Second Hopkins Lecture, 25 July 1979

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Secretary of Energy

HOPKINS LECTURE

ENERGY PLANNING IN NEW ZEALAND

INTRODUCTION

IT IS AN HONOUR AND A PLEASURE TO BE ASKED TO GIVE THIS SECOND ANNUAL LECTURE WHICH RECOGNISES PROFESSOR HOPKINS' DISTINGUISHED SERVICE IN ENGINEERING.

I HAVE KNOWN PROFESSOR HOPKINS FROM THE TIME HE ARRIVED AT CANTERBURY UNIVERSITY IN THE EARLY 1950S, AND HAVE WORKED WITH MANY OF THE GRADUATES WHO RECEIVED HIS GUIDANCE.

ENGINEERING IN NEW ZEALAND HAS BENEFITTED GREATLY FROM PROFESSOR HOPKINS EFFORTS DURING THESE LAST 25 YEARS WHICH HAVE SEEN THE ACHIEVEMENT OF MAJOR DEVELOPMENTAL WORKS.

NEW ZEALAND IS NOW MOVING INTO AN ERA WHERE ENGINEERS CAN EXPECT TO BECOME INVOLVED IN NEW INDUSTRIES AND TECHNOLOGIES BASED ON THE USE OF OUR INDIGENOUS RESOURCES.

MY PARTICULAR INTEREST IS ENERGY AND I PROPOSE TO SAY SOMETHING OF THE PRESENT INTERNATIONAL ENERGY SITUATION, AND THEN INDICATE HOW WE IN NEW ZEALAND ARE INTENDING TO DEAL WITH OUR CURRENT ENERGY PROBLEMS, AND HOW WE MIGHT DEVELOP PLANS FOR THE FUTURE.

International Situation

The OPEC embargoes in 1973-74 focused attention on the world oil situation. Since that time many authorities have made studies of the demand-supply balance and have predicted that a supply gap would occur sometime in the late 1980s, accompanied by shortages and large price increases.

Recent events in Iran have resulted in a shortfall in world oil supply of 2 million barrels per day and raised the prospect of the critical date being much closer. Price increases have lifted the price of crude oil to $20 per barrel. Ten years ago it was $2 per barrel.

The oil depletion problem is compounded by political instability in some producing countries, and no oil importing countries can ignore the warnings. At the same time predictions of the date when gross shortages will occur need to be treated with caution.

Considerable scope exists for more efficient use, conservation, and replacement of oil by other fuels such as gas and coal. Progress in these areas has been slow since the 1973 crisis, and it remains to be seen whether the present disturbance in the balance of supply and demand will strengthen the resolve of Western Nations to tackle the issues.

The pattern of oil use in overseas countries such as the USA and Europe is significantly different from that in New Zealand. More than half the oil is used for heating, industry and power generation, all of which are capable of replacement by other fuels. In New Zealand two thirds of our oil is used in transport, which is not so easily replaced. Conservation, more efficient use, and oil replacement is therefore a tougher proposition here.

THE IEA CONFERENCE HELD IN PARIS DURING MAY THIS YEAR DREW ATTENTION TO THE IMPORTANCE OF NUCLEAR POWER, NATURAL GAS AND COAL. GAS AND COAL ARE SEEN AS LIKELY REPLACEMENTS FOR CRUDE OIL WITH GROWING TRADE AROUND THE WORLD IN THESE COMMODITIES.

WORLD RESERVES OF NATURAL GAS ARE AT PRESENT ESTIMATED AS BEING COMPARABLE WITH OIL RESERVES, BUT DEPLETED TO A MUCH LESSER EXTENT. WORLD RESERVES OF COAL ARE MANY TIMES GREATER THAN OIL OR GAS.

NATURAL GAS PRODUCTION IS AT PRESENT EXPERIENCING EXPONENTIAL GROWTH, AND RECENT DEVELOPMENTS IN THIS ENERGY FORM WERE DISCUSSED AT THE WORLD GAS CONFERENCE IN TORONTO, ALSO IN MAY THIS YEAR.

MAJOR GAS RICH COUNTRIES INCLUDE ALGERIA, INDONESIA, MEXICO, CANADA, OPEC COUNTRIES, USSR, AUSTRALIA. RESERVES IN THESE COUNTRIES ARE AT LEAST AN ORDER OF MAGNITUDE GREATER THAN OUR OWN MAUI FIELD. DISTRIBUTION BY PIPELINE NETWORKS IS WELL ADVANCED IN EUROPE AND NORTH AMERICA, AND CONSTRUCTION OF LIQUIFIED NATURAL GAS FACILITIES AND TANKER TRANSPORTATION IS BEING RAPIDLY DEVELOPED. IF NEW ZEALAND WERE TO BECOME INVOLVED IN LNG EXPORTS, IT COULD EXPECT TOUGH COMPETITION.

AT THE PRESENT TIME THE AMOUNT OF GAS BEING FLARED TO WASTE IN OPEC COUNTRIES IS GREATER THAN THE WHOLE OF CANADA'S GAS CONSUMPTION.

THE USA HAS RECENTLY REMOVED NATURAL GAS FROM PRICE CONTROL. IN THE PAST THE LOW PRICE OF NATURAL GAS IN THE USA ENCOURAGED WASTE AND DID NOT ALLOW AN ADEQUATE FINANCIAL RETURN TO PRODUCERS WHO CUT BACK ON EXPLORATION. THE RESULT OF THIS POLICY WAS THAT THE US BECAME AN IMPORTER OF LNG. WITH THE REMOVAL OF PRICE CONTROL (POLITICALLY UNPOPULAR) IT IS HOPED THAT THE ABOVE TRENDS WILL BE HALTED OR EVEN REVERSED.

GAS IN ITS LIQUIFIED FORM COSTS SOME SIX TIMES AS MUCH AS CRUDE OIL TO TRANSPORT, BUT IS AT PRESENT SELLING AT A LOWER PRICE THAN CRUDE OIL. THIS IS CAUSING MUCH CONCERN IN GAS PRODUCING COUNTRIES WHO CONSIDER THAT PRICING SHOULD BE ON THE BASIS OF EQUIVALENT CALORIFIC VALUES, AT LEAST. THIS BASIS HAS, HOWEVER, NOT YET BEEN ACCEPTED IN THE MARKET PLACE.

SOME RECENT ENGINEERING DEVELOPMENTS IN GAS AND FUEL TECHNOLOGY ARE:

- SECOND GENERATION GAS TURBINES WITH 34 PERCENT THERMAL EFFICIENCY AND HIGH AVAILABILITY ARE NOW AVAILABLE, WHICH IS A SIGNIFICANT ADVANCE ON THE 25 PERCENT EFFICIENCY ACHIEVED SOME 10 YEARS AGO;

- COMPUTER SIMULATION PROGRAMMES ARE NOW AVAILABLE FOR PREDICTING THE HEATING LOADS OF BUILDINGS, AND ALLOWING OPTIMUM DESIGN FOR ENERGY CONSERVATION. IT IS THEORETICALLY POSSIBLE TO HEAT SOME BUILDINGS BY ILLUMINATION ONLY;

- SURVEYS OF HEATING SYSTEMS IN SOME LARGE CITIES REVEAL THAT THESE SYSTEMS ARE OFTEN OVERSIZED 200 - 300 PERCENT. ENERGY SAVINGS OF 40 PERCENT ARE QUITE FEASIBLE IN MANY CASES.

IT IS INTERESTING TO NOTE THAT, WITH THE EXCEPTION OF LNG, THERE IS LITTLE ACTIVITY OVERSEAS IN THE CONVERSION OF GAS INTO LIQUID FUELS, WHICH IS CURRENTLY A TOP PRIORITY CONSIDERATION IN NEW ZEALAND. THE REASON FOR THIS EVIDENTLY LIES IN OUR RATHER UNUSUAL ENERGY SITUATION INVOLVING ELECTRIC GENERATION FROM HYDRO, RELATIVELY LITTLE USE OF OIL IN INDUSTRY, AND PREDOMINANT USE OF OIL FOR TRANSPORT.

BECAUSE MANY OVERSEAS COUNTRIES RELY HEAVILY ON OIL FOR INDUSTRY, HEATING AND ELECTRICITY GENERATION, THE DIRECT USE OF GAS AS A REPLACEMENT FOR OIL HAS A HIGHER PRIORITY IN THESE COUNTRIES THAN THE CONVERSION OF GAS INTO LIQUID FUELS FOR TRANSPORT.

NUCLEAR POWER IS AT PRESENT UNDERGOING A PERIOD OF GREAT DIFFICULTY BECAUSE OF THE ISSUES OF PUBLIC ACCEPTABILITY.

THE IMPORTANCE OF NUCLEAR POWER AS A REPLACEMENT FOR OIL FIRED GENERATION SHOULD, HOWEVER, NOT BE UNDERESTIMATED IN THE WORLD SCENE. FOR EXAMPLE THE UNITED KINGDOM AT PRESENT GENERATES ABOUT 12 PERCENT OF ITS ELECTRICITY FROM NUCLEAR POWER STATIONS AND THIS IS EXPECTED TO RISE TO 20 PERCENT NEXT YEAR. IN 1978 NUCLEAR GENERATION IN THE UK WAS EQUIVALENT TO 7 MILLION TONNES OF OIL PER YEAR. (NEW ZEALAND'S ANNUAL CONSUMPTION OF OIL IS 4 MILLION TONNES).

PRIMARY ENERGY FROM NON-RENEWABLE RESOURCES IS EXPECTED TO UNDERGO THE FOLLOWING PATTERN OF SUPPLY:

- OIL WILL LEVEL OFF BETWEEN THE YEAR 1985 AND 2000 AND THEREAFTER STEADILY DECLINE;
- GAS WILL INCREASE TO THE YEAR 2000 AND THEREAFTER DECLINE STEADILY;
- COAL WILL INCREASE STEADILY WELL BEYOND THE YEAR 2000;
- NUCLEAR, AND NON-CONVENTIONAL GAS AND OIL WILL INCREASE RAPIDLY BEYOND THE YEAR 2000;

PRIMARY ENERGY FROM RENEWABLE RESOURCES IS EXPECTED TO UNDERGO THE FOLLOWING PATTERN OF SUPPLY:

- HYDRO WILL INCREASE STEADILY BEYOND THE YEAR 2000;
- SOLAR, GEOTHERMAL AND BIOMASS WILL INCREASE STEADILY UNTIL THE YEAR 2000, AND INCREASE AT A FASTER RATE BEYOND THAT DATE.

← Diagrams (1) & (5)

THE FOREGOING TRENDS ARE OVERALL WORLD SUPPLY FORECASTS. THE TIMING OF THE VARIOUS ELEMENTS VARIES FROM OOUNTRY TO COUNTRY. FOR EXAMPLE COUNTRIES WITH FAVOURABLE TOPOGRAPHY (E.G. NEW ZEALAND) ARE ALREADY WELL ADVANCED WITH HYDRO DEVELOPMENT, AND OTHERS WITH LARGE LAND AREAS AND FAVOURABLE CLIMATE WILL BE MAKING AN EARLY START ON THE PRODUCTION OF FUEL FROM CROPS (BIOMASS). BRAZIL IN FACT ALREADY HAS AN ONGOING PROGRAMME OF ALCOHOL PRODUCTION FROM SUGAR CANE, AND PROPOSES TO QUADRUPLE ITS PRODUCTION BY 1985, AND REPLACE GASOLINE BY ALCOHOL IN ITS MOTOR CARS, SHORTLY THEREAFTER.

AGAINST THIS BACKGROUND OF THE WORLD ENERGY SITUATION, NEW ZEALAND APPEARS TO BE WELL ENDOWED WITH INDIGENOUS ENERGY RESOURCES. WE HAVE LARGE COAL RESERVES, FURTHER HYDRO ELECTRIC AND GEOTHERMAL RESOURCES YET TO BE DEVELOPED, A LARGE GAS FIELD AND PROSPECTS OF FUELS FROM BIOMASS.

I PROPOSE NOW TO DISCUSS THE NEW ZEALAND ENERGY SITUATION WITH PARTICULAR REFERENCE TO ENERGY PLANNING.

POWER PLANNING IN NEW ZEALAND

PRIOR TO 1957 THERE WAS NO SYSTEMATIC MECHANISM FOR ENERGY PLANNING. DEVELOPMENT OF HYDRO ELECTRIC POWER HAD BEEN PROCEEDING ON AN AD-HOC BASIS, AND THE COUNTRY EXPERIENCED PERIODS OF POWER SHORTAGES AND BLACK-OUTS FOLLOWED BY CRASH PROGRAMMES FOR CONSTRUCTION TO RECTIFY THE SITUATION.

IT WAS SOON REALISED THAT POWER PLANNING NEEDED TO BE PUT ONTO A BETTER BASIS BECAUSE OF THE LONG LEAD TIMES REQUIRED TO INVESTIGATE, DESIGN AND CONSTRUCT THESE MAJOR SCHEMES. (CONSTRUCTION OF A MAJOR HYDRO ELECTRIC POWER STATION TAKES ABOUT 7 YEARS, PRECEDED BY AN INVESTIGATION AND DESIGN PERIOD OF 3 TO 5 YEARS).

THE GOVERNMENT OF THE DAY SET UP A POWER PLANNING COMMITTEE WHICH WAS REQUIRED TO PRODUCE A 10 YEAR FORWARD PROGRAMME FOR NEW GENERATING SYSTEMS. THE COMMITTEE WAS TO REPORT TO PARLIAMENT EACH YEAR AND PRODUCE AN UPDATED POWER PLAN.

THE POWER PLANNING COMMITTEE WAS CREATED IN 1957 AND HAS MET ANNUALLY SINCE THAT TIME AND SATISFACTORILY CARRIED OUT ITS FUNCTIONS. POWERSTATION CONSTRUCTION HAS PROCEEDED STEADILY AND THE COUNTRY'S ELECTRICITY DEMANDS HAVE BEEN MET WITH NEGLIGIBLE RESTRICTIONS.

A COMMITTEE CLOSELY RELATED TO THE POWER PLANNING COMMITTEE HAS BEEN THE COMMITTEE TO REVIEW POWER REQUIREMENTS. THIS COMMITTEE'S TASK IS TO PRODUCE A FORECAST OF DEMAND UPON WHICH THE POWER PLANNING COMMITTEE CAN DETERMINE THE NECESSARY NEW GENERATING STATIONS. UNTIL ABOUT 4 TO 5 YEARS AGO THE CRPR'S FORECASTS APPEARED TO BE QUITE ACCURATE. RECENT TRENDS HAVE, HOWEVER, THROWN CONSIDERABLE DOUBT ON THE FORECASTS AND THERE HAS BEEN A PROGRESSIVE LOWERING OF FORECASTS, AND CONSEQUENT DEFERMENT OF SOME GENERATING STATIONS APPEARING ON EARLIER POWER PLANS.

THE PLANNING MECHANISM WHICH SERVED ITS PURPOSE WELL FOR OVER 20 YEARS IS NOW UNDERGOING CLOSE SCRUTINY, AND CONSIDERABLE STUDY IS BEING CARRIED OUT ON THE EFFECTS OF SATURATION OF DEMAND, THE RELATIONSHIP OF DEMAND TO ECONOMIC CONDITIONS, POPULATION EFFECTS AND SO FORTH.

IT IS NOT POSSIBLE TO FULLY DESCRIBE HERE THE STUDIES WHICH ARE AT PRESENT BEING CARRIED OUT. THESE WILL NO DOUBT BE THE SUBJECT OF TECHNICAL PAPERS IN DUE COURSE. BRIEFLY, HOWEVER, IT SEEMS THAT ELECTRICITY DEMAND FOLLOWED AN EXPONENTIAL GROWTH PATTERN UP TILL ABOUT 1969. SINCE THEN A TREND TOWARDS AN "S" CURVE HAS TAKEN PLACE. GOOD STATISTICAL FITS HAVE BEEN OBTAINED WITH MODIFIED LOGISTIC CURVES. PRIOR TO 1969 AN EXPONENTIAL GROWTH RATE OF 7 PERCENT PER YEAR FITTED THE DEMAND PATTERN FAIRLY WELL. IT APPEARS THAT AN AVERAGE GROWTH RATE FOR THE NEXT 15 YEARS WILL BE 2 TO 2½ PERCENT PER YEAR. SIMILAR TRENDS IN ELECTRICITY GROWTH ARE BEING EXPERIENCED IN SOME OTHER COUNTRIES.

← Diagrams (3) to (7)

The Liquid Fuel Problem

Demand forecasting for electricity is therefore a problem needing particular attention, but we should not become too pre-occupied with electricity because the great problems in energy lie elsewhere.

The recent events in Iran with the consequent restrictions on oil products are a reminder of the delicate equilibrium relating to oil supplies. The first oil crisis of 1973 has now been followed with another. Whether this is a minor disturbance which will be rectified in a relatively short time, or whether it is the beginning of another major price rise and chronic supply problems remains to be seen.

Half of New Zealand's consumer energy is in oil products and the annual bill for this exceeds $700 million. We have extensive reserves of coal, natural gas and hydro-electric power, and the urgent priority is to reduce our dependence on oil imports by appropriate development of our indigenous energy resources.

Natural gas and coal can both be converted to liquid fuels by various means, some of which are well tried and other still in the experimental stage.

To deal with the new range of issues and options which have arisen in energy, the Government has set up some new agencies.

New Energy Agencies

During the last 15 months three new energy agencies have been created: The Ministry of Energy, Petrocorp and the Liquid Fuels Trust Board. The Ministry of Energy amalgamated the New Zealand Electricity Department, the Mines Department and the Ministry of Energy Resources into one organisation responsible for overall energy planning and policies, and for Electricity and Mines operations. Petrocorp is a Government-owned company with responsibility for the development of natural gas and for the Government's interest in oil exploration. The Liquid Fuels Trust Board has been specially set up to investigate liquid fuel options. The New Zealand Energy Research and Development Committee

IS A FURTHER GOVERNMENT AGENCY WHICH HAS BEEN IN OPERATION FOR OVER 5 YEARS.

OVERALL ENERGY PLANNING

UNTIL NOW, THE EMPHASIS HAS BEEN ON ELECTRICITY PLANNING, AND I HAVE MENTIONED THE FORECASTING PROBLEM WHICH IS AT PRESENT UNDER SCRUTINY. THE NEXT PHASE IN ENERGY PLANNING IS TO CONSIDER THE OTHER ENERGY SECTORS: GAS, COAL AND LIQUID FUELS, AND PRODUCE A PLAN FOR THE ORDERLY DEVELOPMENT OF THEM. A COAL PLAN HAS RECENTLY BEEN PUBLISHED. THE VARIOUS ENERGY SECTORS ARE TO SOME EXTENT INTER-RELATED AND INTER-CHANGEABLE, SO THEY CANNOT BE PLANNED IN ISOLATION FROM EACH OTHER.

AN EXAMPLE OF THE PROBLEMS WHICH ARISE WITH THE PLANNING OF ONE SECTOR WITHOUT FULL CONSIDERATION OF THE OTHERS IS THE SITUATION WHICH HAS ARISEN WITH MAUI GAS. THIS LARGE OFFSHORE GAS FIELD WAS DEVELOPED ON THE ASSUMPTION THAT ELECTRICITY DEMAND WOULD FOLLOW A CERTAIN TREND AND THAT THERMAL POWERSTATIONS WOULD BE NEEDED AND WOULD BURN GAS. LARGE INVESTMENTS WERE MADE IN THE DEVELOPMENT OF THE GAS, AND WE NOW FIND THAT MUCH OF IT WON'T BE REQUIRED FOR POWER GENERATION AFTER ALL. THIS CONTINGENCY WAS NOT FULLY ANTICIPATED IN THE PLANNING. SIMILAR PROBLEMS HAVE ARISEN WITH THE ESTABLISHMENT OF NEW COAL MINES.

IT IS OUR INTENTION TO PRODUCE, PROBABLY NEXT YEAR, AN OVERALL ENERGY PLAN FOR NEW ZEALAND WHICH WILL SET OUT THE PROJECTED DEMANDS OF THE VARIOUS SECTORS (ELECTRICITY, GAS, COAL AND LIQUID FUELS) AND HOW THEY CAN BE DEVELOPED TO THE NATION'S ADVANTAGE. ALTHOUGH DETAILS OF THE PLAN ARE STILL BEING EVOLVED, SOME INTERESTING POSSIBILITIES HAVE ALREADY EMERGED. A LIKELY STRATEGY IS TO GIVE PREFERENCE TO THE CONSTRUCTION OF HYDRO-ELECTRIC STATIONS, AND SO RESERVE A MAJOR PROPORTION OF OUR GAS AND COAL FOR CONVERSION TO LIQUID FUELS, OR PETROCHEMICALS.

Market Shares of Energy Sectors

Immediate Measures

Apart from major strategies which may emerge from a long range energy plan, there are certain measures which are technically feasible and economically attractive right now, and can proceed as quickly as practicable. These include:

1. Greater use of electricity in transport. The recent decision to purchase new trolley buses for Wellington City rather than diesels of lower capital cost, is a case in point. Additional financial assistance from the Government helped to bring this about.

2. The direct use of compressed natural gas as a transport fuel is being satisfactorily developed by the Auckland and Wellington Gas Companies. Dual fuelled vehicles are appropriate for fleet operation where natural gas supply is available. Adaption of some Government vehicles is being undertaken. Some taxis have already converted, and a number of organisations are moving towards conversion.

3. Use of LPG has similar application and provides a somewhat greater range between refuelling stages. Grants and tax write-offs are now available for both LPG and CNG.

4. The recently approved expansion of the oil refinery at Marsden Point will enable a greater range of fractions to be produced from imported crude and save significant overseas funds.

5. A local supply of oil would have obvious advantages, and we can therefore expect continued efforts in the exploration of geologically promising areas.

The above measures are being actively encouraged, in one way or another, by the Government.

POTENTIAL MEASURES

THERE ARE OTHER MEASURES OF POTENTIAL BENEFIT WHICH ARE NOT SO EASILY IMPLEMENTED BECAUSE OF TECHNICAL OR ECONOMIC RESTRAINTS. THESE INCLUDE:

L. THE MAXIMUM USE OF CONDENSATE FROM THE MAUI GAS FIELD. THIS WOULD PROVIDE VERY SIGNIFICANT QUANTITIES OF INDIGENOUS LIQUID FUELS AND REDUCE OUR OVERSEAS IMPORTS.

THIS COULD BE ACHIEVED BY RAPID EXTRACTION OF THE GAS, AS THE QUANTITY OF CONDENSATE IS PROPORTIONAL TO THE AMOUNT OF GAS EXTRACTED. A SHORT-TERM ECONOMIC CASE CAN BE MADE FOR 'FLARING THE GAS' TO GET THE CONDENSATE, OR TO BURN IT IN THERMAL POWERSTATIONS RATHER THAN CONTINUE WITH CONSTRUCTION OF HYDRO-ELECTRIC POWERSTATIONS. LONGER TERM CONSIDERATIONS, HOWEVER, LEAD US TO THE CONCLUSION THAT A LARGE PROPORTION OF THE GAS WOULD BE BETTER KEPT IN RESERVE UNTIL OUR LIQUID FUEL PLANS ARE FINALISED.

2. THE MANUFACTURE OF METHANOL FROM NATURAL GAS IS TECHNICALLY FEASIBLE. POSSIBILITIES EXIST AS A PETROL EXTENDER, AND ALSO IN THE EXPORT MARKET. THIS OPTION IS CURRENTLY BEING CLOSELY EXAMINED BY THE LIQUID FUELS TRUST BOARD. THE ALTERNATIVE OF PRODUCING SYNTHETIC GASOLINE HAS A HIGHER CAPITAL COST BUT AVOIDS CONVERSION OF VEHICLES AND INVOLVES LOWER DISTRIBUTION COSTS, AND A PRODUCT COMPATIBLE WITH ORDINARY GASOLINE WOULD BE AVAILABLE. SOME TECHNICAL BREAKTHROUGHS IN THE IMPROVED MANUFACTURE OF SYNTHETIC GASOLINE ARE IMMINENT. IT SHOULD BE NOTED THAT THE GERMANS AND SOUTH AFRICANS HAVE BEEN PRODUCING SYNTHETIC OIL FROM COAL FOR MANY YEARS, SO THERE IS NO DOUBT ABOUT ITS TECHNICAL FEASIBILITY.

A SHORT TIME AGO THE MOBIL OIL COMPANY ANNOUNCED A NEW PROCESS BASED ON A ZEOLITE CATALYST WHICH CONVERTS METHANOL OR ETHANOL TO HIGH OCTANE GASOLINE. THIS SYTEM IS BEING CLOSELY STUDIED AT THE PRESENT TIME.

THE DILEMMA OF WHETHER TO GO FOR HYDROCARBONS (EG SYNTHETIC GASOLINE) OR ALCOHOLS (EG METHANOL) AS LIQUID FUELS IS CONFRONTING EXPERTS AROUND THE WORLD, AND OUR OWN SCIENTISTS AND ENGINEERS ARE CURRENTLY WORKING HARD ON THIS PROBLEM. EITHER ROUTE CAN FIT IN WITH THE LONG RANGE CONCEPT OF USING FIRST GAS, THEN COAL AND EVENTUALLY CROPS OR TREES FOR PRODUCING LIQUID FUELS, AND SO ACHIEVING A LARGE DEGREE OF SELF-SUFFICIENCY.

← Diagram (10)

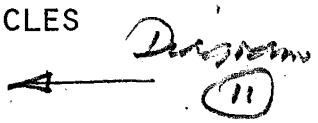
CONSERVATION

> "THE OBJECT OF CONSERVATION IS NOT TO DENY OURSELVES CONVENIENCES, PREFERENCES, NECESSITIES OR OTHER ASPECTS OF LIFESTYLES, BUT INSTEAD TO MAKE THESE ACTIVITIES MORE ECONOMICALLY EFFICIENT".

I HAVE MENTIONED SOME OF THE NEW DEVELOPMENTS WHICH WE MAY EXPECT TO SEE IN ENERGY. MOST OF THESE INVOLVE SIGNIFICANT CAPITAL INVESTMENT AND NOT ALL OF THEM CAN BE EXPECTED TO PRODUCE LARGE ECONOMIC RETURNS. SOME OF THEM ARE NEEDED RATHER FOR REASONS OF SECURITY OF SUPPLY.

CONSERVATION CURRENTLY PROVIDES THE BEST INVESTMENT. A RELATIVELY SMALL EXPENDITURE ON CONSERVATION CAN PRODUCE SPECTACULAR RESULTS. SOME FIRMS HAVE ALREADY REDUCED THEIR FUEL AND POWER BILLS SUBSTANTIALLY BY INSTALLING HEAT RECOVERY SYSTEMS AND COMBINED ENERGY INSTALLATIONS. WE CAN EXPECT TO SEE A STEADY INCREASE IN CO-GENERATION (COMBINED HEAT AND ELECTRICITY). IN SOME EUROPEAN COUNTRIES UP TO 15 PERCENT OF ELECTRICITY DEMAND IS GENERATED BY THESE METHODS.

IT IS WORTH NOTING THAT NEW ZEALAND'S PETROL CONSUMPTION HAS REMAINED PRACTICALLY CONSTANT SINCE THE OIL CRISIS IN 1973. PRIOR TO THAT CONSUMPTION HAD BEEN RISING 5 TO 6 PERCENT PER YEAR. THIS CHANGE HAS BEEN BROUGHT ABOUT BY TWO FACTORS: INCREASE IN PRICE OF PETROL AND A DRAMATIC SHIFT TO SMALL AND MORE EFFICIENT CARS. THE GRADUATED SALES TAX ON VEHICLES HAS STRONGLY INFLUENCED THIS TREND.



CONSIDERABLE POTENTIAL FOR CONSERVATION REMAINS IN SUCH AREAS AS BETTER DESIGN OF BUILDINGS AND IN THE TRANSPORT SECTOR. BECAUSE OF THE CRITICAL NATURE OF OIL SUPPLIES, THE MAIN THRUST OF OUR CONSERVATION PROGRAMME THIS YEAR WILL BE ON MORE EFFICIENT TRANSPORT. YOU WILL ALSO BE AWARE OF THE RECENT MEASURES RELATING TO RESTRAINTS ON THE DEMAND OF PETROL, AND OTHER OIL PRODUCTS.

New Technologies

We have a section in the Ministry of Energy which keeps abreast of new technologies, e.g. developments in wind and wave power, storage batteries, new engines and fuels, solar energy, biomass, and geothermal development.

Some interesting devices which give improved fuel economy in engines are emerging. The DSIR and Universities are conducting research on these.

The place of biomass, or energy farming, in the overall energy plan has yet to be decided. It seems clear that liquid fuels from natural gas is the most economic option and will preceed liquid fuel from coal or biomass on a commercial scale by a good many years. However, steps will need to be taken towards the conversion of coal and/or biomass into liquid fuels well before the gas runs out (approximately 30 years). The timing of biomass depends upon its economics in relation to coal conversion, and in relation to the markets for food and forest products.

In the meantime pilot plants for the production of alcohols from crops, woodwaste, and dairy factory whey are being actively considered.

Samples of coal are being sent overseas to test suitability for conversion into oil.

Pitfalls in Energy Planning

I mentioned previously some problems which had arisen in the forecasting of electricity consumption. We are now embarking on broader energy planning involving the other energy sectors. It is necessary to be aware of the dangers in long range forecasting and to recognise the confidence limits on such projections. Plans need to be flexible and robust enough to be capable to being adapted to unexpected changes.

IT MUST BE ADMITTED THAT THERE IS A LACK OF UNANIMITY REGARDING CRITERIA FOR THE ECONOMIC EVALUATION OF LONG RANGE OPTIONS. CURRENT METHODS INVOLVING PRESENT WORTH STUDIES AND DISCOUNTED CASH FLOWS CAN PRODUCE A WIDE VARIETY OF RANKINGS DEPENDING UPON THE ASSUMPTIONS MADE FOR DISCOUNT RATES, INFLATION AND SO FORTH.

PLANNING MUST ALWAYS BE RECOGNISED FOR WHAT IT IS, THAT IS, A FIRST STEP IN A SEQUENCE OF ACTIVITIES WHICH FINALLY END UP WITH SOME USEFUL ACHIEVEMENT. WE ARE FORTUNATE IN THE MINISTRY OF ENERGY IN HAVING TWO OPERATING DIVISIONS AS INTEGRAL PARTS OF THE ORGANISATION. OPERATING POWERSTATIONS AND EXTRACTING COAL FROM MINES ARE ACTIVITIES WHICH CONSTANTLY REMIND THE PLANNERS OF THE CONSEQUENCES OF THEIR PLANS. LIKEWISE, THE PRACTICAL PROBLEMS INVOLVED IN THE ESTABLISHMENT OF GAS FACILITIES ARE NOT TO BE TAKEN LIGHTLY.

THE FUTURE FOR ENGINEERS

DEVELOPMENTAL ACTIVITIES PROCEED ALONG A PATH OF RAPID (OR EXPONENTIAL) GROWTH IN THE EARLY STAGES FOLLOWED BY A FLATTENING OFF INTO AN "S" (OR SATURATION) CURVE.

SOME ACTIVITIES, LIKE RAILWAY AND MOTORWAY DESIGN AND CONSTRUCTION HAVE RELATIVELY SHORT DURATION, AND ENGINEERS INVOLVED IN THESE WORKS CAN SEE THE BEGINNING AND END WITHIN THE SPAN OF THEIR OWN CAREERS. IT IS QUITE POSSIBLE THEREFORE FOR ENGINEERS TO MOVE FROM ONE FIELD OF ACTIVITY INTO ANOTHER, AND IN MY EXPERIENCE IT IS NOT TOO DIFFICULT TO DO THIS BECAUSE THE BASIC DISCIPLINES HAVE GENERAL APPLICATION.

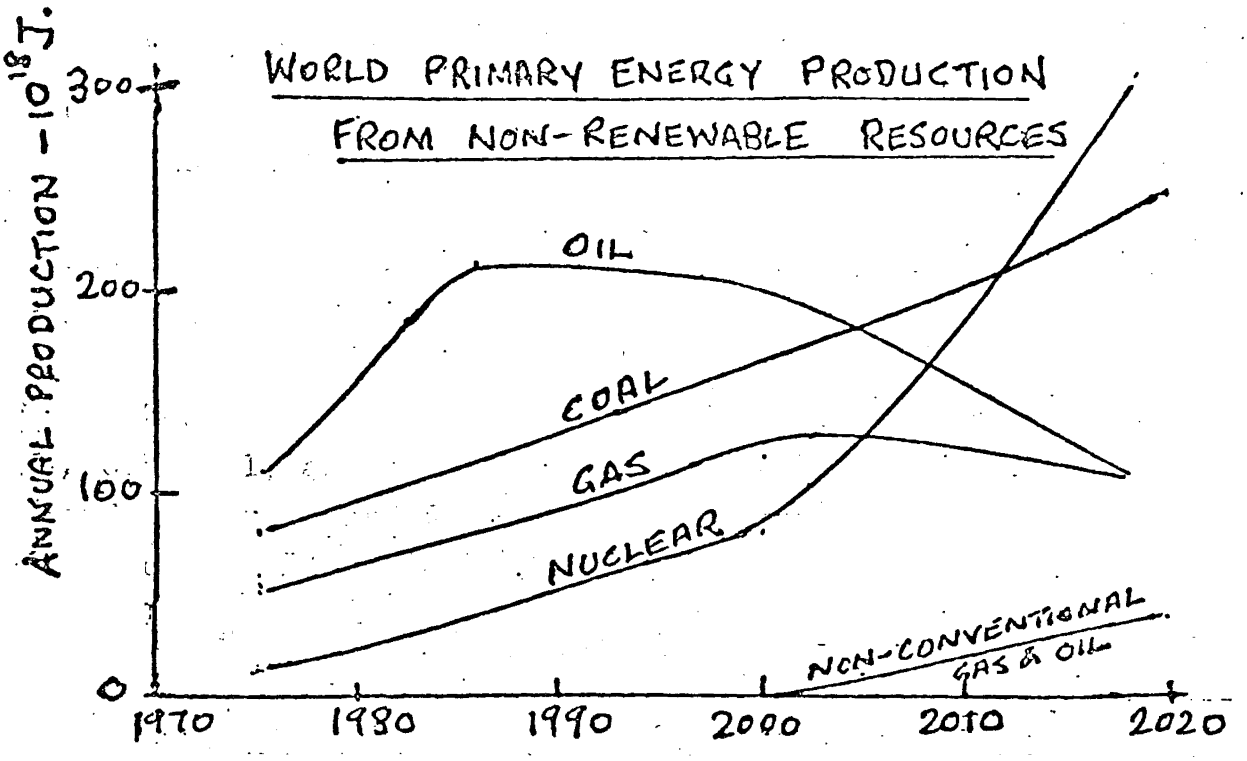
OTHER ACTIVITIES LIKE WATER SUPPLY, SOIL CONSERVATION AND BUILDING DESIGN AND CONSTRUCTION SEEM TO HAVE MUCH LONGER TIME SPANS OF DEVELOPMENT. ENGINEERS INVOLVED IN THESE FIELDS CAN FIND REWARDING CAREERS WITHOUT MOVING INTO OTHER AVENUES.

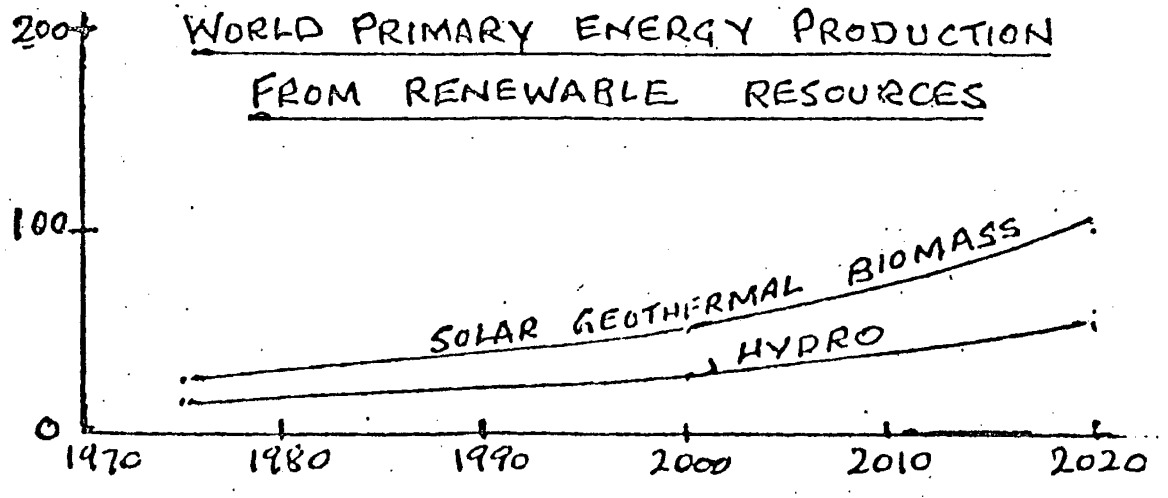
ENERGY IS A VERY BROAD FIELD AND ENCOMPASSES BOTH SHORT TERM AND LONG TERM ACTIVITIES. FOR EXAMPLE IT APPEARS THAT HYDRO ELECTRIC DESIGN AND CONSTRUCTION WILL CONTINUE PAST THE TURN OF THE CENTURY, WHEREAS FOSSIL FIRED THERMAL STATIONS HAVE EXPERIENCED A CONCENTRATED AND RELATIVELY BRIEF BURST.

DEVELOPMENT OF NATURAL GAS IS AT PRESENT IN THE EXPONENTIAL GROWTH PHASE, AND SHORTLY WE SHOULD SEE THE COMMENCEMENT OF A LIQUID FUELS PROGRAMME. SCOPE WILL EXIST IN THESE AREAS FOR ALL BRANCHES OF ENGINEERING, AND I AM QUITE SURE THAT TODAY'S GRADUATES WILL MEET THE NEW CHALLENGES WITH ENTHUSIASM AND DISTINCTION.

W.M. DUNCAN BE (HONS), FNZIE
SECRETARY OF ENERGY

LIST OF DIAGRAMS


WORLD PRIMARY ENERGY PRODUCTION
FROM NON-RENEWABLE RESOURCES
ANNUAL PRODUCTION - 10^{18} J.
300
200
100
0
OIL
COAL
GAS
NUCLEAR
NON-CONVENTIONAL GAS & OIL
1970
1980
1990
2000
2010
2020


WORLD PRIMARY ENERGY PRODUCTION
FROM RENEWABLE RESOURCES
200
100
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SOLAR GEOTHERMAL BIOMASS
HYDRO
1970
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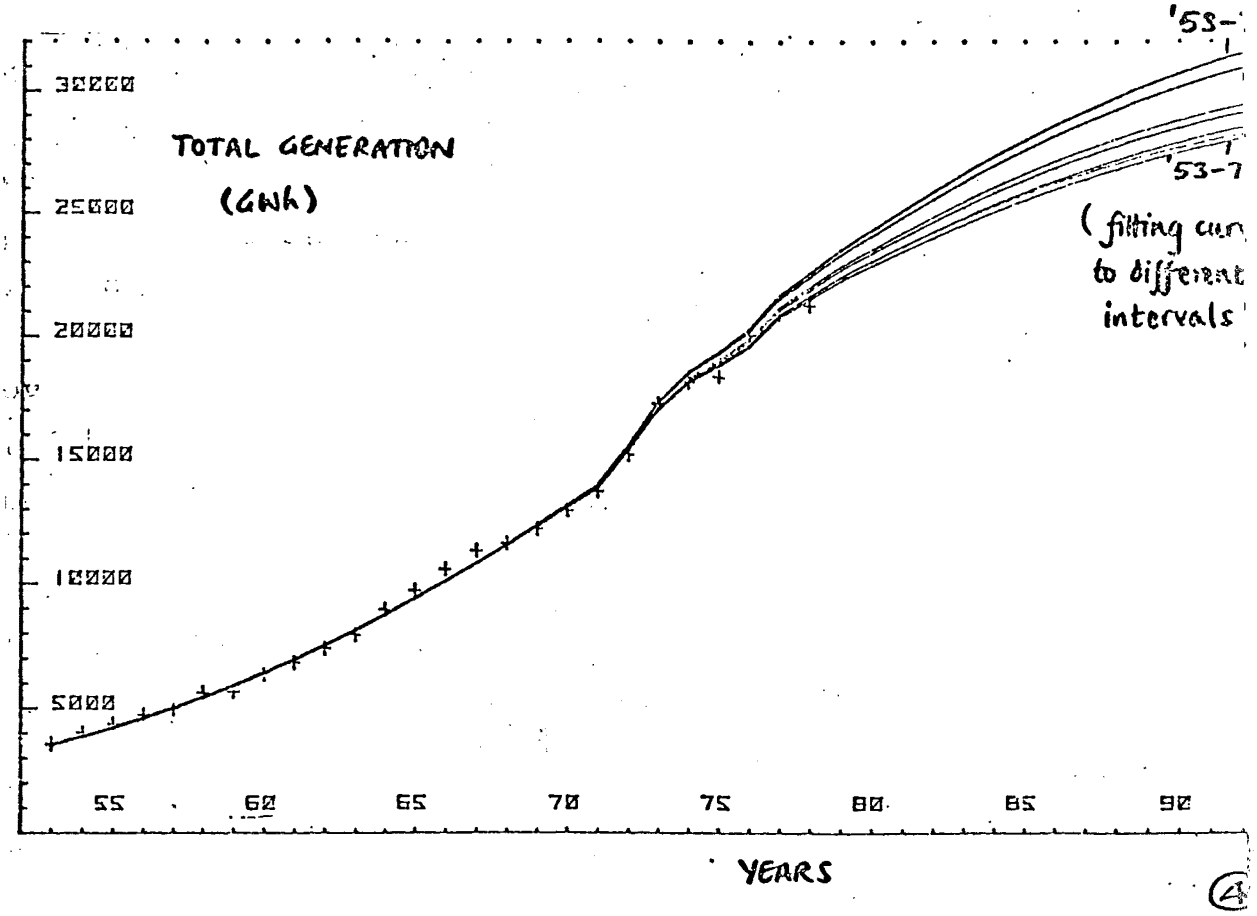
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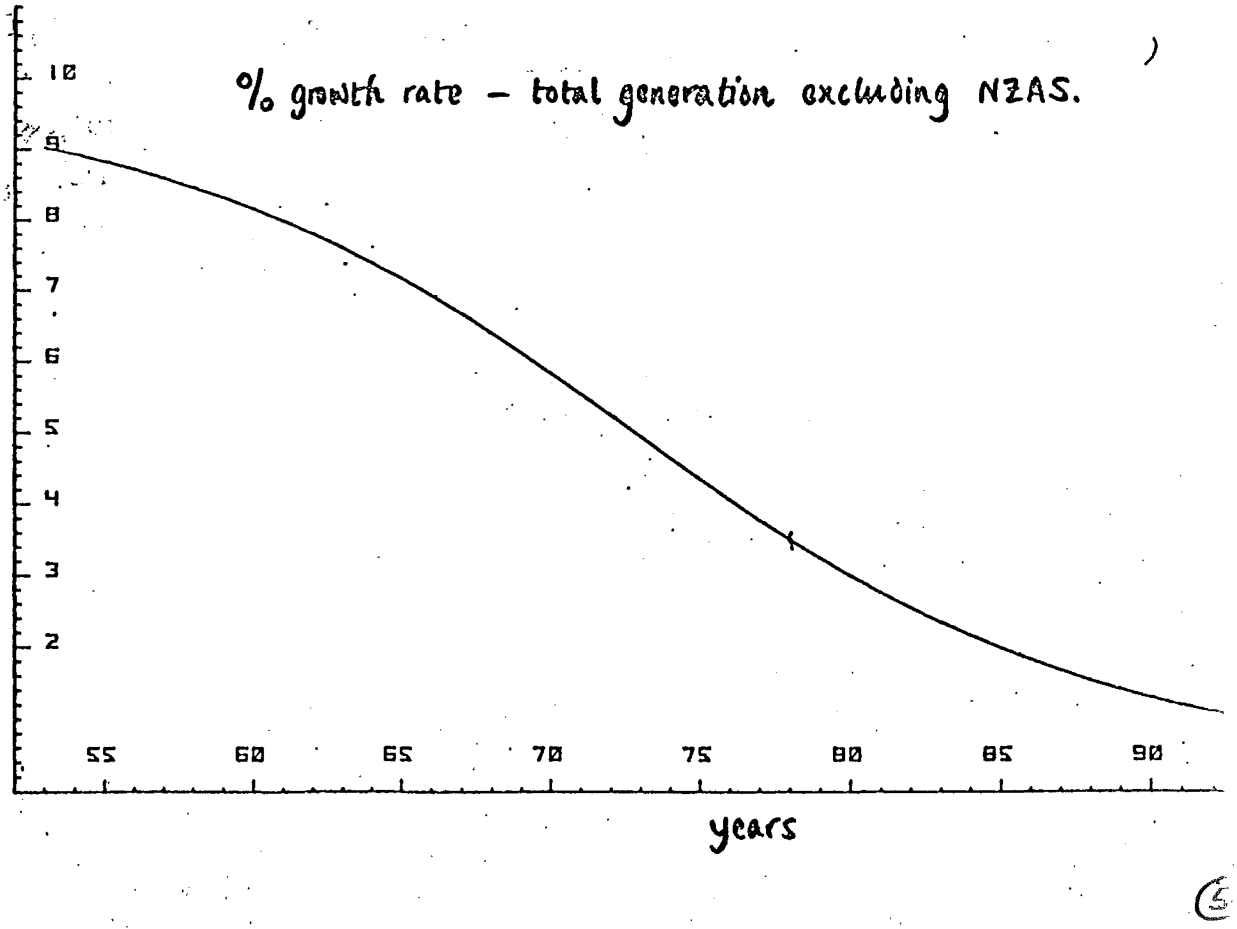
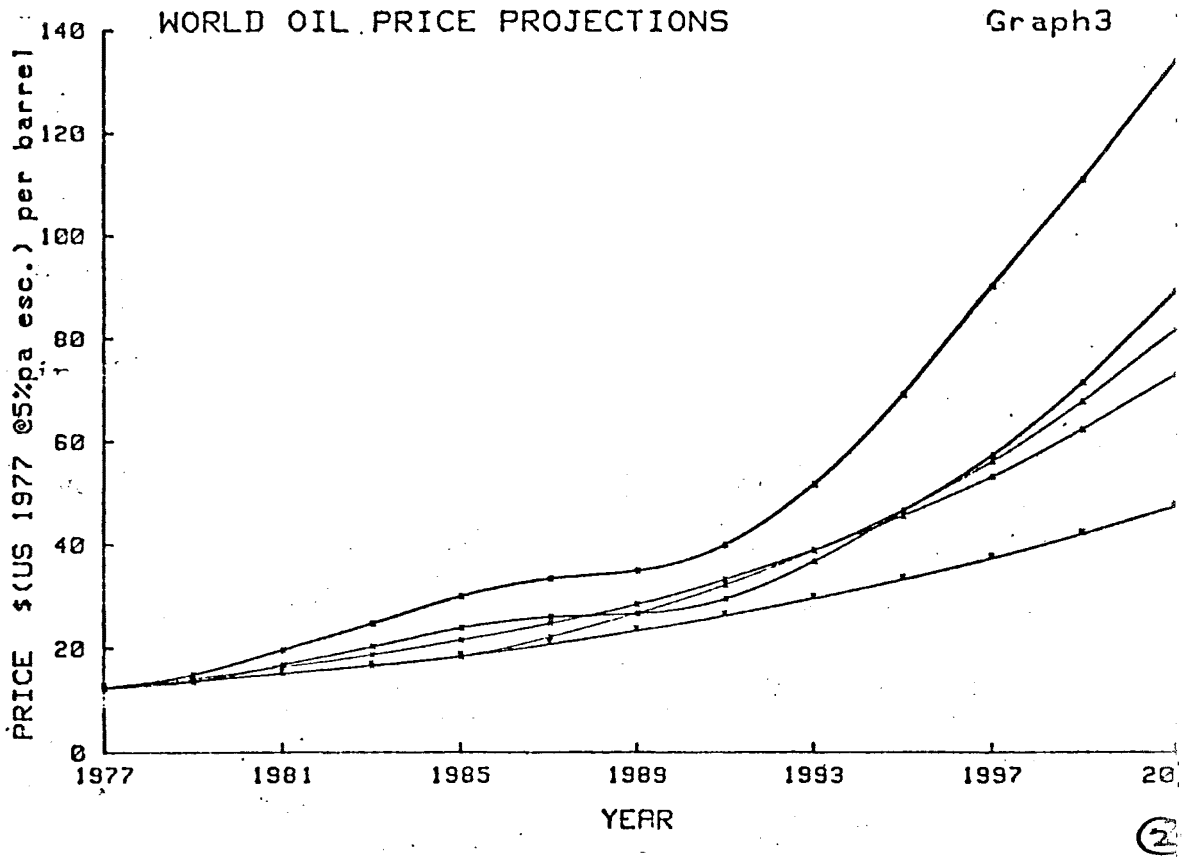
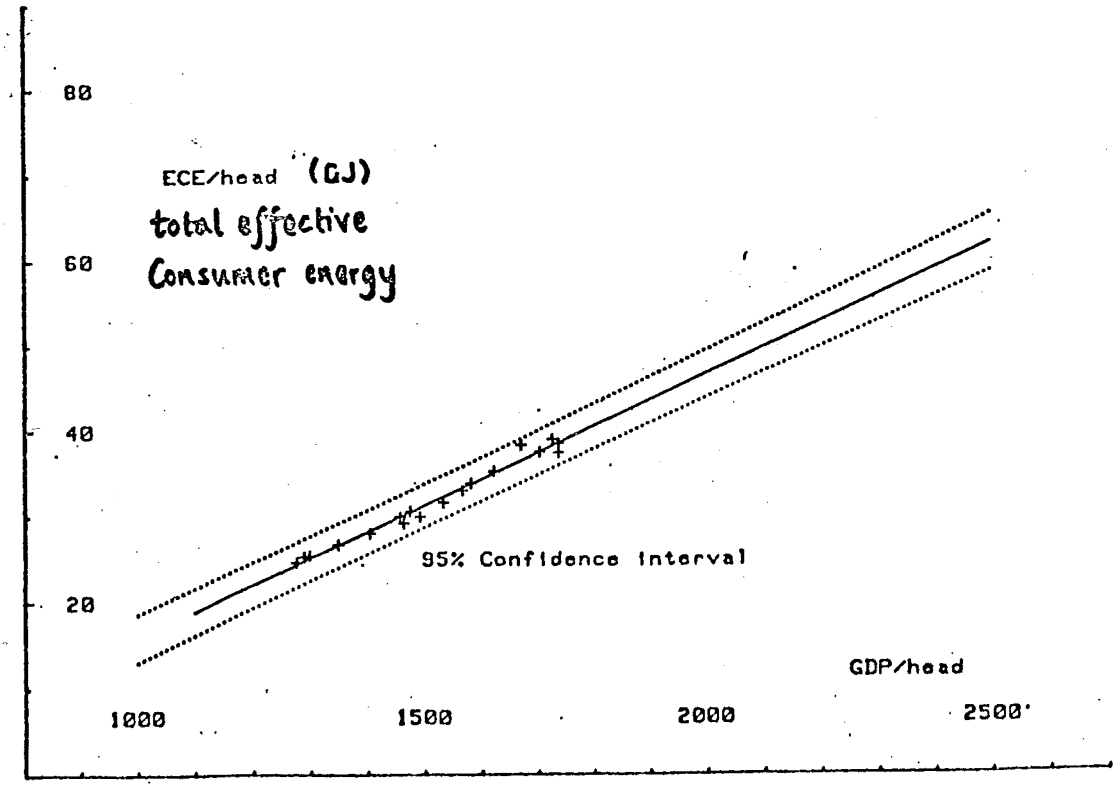
30000
TOTAL GENERATION
(GWh)
25000
'53-7
(fitting curv
to different
intervals
20000
15000
10000
5000
55
60
65
70
75
80
85
90
YEARS

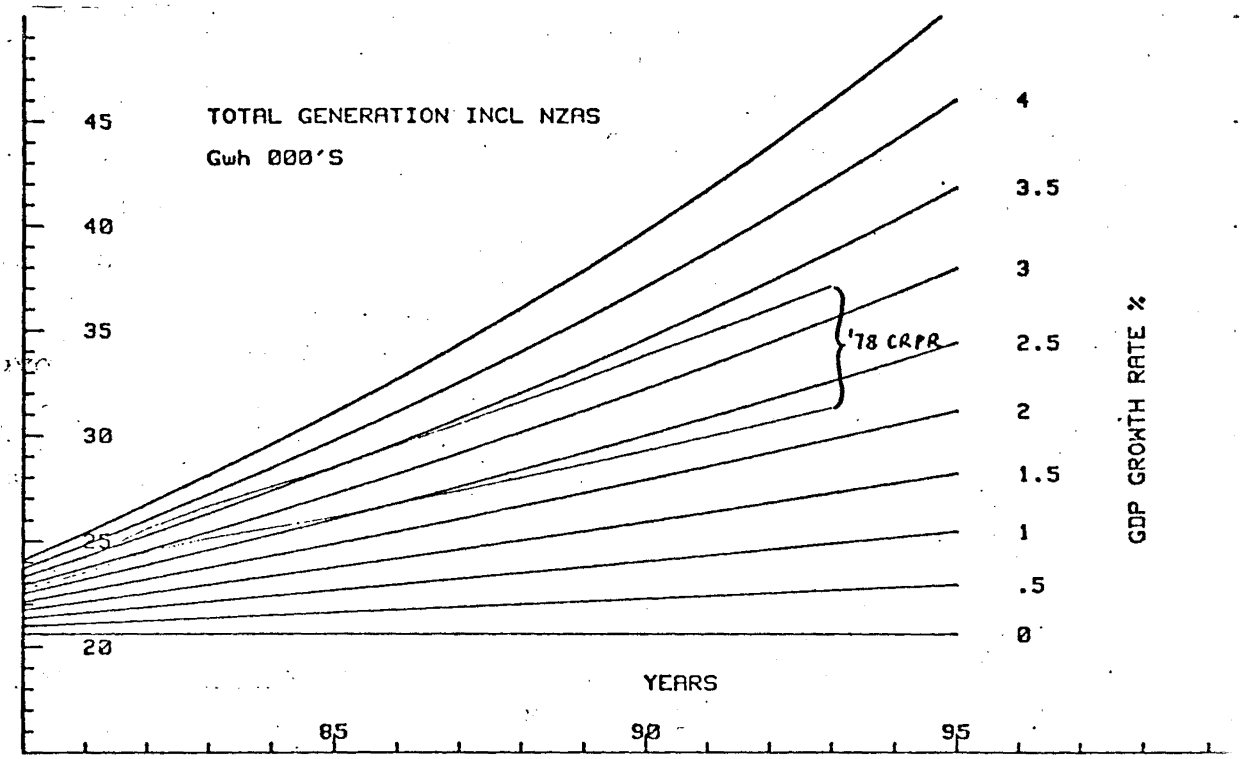
(4)


% growth rate – total generation excluding NZAS.
10
9
8
7
6
5
4
3
2
55
60
65
70
75
80
85
90
years

(5)

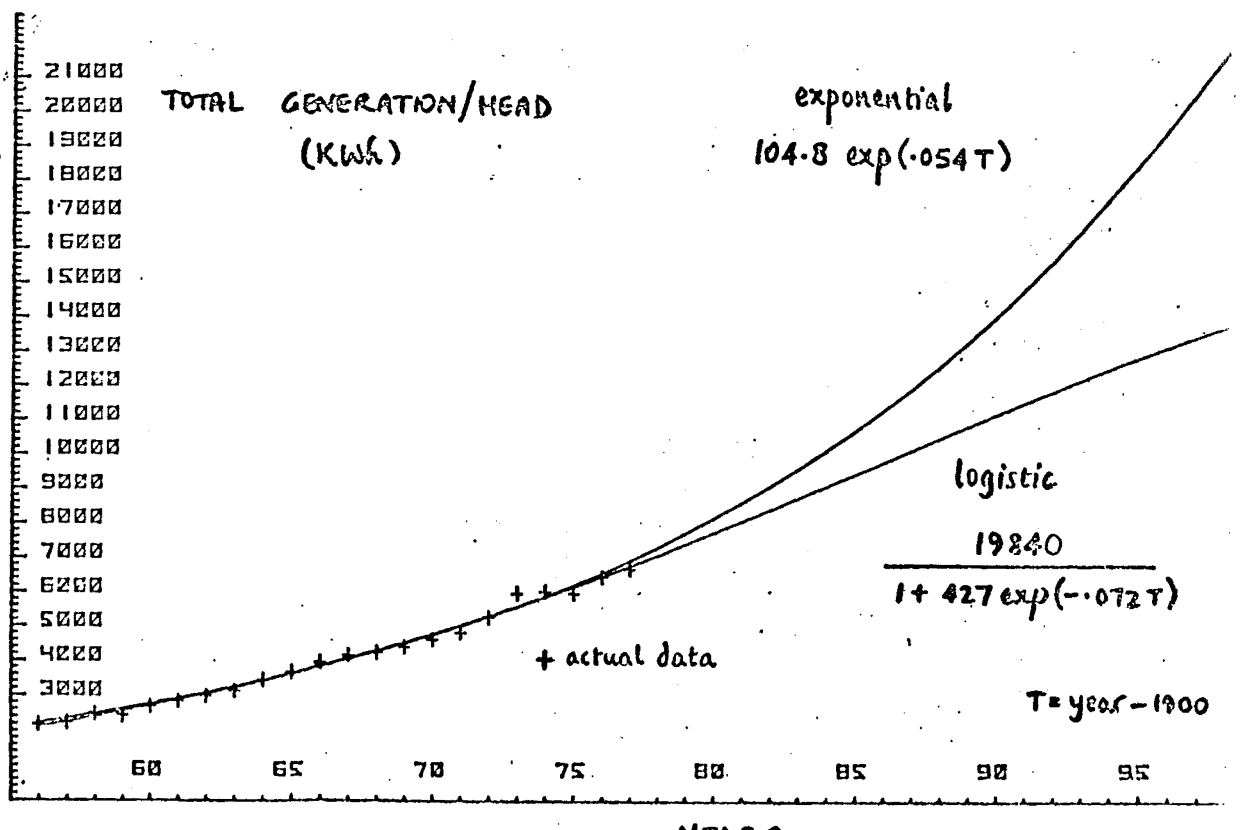

WORLD OIL PRICE PROJECTIONS
Graph3
PRICE $(US 1977 @5%pa esc.) per barrel
140
120
100
80
60
40
20
0
1977
1981
1985
1989
1993
1997
YEAR


80
60
40
20
ECE/head (GJ)
total effective
Consumer energy
95% Confidence Interval
GDP/head
1000
1500
2000
2500

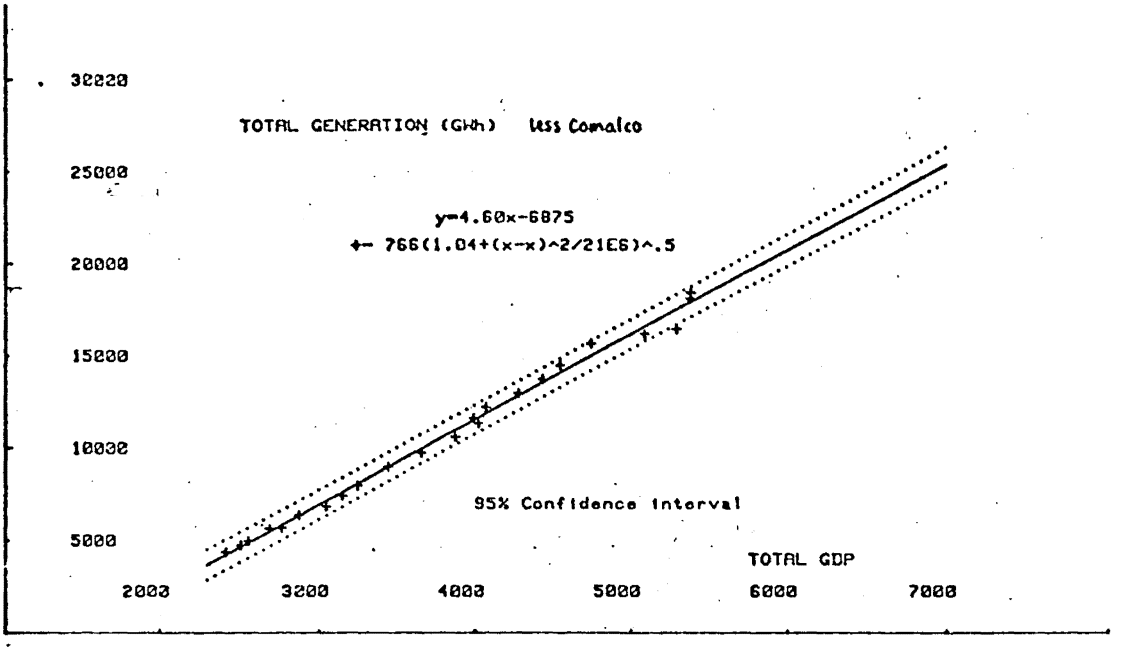


1977 GDP in '65/66 prices is datum.

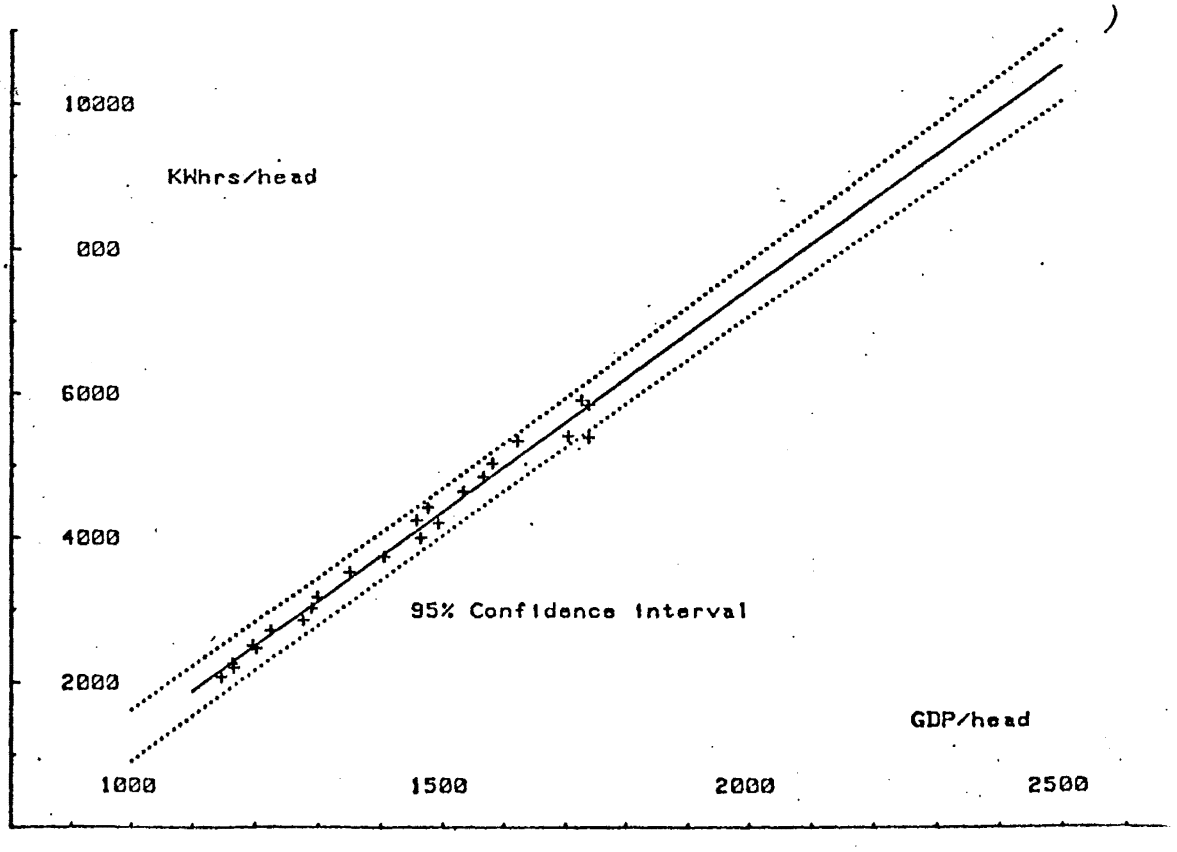
(4)



(3)

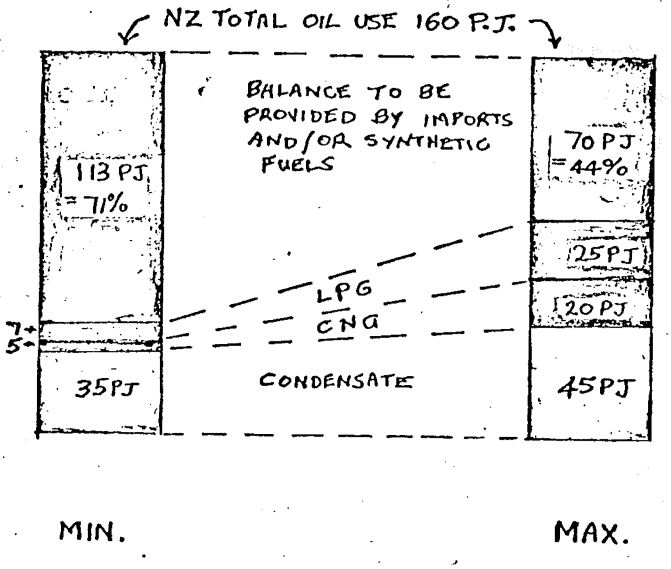

30000
TOTAL GENERATION (GWh) less Comalco
25000
y=4.60x-6875
+- 766(1.04+(x-x)^2/21E6)^.5
20000
15000
10000
95% Confidence Interval
5000
TOTAL GDP
2000
3000
4000
5000
6000
7000

6

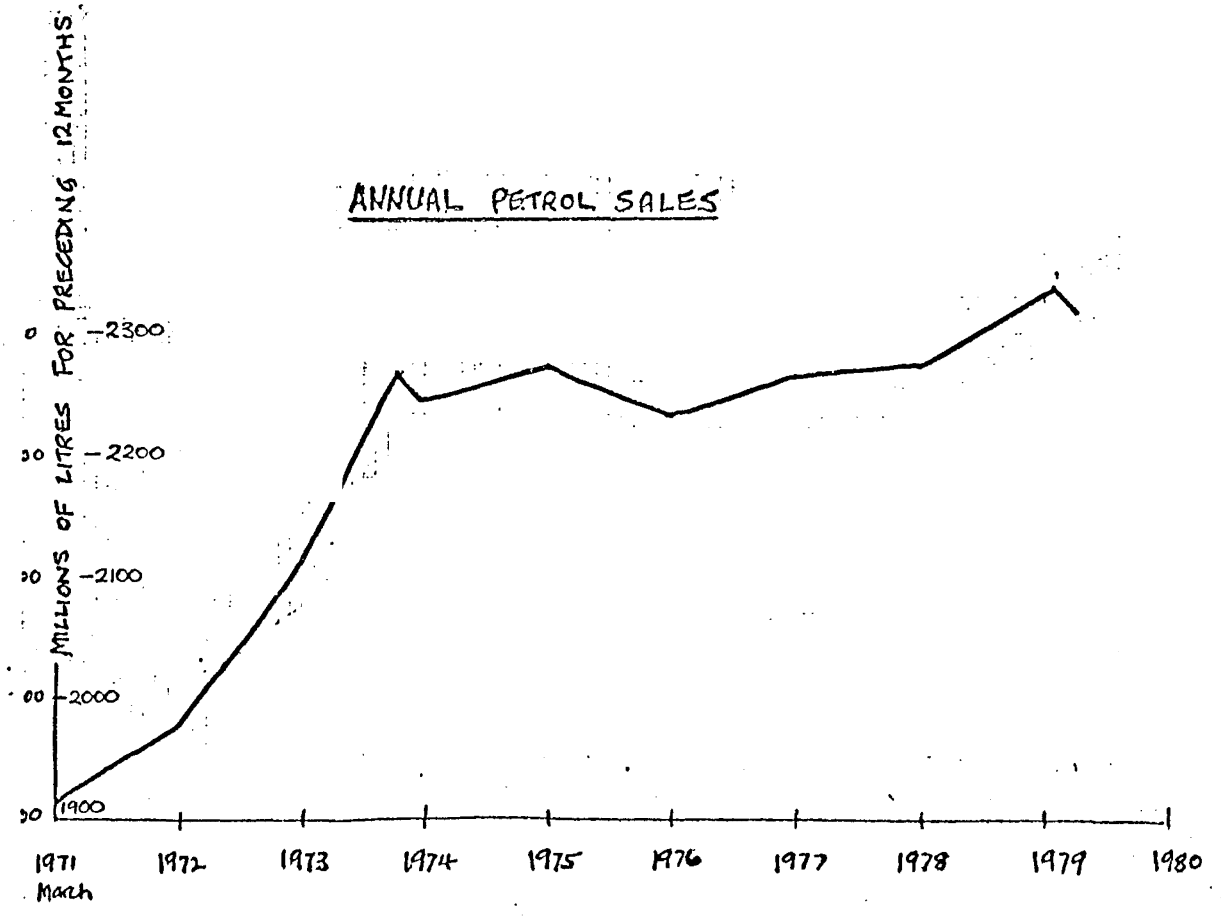

10000
KWhrs/head
000
6000
4000
95% Confidence Interval
2000
GDP/head
1000
1500
2000
2500

7

OIL USE V. INDIGENOUS LIQUID FUELS



ANNUAL PETROL SALES



SYNOPSIS

The present oil supply problem has again emphasised the warnings which arose in 1973 with the OPEC embargoes and price rises.

Progress on conservation and development of alternatives in the developed countries has been slow, and it now remains to be seen whether the latest problem in supply and demand will result in more positive measures.

Considerable scope exists overseas for the replacement of oil by gas and coal in industry, heating and power generation.

The pattern of oil use in New Zealand is somewhat different than that in many overseas countries. Electricity generation here is mainly from hydro. Our main oil use is in transport, and replacement of oil in this sector is a more difficult proposition.

Some of the measures being considered here have a high priority for our situation, but a lower priority overseas.

Energy planning in New Zealand has for the past 25 years been confined to electricity. An annual power plan has been presented to the Government each year, listing a programme of new work 10 to 15 years ahead.

It is now proposed to broaden energy planning to include the other sectors such as gas, coal and liquid fuels. A coal plan has recently been published. Next year it is proposed to publish plans for the other sectors and include these in an overall energy plan.

The Government has recently set up three new agencies for dealing with energy problems, the Ministry of Energy, Petrocorp, and the Liquid Fuels Trust Board. These agencies are currently devoting a large part of their attention to Maui gas and how best to use it in relation to the oil import problem.

Recent moves in the direction of greater self-sufficiency in transport fuels have been the introduction of compressed natural gas for motor vehicles, and the revival of electric trolley buses.

Urgent investigations are being made into a number of liquid fuel options such as methanol, synthetic gasoline and synthetic oil from gas. Studies are also being made of longer range options such as liquefaction of coal and production of alcohol from crops and wood.

New Zealand has substantial resources of coal, hydro power, geothermal, and natural gas. With good planning and development and proper regard for conservation we should be able to use these indigenous resources to offset the effects of the oil supply problem.