term Australia's coal and natural gas provide considerable scope for prolonging this country's crude oil reserves through substitution in appropriate applications thus releasing crude oil products for the transport sector. Institutional and legal constraints on this process must be examined and where possible eliminated. For example in most States the legal requirements for supervision of coal fired boilers do not reflect modern coal handling techniques or boiler design. Conservation and substitution policies must be

supplemented by increased exploration for crude oil. Further discoveries of accessible indigenous reserves of crude are obviously preferable either to increased dependence upon vulnerable imports or the adoption of high cost alternatives such as synthetic crude oils from coal or shale. Australia's oil prospectivity was summarised by Esso as

> 'an 80% chance of finding about 1.8 billion barrels, a 50% chance of finding 3.6 billion barrels, but only a 20% chance of finding more than 5.0 billion barrels.'[2]

3.6 billion barrels represents slightly more than reserves discovered to September 1979. At present the search for oil in Australia - 67 wells drilled in 1979-80 - is very small compared with overseas efforts. It was suggested to the Committee by Mr I. McFarlane representing the Rundle partners[3] that geological survey, seismic and drilling activity need to be increased to provide a sustained rate in excess of 500 wells per year which would enable a much better estimate of the prospects of finding more oil in Australia to be made. Oil exploration, particularly off-shore, is a high cost/high risk activity and to achieve the level of exploration mentioned above will require a range of incentives to enable private enterprise to marshall funds and may require public enterprise to supplement the program.

The lifetime of existing reserves of crude oil can be extended by a number of methods. Increased recovery from existing wells - at present 35 per cent recovery of crude oil is considered good - is important on a world scale and research into recovery techniques should be encouraged. The potential for Australia is not as great as overseas, since recovery from Bass Strait wells is already at a high level. The decision in 1977 to increase the returns to producers incrementally to world parity prices provided an incentive to maximise the production from existing wells and to use advanced drilling techniques to exploit known, but previously non commercial, pools of crude oil. As

substitution reaches significant levels reserves of crude will also be extended by extracting increased proportions of transport fuels from each barrel in the refinery process. This will require 'cracking' of the heavy ends, currently used to produce fuel oil, to yield lighter fractions. This process will also become increasingly important as dependence on Middle East oil increases. Future imports are expected to include higher proportions of heavier oils, requiring more extensive refining if they are to yield the same proportions of motor spirit, aviation fuel etc, as that obtained from high quality crudes such as that produced from Bass Strait.

Conservation, substitution, increased exploration and more extensive refining of available crude oil are the only policies which can be expected to have a significant impact on restraining Australia's imports of crude oil over the next decade. However beyond that time it is inevitable that Australia will be required to develop alternative sources of energy for transport if this country's dependence on imports is not to increase to inacceptable levels. Thus it is vitally important that activity in energy research be brought up to a level which reflects the long term importance of energy to the community. This country must develop and maintain a strong indigenous energy research sector which reflects Australia's specific needs and the properties of the resources from which alternative fuels will be derived. In addition it is imperative that the long term fuel needs of this country's Defence Forces, which are totally dependent upon petroleum fuels, can be met from secure indigenous resources. It is both commercially and technically unwise to assume that breakthroughs achieved overseas will be readily applicable to Australia or indeed that this country will be allowed easy access to such research, unless it is already making a worthwhile contribution to energy research.

CHAPTER 2

CONSERVATION AND SUBSTITUTION OF PETROLEUM FUELS

Crude oil provides approximately 47 per cent of Australia's primary energy needs. The transport sector, which consumes nearly 60 per cent of the oil used in Australia, is 99 per cent dependent on petroleum. This dependence on petroleum-based fuels is a result of the physical characteristics of those fuels, their ready availability and, until recently, their low cost.

The principal petroleum fuels used in Australia, petrol, diesel and aviation fuels are energy dense, relatively stable at normal temperatures and pressure and readily transportable both in large and small quantities. In addition the use of petroleum fuels has become firmly entrenched in Australia's economy and society. Major industries to manufacture, distribute and maintain motor vehicles, the petroleum and petrochemical industries, patterns of urban and regional development and social habits are all evidence of this.

Petroleum fuels are also relatively cheap, even now. No alternative fuel suggested to this Committee, in the key area of transport, can compete with them at current prices - all have clear disadvantages in application. In non-transport areas coal, electricity and natural gas already provide competitive alternatives, but in transport, petrol, diesel and aviation fuels will remain the preferred fuels for many years to come. Thus it is essential that substitution away from petroleum fuels in non-transport applications be pursued as a matter of urgency. Australia's reserves of crude oil, while declining, will continue to be a significant source of energy in the future and the

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