ENERGY RESOURCES OF PAKISTAN

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By

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Introduction :

The region of South Asia sub-continent in which the people of Pakistan are seeking to build a modern economy is by the standards of Europe and North America not exceptionally rich in natural resources of energy. In the past the people of Pakistan depended entirely on the traditional non conventional fuels viz. fire wood and cowdung for meeting their energy requirements. It is only in the past few decades that commercial fuels, coal, natural gas and electricity have all been developed. Recently the first steps have been taken for developing nuclear fuels and introducing nuclear energy.

In the context of energy development which is a reliable index of economic development the world could be divided into three broad groups :

(*i*) highly developed countries with per capita energy consumption of 4,000 kilo gram coal equivalent and above

(*ii*) developed countries with per capita consumption between 1,000-4,000 kilo gram coal equivalent ; and

(*iii*) developing countries with per capita energy consumption below 1,000 kilo gram coal equivalent.

Pakistan is in the third group with per capita energy consumption of 200 kilo gram coal equivalent. It is note-worthy that the countries in Asia which account for over 50 percent of the total world population consume only about two three percent of the world's *commercial* energy. This low figure, however, does not give a true picture of total energy consumption as the major sources in these countries are non commercial like fire-wood charcoal and cow-dung etc.

Before we embark on a discussion on the sources and quantum of commercial energy, it would not be out of place to dwell briefly on

the non-commercial sources which still find a wide application in Pakistan.

One such source is Animal energy. In Pakistan animal energy is still used in a large way for cultivation, for raising crop processing, small scale industries and for transportation of heavy weights. Obviously the efficiency is extremely low.

The second category of energy source consisting of wood charcoal and cowdung etc., are also less economical and inefficient because of their low energy content and energy lossess. In Pakistan the share of these non-commercial sources of energy in the mid sixties was estimated at about 63 percent of total energy consumption. There appears to be an interesting parallel between pattern of consumption of energy in USA hundred years ago as compared to Pakistan of to-day.

The non-commercial sources are highly un-economical and their gradual replacement by commercial forms need planning by an assessment of the total energy resources of the country and future requirements based on pre-determined magnitudes of development in all economic sectors.

Supply Pattern.

Pakistan's deficiency in the sources of energy supply has always been evident. This realization has generally found expression in emphasizing search for oil. In its search for oil, Pakistan was rewarded early by the discovery of sizeable deposits of natural gas, the discovery of which combined with sizeable exploitation of hydro-electric resources sustained in the initial stages of Pakistan's industrial development.

For economic growth energy in all its forms is the input and the economic well-being of the country could be measured directly in relation to the energy it consumes. The energy survey in hand will reveal the elasticity coefficient between growth in Gross Domestic Product and growth in commercial energy consumption. For the purpose of this paper the elasticity coefficient has been assumed to be in the range of 1.6 to 2.0 in order to assess the order of commercial energy required to sustain planned economic growth.

For the current year per capita consumption of all forms of commercial energy is estimated at 200 KG of coal equivalent. The pattern

of energy input consumption in the base year 1974-75 is estimated as follows :—

Source		Quantity	Heat Conent BTU	%
			Trillion	
Natural Gas (excluding its use as feed stock.	MMCF	123,835	117.5	30.6
Coal	Tons	1,600,000	30.5	8.0
Oil	Tons	3,588,000	160.8	42.0
Hydro-Electric	Gwh	5,500	66.0	17.2
Nuclear	Gwh	660	7.9	2.0
LPG	Tons	18,700	.9	.2
			383.6	100.00

Per Capita opnsumption 200 KG of coal equivalent

Petroleum industry furnishes and will continue to furnish a major part of our energy requirements. The share of oil and gas in meeting our energy requirements has increased from 70 percent in 1960 to 72.5 percent in 1973-74. This shows the increasingly important role which oil and gas have to play in meeting the energy requirement of the country in the years ahead.

The demand for oil and its products is increasing by 10 to 12 percent every year. The steep rise in oil prices after the Middle East War of October 1973 has caused a crisis of worldwide dimensions. The foreign exchange burden of petroleum importing countries like Pakistan suddenly increased many times. Pakistan's oil import bill has grown from $ 60 million in 1972-73 to $ 225 million in 1973-74. In 1974-75 it is expected to reach $ 387 million. It is estimated that by 1980 the import bill will reach $ 623 million at current prices in case no sizeable discovery is made of oil and gas reserves.

Presently gas is a major source of energy in Pakistan. Though at present we have sufficient gas reserves we are fast approaching the level of optimum utilisation of proven reserves. Other sources of energy such as coal, hydro-electricity and nuclear will have to be harnessed for their maximum utilisation but it is difficult to change to an appreciable extent the pattern of energy consumption in the foresee-

able future. As you will find out in our analysis of the energy supply pattern for 1980, the major dependence will be on oil and gas. The solution lies in quick development of indigenous oil and gas resources.

Existing Consumption Pattern :

Reliable data is not available on the existing energy consumption pattern but a rough and ready assessment of final uses is as follows :

	Percentage
Agriculture	11.0
Transport	24.0
Industry	52.0
Domestic and Commercial	13.0
	100.0

Agriculture :

The energy use is mainly for operating tubewells and tractors. The source of energy is 40 percent petroleum (direct) and 60% electricity.

Transport :

Sector consumed mainly petroleum products. Use of electricity and coal by railways was insignificant.

Industry :

Nearly 43% of the requirement was met by electricity and 41% by gas. The balance was met by oil. A small quantity of coal was also used.

Domestic and Commercial :

Nearly 55% of the energy used was in the form of the kerosene and the balance requirement was met by electricity (33%) gas (11%) and coal (1%).

At this stage it will be difficult to predict precisely the consumption targets of different competing sources of energy for the Fifth Plan unless a comprehensive energy survey brings out the requirements in all the sectors of the economy and a coherent and integrated energy policy in evolved taking into account all complexities and inter relation-

ship between the various sources involving such facets as the impact on balance of payments, economic growth and finally the quality of life the people of Pakistan aspire to achieve in the years to come. Such a policy would include both development as well as preservation of the existing sources of energy and experimentation with new sources of energy. Such a survey is being undertaken currently with the assistance of United Nations but the results of this survey are not likely to become available before 1976. Accordingly, for the present we will have to be contend with an assessment of presently known sources of energy, possibilities for development of energy resources and broad indications of consumption and a broad outline of an energy policy framework which will need to be reviewed after the results of the survey become available.

Sources of Energy :

Pakistan has four main sources of energy, viz, Coal, Oil, Natural Gas and Hydro-Electricity ; whereas recently Nuclear Power has made a modest beginning.

Coal Resources :

Several reports are available on the coal resources of West Pakistan. The earliest report was in 1949 by Powell Duffryn Technical Services Ltd., based on their surveys of Coal fields and examination of geological data available at the time. The estimates in 1949 were 165.5 million tons. In 1959 the same out-fit reviewed and confirmed their earlier estimates. In 1960, sizeable deposits of coal were found in Lakhra area in Dadu district estimated to be around 240 million ton. Latest estimates by the Geological Survey of Pakistan place the total recoverable coal reserves at 470 million ton. Assuming an average heating value of 8500 BTU per pound the total energy that could become available from this source is 8911 million million BTU or abut 10% more than rhe energy yield from the entire gas reserves at Sui. These can be broken up into 66 million measured, 100 million tons indicated and 304 million tons inferred.

The coal found in West Pakistan belongs to the Lignitic family. It is highly volatile and deteriorates rapidly on exposure to atmosphere. Many of these coals consequently deteriorate at storage and are liable to spontaenous cumbustion.

About 50% of Pakistan coal is located in the Lakhra area. This coal has the highest moisture content averaging 34% volatile matter ranging between 28 to 31%. The carbon content is only between 26.8 to 30%. The calorific value of this coal ranges between 7,010 to 7,600 BTU per lb. Its storage poses a serious problem because if stacked in depths of 4-5 feet it lends itself to sponstaneous cumbustion. The mining of this coal is restricted to a small area and its utilization for the purpose of power generation has been under the examination of Government for sometime. M/s Biura Projectow Guluivice of Poland studied the feasibility of utilizing coal for a 200 MW nine-mouth power station. According to this report production of 300 tons per day will be started initially to sustain the fuel requirments of the Power Station. The cost of production was estimated in 1966 to be Rs. 26 per ton and if sold to WAPDA at Rs. 35 per ton to allow for transportaticn costs plus profit, the Cost of energy generated at the 200 MW. Power Station would be 4.2 paisa per kwh. The report is being reviewed by WAPDA through a local consulting firm and it is now proposed to set up a 240 MW power station by 1974. In the content of the energy crisis this would certainly be the only meaningful use of this natural energy resource.

The next biggest deposit of coal in Pakistan is in the Salt Range. It has five to ten time less moisture content as compared to Lakhra coal but has a higher percentage of volatile matter and large variation in heating value which ranges between 7100 to 11,100 BTU per lb. The coal has been in use for sometime and the production from this coal field has steadily risen from an estimated 40,000 tons in 1948 to nearly 2.50 lac tons. The coal from salt range is extensively used for the manufacture of bricks.

The best coal deposits in Pakistan are found in Baluchistan in the Sor range—Deghari, Khost, Sharigh, Harnai and Mach. The calorific value of Baluchistan coal varies from 8,500 to 12,400 BTU per lb. and production has risen from a lac ton in 1948-49 to nearly 7.50 lac ton. Between 1957 and 1959 the Sharigh, Deghari, Khost and Sor range collieries were transferred to PIDC for Scientific development and considerable scope exists for expanding production capacity provided demand for this energy source justifies this development.

Production and Adequacy of Coal Reserve :

The production of coal in Pakistan increased from 246100 tons in 1948 to 1,920,000 tons by 1967 and thereafter declined and during the last few years has remained static at about 1.3 to 1.5 million tons. Since indigenous coal belongs to the lignite family, in order to meet requirements of hard coal/coke for railways, foundaries, engineering workshops it is imported, which over a 14 year period has averaged 44,430 tons per annum.

The major use of indigenous coal in Pakistan (as much as 80 to 90 percent) is in brick making. The production of bricks is increasing steadily every year and it is estimated that this would call for an increase of about approximately 0.5 million tons of coal during the next five years.

In the transport sector strictly speaking there is hardly any indigenous coal which meets the full specifications of the railways. Moreover, on account of much higher efficiencies of diesel and electric traction, the reduced cost per ton mile/passenger mile the steam locomotives some of which still use coal have been gradually withdrawn and at present 82% of the duty was performed by diesel locomotives. The amount of money spent on coal during the year 1972 was only Rs. 40 lacs as compared to Rs. 891 lacs on high speed diesel oil and Rs. 594 lacs on furnace oil. In view of the above the prospects of coal for railway traction in the years to come appears bleak and is likely to further reduce from the present level.

Consumption of coal for electric power generation is widely used all over the world. In 1955, 98,000 tons of coal were consumed every year for power generation in West Pakistan. With the advent of natural gas the consumption of coal in this sector started declining and all new power stations constructed were designed to burn gas and even those stations which burnt coal were either closed down or switched over to oil natural gas. There are good prospects of utilising Lakhra coal for power generation which if it materialises will consume about 9 lakh tons of coal a year to sustain a 240 MW. nine mouth power station. By 1964-65 power industry requirements which had declined to about 65,000 to feed only one power station of 15 MW at Quetta is likely to go up to 9.6 lakh ton by 1979.

In the production of fertilizer only Daudkhel Fertilizer Factory uses Makerwal coal. Lurgi process of pressure gassication with steam and oxygen has besn working at Daudkhel which produces a million tons of amonium sulphate per year. In Cement Industry, before the advent of natural gas coal was used as a fuel. The Daudkhel Cement Factory which was the last one to use coal also fell victim to natural gas last. years. In the context of the fast depleting gas resources it is high time, that we start thinking of switching back to coal from Natural gas wherever it is feasible say at Daudkhel and consider its use as fuel for the new Cement Plants which are being proposed to be set up in the vicinity of coal fields like Kohat and Spintangi.

The consumption of coal for domestic use is small of the order of 14 to 15 thousand tons per annum which constitute about 1% of the present total coal production in the country. From the above analysis it will be observed that demand which Is stagnating at about 1.5 million tons has good prospects of increasing to more than 3 million per annum in the next fourth five years plan.

Oil Resources :

The total oil production in the country is only about .35 million tons per annum from indigenous sources which meets roughly 9.75 of total demand which is estimated at 3.588 million tons for 1974-75. According to a recent study Pakistan is not short of sedimentary basins and has certain structures which are likely to have trapped oil but the rate of exploratory drilling has not been adequate. The Indus Basin covers about 166,000 square miles and potentialiy oil bearing sediments are estimated at about 282,000 cubic miles. So far only one well has been drilled in every 2400 sq. mile as against 6 sq. mile in USA.

The prognosticated reserves of the on-shore prospective sedimentary areas are estimated at 53,000 million barrels and a very small amount of oil has so far been found. Besides Indus Basin other large sedimentary areas have not even been probed so far such as Baluchistan and the coastal areas of Makran and Sind.

Production and Adequacy of Oil Resources

Oil plays a vital role in meeting the energy requirements of Pakistan. In 1975 as much as 43 percent of the total energy requirements were met by petroleum products. During the period 1960-70 the demand

for petroleum products increased from 1.7 million tons per year to nearly 3 million tons per year showing an average growth rate of 6.5 percent per annum. For 1975, the oil consumption estimates are placed at 3.588 million tons which has been estimated to increase to nearly 5.799 million tons by 1980 which amounts to an average increase of 7.5 percent per annum. The existing consumption pattern of petroleum products is given as under :

(1) Defence		6.5%
(2) Transport :		
(*a*) Rail	14.3%	
(*b*) Road	30.1%	
(*c*) Bunkers	5.3%	
(*d*) Aviation	9.0%	58.7%
(3) Power		3.4%
(4) Industry		10.1%
(5) Domestic (Kero only)		12.2%
(6) Miscellaneous (Agriculture)		9.1%
Total :		100.0%

At present the position is that two refineries located at Karachi and the third at Morgah near Rawalpindi, currently processes some 3.5 million tons of oil products a year. Of the total petroleum products processed about half million ton of oil products mostly Naptha and furnace oil surplus to local requirements are exported. As against this more than one million tons of oil products mostly middle distilates are imported to meet the country's requirements.

To meet the rising requirements of petroleum products the expansion of National Refinery capacity from existing 0.55 million tons to 2 million tons per annum is in hand besides the introduction of a visbreaker unit at Pakistan Refinery to increase the production of middle distilates which are in short supply. With 1 : 3 equity participation from Abu Dhabi 2 million tons refinery at Multan alongwith a crude oil pipeline from Karachi to Multan, is likely to be completed in the Public Sector by 1978.

The setting up of a new up-country refinery based on imported crude oil and expansion of NRL will no dobut meet the petroleum requirement of the country but at the same time will impose a heavy burden on country's foreign exchange resources. At present the import bill of oil which is 387 crore per annum is likely to go up to Rs. 623 crore by 1980. Let me again emphasise that the solution to Pakistan oil problems lie in intensive search for oil. If an exploration programme in the public sector can be mounted to drill at least 10 wells every year for the next five years it would entail an average expenditure at current prices of Rs. 30 crore with foreign exchange component of Rs. 16 crore per year which is only 4% of our present fuel bill. We can even consider drilling 100 wells every year in the public sector but are contrained to make that suggestion in the contract of the extreme poor performance of OGDC in the past fourteen years in which they have only 16 exploratory wells to their credit.

Gas Resources :

After extensive exploration effort over the past 25 years, Pakistan succeeded in discovering gas fields at 9 different places. The gas fields are at Sui, Zin, Uch in Baluchistan, Mari, Kandhkot, Khairpur, Mazarani, Sari and Hundi in Sind. The total recoverable reserve gas in all 9 fields are estimated to be 16.891 million million cubic feet. Gas is also produced alongwith oil from Dhulian and could also be produced from Meyal and Tut oil fields in Punjab. The associated gas reserves of these fields, however, has so far not been evaluated. In any case these are not expected to be appreciable to make any effect on the total estimated gas reserves.

The three gas fields at Uch, Zin and Khairpur have a total reserve of 3.6 million million cubic feet (0.980 million million cubic feet in terms of Sui quality gas) are not economically exploitable due to their remote location or on account of their low quality. The other small fields namely Sari, Hundi, Kandkot and Mazarani having a recoverable reserve of 0.579 million million cubic feet could however be developed either for supplying to industries located near gas fields or to supplement Sui gas supplies. The Mari and Kandhkot gases which contain sufficient percentage of inert gases and have relatively low calorific value are suitable for the manufacture of fertilizer.

As a result of this analysis, it will be observed that only 6 out of 9 gas fields so far discovered, could be economically exploited in addition to the associated gas available from Dhulian oil fields.

Name of the Gas	Field recoverable reserve	Heat Value BTU/CFT	Reserve in terms of Sui quality gas
Sui	8.620	933	8.620
Mari	3.942	723	2.990
Kandhkot	0.410	842	0.370
Mazarani	0.090	976	0.094
Sari	0.029	856	0.027
Hundi	0.050	830	0.040
Dhulian	0.150	1100	0.176
	13.291		12.317

Accordingly, in assessing the production requirements and adequacy of reserve, we will confine ourselves to the above figures of recoverable reserves *i.e.*, 12.317 million million cubic feet in terms of Sui quality gas from the known economically exploitable gas fields.

The largest gas field in Pakistan was discovered at Sui in 1952 and production from this field commenced in 1955. Revised estimates made in 1970 placed the original recoverable gas reserve (raw) at 8.62 million million cubic feet. So far 17 wells have been drilled at the site and a total 879,060 mllion cubic feet of gas has been produced till the end of 1972 which constitutes 10% of the total gas reserves at Sui.

The second largest gas field was discovered at Mari in 1957. According to the latest estimates the original recoverable gas reserve are of 3.942 million million cubic feet. The production from this gas field started in 1967 and by the end of 1972 only 42,000 million cubic feet has been produced and used as feedstock for a fertilizer factory.

Production and Adequacy of Reserve :

As mentioned earlier only Sui and the Mari Gas fields are in production besides associated gas from the Attock Oil field at Dhulian.

The share of natural gas in overall energy consumption is 31 percent. The general pattern of utilization is as under :—

1.	Power	35 percent
2.	Fertilizer	21.5 percent
3.	Cement	15.2 percent
4.	General Industry	24.2 percent
5.	Commercial and Domestic	4.1 percent

The utilization of natural gas from Sui field is fast approaching its optimum level. The programmes in hand will increase the average day consumption of Sui gas from nearly 400 MMCFD to nearly 750 MMCFD by 1979-80. The Sui Northern Gas Pipeline development project No. 4 is likely to be the ultimate project for enhancing gas supply to the northern region based on known reserves and similar will be the position in respect of Indus Right Bank Pipeline project of Sui Gas Transmission Company for the southern region. This coupled with the committed off-take of 140 MMCFD for the Guddu Power Station brings the off takes from Sui fields to its optimum level. At this rate of consumption the Sui-field will last only upto 1995-1997.

The situation brings out not only the need to open up the dorment gas fields which have yet to be tapped but also to intensify the search for additional oil and gas resources in the country. The Pakistan Petroleum Ltd., will have to undertake a development programme which would, cover not only the drilling of additional development wells but also introduction of compression in the Sui field to meet the requirement of the two gas transmission companies and the Guddu thermal power station.

From the gas field at Mari which started production in 1967 cumulative withdrawal till the end of 1972 was only 42,000 million cubic feet which was used as feed-stock for the production of fertilizer as against the field's recoverable gas reserve of 3.942 million million cubic feet. It is estimated that ESSO's plant upto 1990 will consume 1,83,960 million cubic feet gas. Besides, there is a proposal for setting up two additional fertilizer plants which will over their life time are expected to consume 5,89,600 million cubic feet, each. Thus by 1990 the cumulative withdrawal of Mari Gas for the purpose of fertilizer production for which it is ideally suited would be 1.381 million million cubic feet.

leaving a balance of 2.561 million million cubic feet of recoverable gas. What we will do with this gas is yet to be determined. My conjucture is that it may be employed for the manufacture of industrial grade methanol for export. Incidentally this proposal envisages the manufacture of 2,000 tons of methanol per day which would require approximately 111 million cubic feet per day and would cumulatively consume half of the balanced recoverable gas over a period of 30 years.

The best possible use of the other four small fields namely Sari, Hundi, Kandhkot and Mazarani having a recoverable reserve of 0.579 million million cubic ft. is to supplement Sui gas supplies as they are located near the main transmission pipeline system. In this context the Sari and Hundi fields will be exploited by August, 1974 for a periad of 10 years in the first phase of the Sui Karachi Indus Right Bank Pipeline Project.

In the light of the above you might have already gained that Pakistan's only known sizeable source of thermal-energy namely natural gas is such that the country is obliged to adopt gas conservation policy unless new commercially exploitable gas reserve are discovered soon.

Liquid Gas

At present some 25,5000 tons of LPG are produced annually. Petroleum experts indicate that production can increase to over 100,000 tons with the expansion of refining capacity in the country and with adjustments in the refineries mix. The present production and allocation for local marketing and export of LPG is as follows :

(1) 8000 tons ex-PRL (Karachi)	5000 tons to Burshane for local market.
	3000 tons to 16c for air mix projects at Larkana & Quetta.
(2) 16800 tons ex A.O.C (Dhulian)	14000 tons to Fauji Foundation for local marketing. 2800 to Burshane of which 1000 tons is meant for export.

Hydro Electric Resources

The Indus system of rivers comprising the main Indus and its western tributeries Kabul and Kurram and eastern tributory Jhelum provide the main hydro electric potential in their upper reaches. The

rivers of the basin, however, are subject to extreme variations of flow, the maximum discharge being about 100 times the winter minimum. Various estimates have been made of Pakistans hydro electric potential WAPDA estimates the potential to be of the order of 25 million KW. The bulk of the hydro potential is confined to the inaccessible highly regions of the north-west of the country. On account of this the Planning Commission in the Second Five Year Plan estimated the total hydro potential of the country to be f the order of 10 million MW only. Out of this 667 MW have already been exploited, 200 additional MW, are near completion at Mangla, and 2,100 MW additional would become available on completion of Tarbela bringing the total hydro electric potential exploited by 1984/85 to about 3 million KW, located in the northern part of the country.

With the development of Tarbela power upto 8 units of 175 MW each by 1980, the annual energy generation is expected to reach 12000, million KWh. The annual generation from hydro electric source after the full development of Tarbela (12 units of 175 MW each) by 1982-83 is likely to reach 15,000 million KWh. There would be scope for further expansion in the hydro-electric field and Pakistan's energy requirement to the extent of 45,000 million KWh could be met from this source.

Nuclear Power

Nuclear Power Station at Karachi is expected to generate 760 million kwh of energy in 1975. The capability of this station at 90 percent L.F. is 1,000 million kwh. The Atomic Energy Commission is planning to add another 500/600 mw nuclear station in the northern region by 1981/82. This would raise the total energy from nuclear source to about 4,000 million kwhs by 1982.

The favourable aspect of nuclear power is its lower dependence on continuous supply of fuel. On the other hand, problems arise because of large initial investment required, economies of scale which require large-sized units and the disposal of nuclear waste. But this is an area which would receive increasing attention in the industrialized countries as it reduces dependence on fuel supply. Technological developments may reduce initinl cost and would considerably improve the economies of nuclear power farther. These would have to be watched carefully.

Tentative Policy Framework

1. Coal

(*i*) A comprehensive review of the coal industry be undertaken with a view to critically examine various cost components-particularly aimed at increasing productivity and reducing transport costs. It is believed that in the face of recent rupee devaluation and increased oil process, the techno-economic prospects of utilizing Pakistan's coal reserves merit a complete re-appraisal of the industry.

(*ii*) Efforts should be made to utilise indigenous coal both for power generation as well as fuel for future industrial projects.

(*iii*) There are good prospects of utilising Lakhra coal based on H.R. Milner process for power generation. The Fifth Plan aims at utilising 9 lakh tons for a 240 m.w. power station based on this coal.

(*iv*) The Fifth Plan cement projects in the north at Kohat and Spintangi should be based on indigenous coal. Annual consumption by the two cement factories is estimated at 3.0 lakh tons.

(*v*) P.I.D.C. should examine the relative cost economies of switching back to coal from natural gas to meet the fuel requirements of the industrial complex at Daudkhel.

(*vi*) Based on Sharigh coal deposits a coal distillation plant of medium to large size may be set up near Sibi for the production of coking coal, coal tar and coal gas.

(*vii*) The consumption of coal should be increased from existing 1.5 million tons to 3.3 million tons over the next five years in the first stage. Bulk of the increase (1.2 million tons) should come about from public sector and balance (0.6 million) from private sector.

(*viii*) The programme for the development of coal industry is covered in the chapter relating to minerals.

2. Oil

(*i*) Solution of oil shortage lies in intensive search for oil.

(*ii*) OGDC should strengthen its drilling side. They have carried out surveys of large areas. However, actual drilling of wells has been of relatively small magnitude. OGDC should aim at drilling 427,000 feet and at least 50 exploratory wells during the Fifth Plan.

(*iii*) Stripper wells must be utilized notwithstanding their small output.

(*iv*) Indigenous production of crude oil is about 10,500 barrels/day as against the existing country's requirements of 70,000 barrels/day. Indigenous proven reserves of the Toot oil field have been estimated by OGDC to be of the order of 55 million barrels. Systematic reservoir engineering studies which have not been undertaken todate may prove the present estimates to be highly conservative. Based on the existing estimates, OGDC should drill six more development wells in Toot oil field to gradually increase its production to 10,000 barrels/day mid Fifth Plan which could enhance total oil production to about 20,000 barrels/day. This will affect savings of about $ 50 million a year. At the enhanced rate of exploitation Toot oil field reserves at the conservative level will last for 12 years. Requisite refining capacity could be made available firstly at AOC and then at Multan.

(*v*) The transport bottlenecks in the movement of petroleum products should be minimised by

(*a*) Construction of oil pipeline between Karachi and Multan expeditiously.

(*b*) Creation of petroleum storage facilities.

(*c*) Strengthening of the rail-road transport capacity.

(*vi*) Petroleum concession rules and regulations form an important link in the overall oil exploration effort of the country. They should be kept under continuous review to give incentives to major foreign propective companies on the one

hand at the same time protecting the interests of the local companies. The possibility of incorporating clauses relating to production sharing as well as strict enforcement of exploring and drilling obligations should also be examined.

(*vii*) Measures to improve the mix by introducing catalytic processing at the existing refineries should continue and the new refinery at Multan should also incorporate vis-breaker plant. Efforts to tailor the demand pattern to suit production pattern be also made.

(*viii*) Surplus petroleum products, Naptha and furnace oil from coastal refineries should continue to be exported to take advantage of the prevailing premium international prices of these two products.

(*ix*) Recovery of LPG should be given emphasis and plant and equipment required for this purpose should be installed at the earliest.

(*x*) Petroleum storage development corporation should chalk out a comprehensive plan of developing storage capacity at important places in the country to ensure that there will be no shortage of petroleum products in various regions due to transportation bottlenecks and in the events of emergency.

(*xi*) On schedule completion of the Pak-Arab refinery at Multan and the crude oil pipeline between Karachi and Multan.

3. Gas.

(*i*) The utilisation of natural gas from Sui Field will approach its optimum level during the Fifth Plan, with the completion of SNGP project 4 in the North ; the Indus Right Bank Project of SGTC, and the completion of second stage of Guddu thermal power station. Accordingly in the immediate future the use of natural gas should be encouraged only as feed-stock in industry and its indiscriminated use for future power generation projects, new cement plants etc. should be discouraged.

(*ii*) Furnance Oil be given priority over use of Gas in Power Generation. Plans should be made to make maximum use of the furnace oil of Pak-Arab Refinery within the country and fresh commitment for gas for power generation purposes be made only when extremely necessary.

(*iii*) The under utilised Mari gas field should be opened up for new fertilizer plants for which its gas is most suitable.

(*iv*) The dorment gas fields which lend themselves to economic exploitation should also be utilized for augmenting existing supplies/manufacture of fertilizer.

(*v*) The sui gas field should be developed to meet the requirements of the two gas transmission companies and WAPDA thermal station at Guddu.

(*vi*) New gas fields which are being discovered as at Taunsa Sharif (Rhodo well) be studied in detail to examine the reservoir capacity and future economical uses.

(*vii*) Emphasis be given for increasing the drilling capability of OGDC, and concessions for exploration should be propotionately enhanced.

4. Power.

(*i*) Integration of the power demand forecast with the economic framework.

(*ii*) Increase capability of the power systems during the Fifth Plan period to overcome not only the load shedding which has become a regular feature during the Fourth Plan period but also to cater the suppressed demand and to match the capability with the normal growth of load.

(*iii*) Adoption of system reserve criteria which should ensure a reasonable degree of reliability by providing spining reserve for unscheduled out ages and planned withdrawal of items for maintenance and major overhaul *i.e.*, scheduled outages.

(*iv*) Adoption of a realistic generation schedule in accordance with the disbursement schedule of external financing agencies to achieve the objective stated at (*i*) above.

(*v*) Maximising hydro-electric generation to the extent of 75% of total electrical energy requirements of WAPDA and

reduction in thermal fuel requirements by 50% by improved dispatching techniques.

(*vi*) Introduction of coal as fuel in power generation by establishing a first large size thermal power station (240 mw) based on Lakhra coal.

(*vii*) Development of primary transmission programme to integrate the northern zone with southern zone should proceed in gradual stages in accordance with the quantum of inter-market power transfers and the distances involved, with maximum utilization of existing facilities.

(*viii*) Improvement in operation efficiency by

(*a*) improved dispatching procedures

(*b*) reduction in power losses

(*c*) improved coordination of protective gear

(*d*) improvement in power factor and voltage conditions through installation of capacitors near consumer premises.

(*ix*) To provide service to 7.5 lakh new consumers—6 lakh in the WAPDA system and 1.5 lakh in Karachi.

(*x*) Electrification of 1000 villages per annum.

Tentative Energy Targets

In the light of the policy framework and the resources available, the targets in the energy sector are tentatively indicated as under :—

TABLE—2

Source		Quantity	Heat Content Million BTU	%
Natural Gas (excluding its use as feed stock)	MM6F Gas Cos.	1800720*	198.27	29.40
	Guddu	22,641**		
Coal — tons		3,300,000	62.83	9.32
Oil — tons		5,779.000	258.89	38.41
Hydro-electric- city Gwh		11,680	140.16	20.79
Nuclear — Gwh		760	1.20	1.35
LPG — Tons		100,000	4.93	0-73
				100.00

Per capita consumption=303 KG coal equivalent.

*Gas company's sale excluding use of N. Gas as feedstock.

**Sale of Gas to Guddu Thermal Station.