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ASPECTS OF THE ROLE AND OPERATION OF ENERGY INSTITUTIONS IN SELECTED ARAB COUNTRIES

CONTENTS (Cont'd.)

ASPECTS OF THE ROLE AND OPERATION OF ENERGY INSTITUTIONS IN SELECTED ARAB COUNTRIES*

INTRODUCTION

When people outside the Middle East think of "energy" in relation to the Arab countries, they tend to think only of hydrocarbon production, in particular of oil production and of the importance of oil exports for the supply of energy on world markets. The institutions concerned with the production and export of oil and gas have, accordingly, received a great deal of attention both within the Middle East, notably from OAPEC, and outside it, not only from OPEC but from all sorts of national and international public and private organizations, including universities. The role and the nature of the operations of these institutions, their problems and achievements, are fairly well known, at least so far as the relevant governments are prepared to reveal information.

ECWA is, of course, among the organizations with an interest in this aspect of energy in the ECWA region, as is evident from other studies it has conducted or sponsored. But any one study must be limited to areas that can be handled within the constraints imposed by budgets and time. In view, therefore, of the widespread attention given to what can now be called the "international energy institutions" in the Arab world, and of the fact that the energy institutions within the Arab countries which operate wholly within and for the domestic markets are very much less well known and little studied, it was decided to concentrate the limited time and money available for this study on the role of these latter institutions.

As the oil-exporting countries develop and, in particular, as the role of industry grows in their economies, their consumption of their own hydrocarbon resources will grow, in the form both of energy and of raw materials used in a number of their basic industries. It is also obvious that the efficiency and general policies of institutions concerned with the production and distribution

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of energy for the domestic markets are of great importance, in the short as well as in the long run, for the development of agriculture, industry and transportation, and in relation to rising standards of household consumption, not only in the major oil-producing countries but also, and perhaps especially, in the oil-importing countries. Moreover, since some countries of the region have large supplies of hydrocarbons that are surplus to their own requirements while others are deficient, it is desirable to consider the question of regional co-operation. And since there are considerable economies of scale in electricity production and distribution, it is desirable to consider the scope for the linkage of networks.

In this study, therefore, we shall examine the role and operation of the institutions concerned specifically with the supply of oil products for the domestic market, with the generation and transmission of electricity and, where relevant, with the supply of gas. In addition, we shall take account where relevant of the possible introduction of nuclear energy, and of research with respect to the less conventional sources of energy. We cannot pretend to comprehensive coverage in view of the lack of easily available information and the constraints of time. Hence, the study is in the nature of a pilot study in which we attempt to trace the outlines of the situation in each of the countries studied and raise some of the more important issues.

We have included seven countries, all of which were visited in the course of two field missions undertaken in October 1978 and May 1979. They consist of three major oil-exporting countries (Kuwait, Saudi Arabia and the United Arab Emirates), two minor oil-exporting countries (Egypt and the Syrian Arab Republic) and two countries with no oil production of their own (Democratic Yemen and Yemen).

I. MAJOR OIL-EXPORTING COUNTRIES

Kuwait, Saudi Arabia and the United Arab Emirates are among the largest oil-exporting countries in the ECWA region. It might be assumed that none of these countries would have any particular difficulties with respect to the supply of energy and, therefore, that there would be little to be gained from including them in a study such as this one. Such an assumption would be unjustified, for energy is not an homogeneous commodity and not all forms of energy serve all purposes. Although crude oil and natural gas are both easily available as a primary source, they must be altered to forms suited to the needs of local consumption. Oil refining and the subsequent distribution of products pose no special problems even when refinery yields do not entirely accord with the pattern of market demand, but the gathering and processing of gas and the creation of a distribution network are more difficult. Of greater economic significance, however, is the establishment of an efficient organization for the production and distribution of electricity, and in this respect the problems encountered by the major oil-exporting countries in meeting demand may be greater than those of countries with lower levels of government expenditures. We shall now outline the situation in each of the countries renewed and raise what seem to us to be some of the important difficulties.

A. Kuwait

1. Petroleum

The chief organizations concerned with domestic oil supply in Kuwait are the Supreme Petroleum Council, the Ministry of Oil, the Kuwait National Oil Company (KNPC) and the Kuwait Oil Company (KOC). The Ministry of Planning is concerned with the development and co-ordination of overall policies. The Supreme Petroleum Council is a cabinet committee headed by the Prime Minister which is responsible for final approval of all projects put forward by the Ministry of Oil. These in turn come up through the various companies. KNPC is concerned with the supply of products to the domestic market. It runs the Shuaiba refinery and the Mina Abdulla refinery, which had previously been operated by the Kuwait Wafra Petroleum Company, the successor to Aminoil. Both are primarily export refineries and KNPC exports products (including bunkers) on behalf of the Government on a

commission basis. KOC is primarily concerned with crude oil and natural gas production. It also runs a refinery and supplies some products to KNPC. The Ministry itself exports crude oil.

Domestic consumption of petroleum products has been rising rapidly in Kuwait with gasolene the most important product, exceeding 827 million litres in 1977, an increase of 13.2 per cent over 1976. Gas oil sales increased even more, however, by nearly 22 per cent. Of the 1.2 million kilolitres of sales in 1977, 50 per cent were premium gasolene (90 octane), 8 per cent super premium (98 octane), 28 per cent gas oil, 4 per cent kerosene and less than 1 per cent lubricating oil. As to the heavier products, out of total sales of 172 thousand metric tons, 46 per cent were heavy fuel oil, 42 per cent asphalt, 9 per cent light fuel oil, and 3 per cent marine diesel oil. (Bunkers are no longer treated as domestic sales).

KNPC has had little difficulty expanding its distribution facilities to meet local demand, and any imbalances of products are easily made up by imports. A lubricating oil blending plant to supply the local market has been completed in the Shuaiba refinery, and a new storage depot is being planned with pipelines to both the Shuaiba and Ahmadi refineries (the latter run by the KOC). Three new filling stations were completed in 1977 and additional ones are planned. Distribution from the product depots is by lorry.

Crude oil is made available at subsidized prices to KNPC and the Company makes a profit on its local marketing. But although the total value of domestic sales increased in 1977, profits fell by almost half due to a rise in costs without any increase in domestic prices. Prices of products in the local market are now what they were in 1971 although in August 1972 KNPC attempted to raise the prices of three of its products (90 octane gasolene, kerosene, and gas oil). There was considerable opposition to this move and the National Assembly called on the Government to force its withdrawal on the ground that people could not afford to pay the higher prices. Early in 1975 the Government finally forced the Company to reduce its prices to the level existing before 1972. At present 98 octane gasolene sells at 25 fils[1/] a litre, 90 octane at 15 fils, and kerosene and gas oil both at 6 fils. The only prices of locally sold products that have been increased are jet fuels and bunkers, for these are sold primarily to foreigners.

1/ One Kuwaiti dinar is divided into 1000 fils.

The subsidization of the domestic market, including premium gasolene, is therefore extensive and growing for reasons that are essentially political, and early in 1978 a ministerial committee was set up in the Ministry of Oil to study the pricing problem, especially in relation to wasteful consumption, not only of oil products but also because low-priced gas sold to electric power stations supports excessively low electricity prices and encourages wasteful consumption of electricity as well. The committee was expected to report towards the middle of the year but no announcement has been made regarding its deliberations.

KNPC has to rely largely on imported manpower. Of the Company's total employment of 2,771 in 1977, Kuwaitis accounted for only 15 per cent and other Arabs for 68 per cent. However, at the Head Office and in international marketing, Kuwaitis account for between 20 and 30 per cent. In local marketing, on the other hand, there are only 54 Kuwaitis, or less than 5 per cent of total employees in that activity.

2. Electricity

In Kuwait, electricity and water are usually produced as joint products and are the responsibility of the Ministry of Water and Electricity. Boilers in the dual purpose plants feed the electricity steam turbines and the degraded steam can then be used for water distillation. Up to a point electricity and water output are complementary, but eventually one can only be increased at the expense of the other. Water, for which demand is growing faster than for electricity, must be given priority.

The installed capacity in 1977 for electricity generation was over 2,200 megawatts (MW), having risen from 1,364 MW at the end of 1974, or by over 60 per cent, the chief generating complexes being at Shuwaikh, Shuaiba and Doha. Peak consumption rose from 975 MW to over 1,700 MW, or by 74 per cent. There are four power stations and a 132 kilovolts (kV) grid system, but the authorities have had considerable difficulty keeping up with consumption. Power failures have not been uncommon, especially between May and October when demand is highest, air conditioning accounting for some 70 per cent of total consumption. But the opening of a number of new power stations during 1978 and the extension of transmission lines were reported to have largely solved the problem. There is

an attempt to keep a considerable margin for emergencies, especially for water, which is the more critical commodity, but it has not always been successful.

A new 300 kV system is expected to come on stream in 1981. The lead time for the development of a new power station is about five years (four years from signing the contract), and another one is under study for 1981-1985. Construction is undertaken by foreign firms on a turn-key basis, but Kuwaitis do a great deal of the engineering themselves. In the case of the Doha East project, we were informed that Kuwaitis did all of the engineering. In the 1978/1979 Kuwait Development Programme, the Ministry of Electricity and Water was reported to have projects valued at 122 million Kuwaiti dinars (KD)[1/] under implementation and new projects costing KD 43 million provided for.

Electricity prices are very low, 2 fils/kWh, except for big industry, which is charged one fils. The experts believe that 7-13 fils/kWh would be the minimum economic range. The subsidies are therefore high and provide no incentive to economize on either water or electricity, and especially water. There is not even an attempt to impose higher prices in periods of peak electrical consumption than in periods when consumption is low and excess capacity could easily be used. The Ministry of Planning has been concerned about the effect of the low prices, not only because of the encouragement of wasteful consumption but also because of rising budgetary costs. But all decisions of this kind are made by the Cabinet where political considerations tend to take precedence over economic and financial considerations. The Ministry of Planning has commissioned a number of serious studies of energy and other questions. These are for the moment shelved, but it hopes that they will be useful when the problems have become sufficiently acute for the political authorities to take them seriously.

There are considrable economies of scale in power production, and here linkages with Iraq and Saudi Arabia would be useful, especially to deal with fluctuations in demand. Both the Kuwaiti and Iraqi electrical systems operate on 50 cycles but Saudi Arabia, alone among the Arab countries, has adopted the American system of 60 cycles. Thus the systems of Kuwait and Iraq are compatible,

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1/ US$ 1 = KD 0.27 (February 1979).

but not those of Kuwait and Saudi Arabia, although there are means of making linkage possible. The maintenance of minimum efficient throughput and adequate emergency reserves, and the avoidance of shortages and disruptions, would all be easier if co-operation were organized. For Kuwait, water is expected to be the scarcest resource and variety of schemes are being considered to improve the existing utilization, such as recycling waste and sewage water for agriculture, but it is believed that the main source of additional water will have to be imports. Talks have taken place and a preliminary agreement has been reported between Iraq and Kuwait under which Kuwait would provide Iraq with some 125 MW of power in exchange for 35,000 gallons of water a day. Kuwait's expertise in water technology is a valuable asset and assistance is given to Bahrain and even Saudi Arabia, while technological knowledge is widely exchanged with other Asian countries, including China, where, we were informed, water technology can be traded for nuclear knowledge.

Kuwait's market is too small for an optimun nuclear power plant at present, but some small research projects are desired to gain experience.

Use is also made of associated gas and the Ministry of Electricity and Water deals with the distribution of gas. Gas is piped to Government buildings and hospitals but it is not in abundant supply and attempts are made to discourage consumption and limit its use. As for electricity, prices of gas are decided by the Government but its use as a fuel for electricity generation is limited since output is high in winter when oil output is high but lower in summer when electricity demand is at its peak.

In addition to a rigid and uneconomic pricing policy, the Ministry faces serious problems in keeping personnel, especially at the technical and supervisory level. Outside wages and salaries are approximately three times those of Government departemts. Government companies are not subject to the "civil service" salary regulations as are the ministries, and the discrepancy leads to a loss of people from the ministries to Government companies and especially to the private sector. Recently, the Government has attempted to stop this poaching by requiring prospective employers in Government agencies to obtain permission before they take someone new on. One result, of course, is that new entrants may avoid Government departments.

The salary diffrentials also affect the value of training programmes, of which there are many in the field of energy. Personnel from other countries (e.g., Bahrain or Qatar) who are trained in Kuwait may go back to their home countries at first, but many soon drift back to more remunerative employment in the private sector or in Government companies. The Ministry of Water and Electricity, along with other employers, finds some difficulty in providing adequate incentives to attract Kuwaitis into employment since the financial incentives are often unattractive.

3. Research

In the Kuwait Institute for Scientific Research (KISR), the emphasis in energy research is on the use of solar energy for thermal power and recently a contract has been signed with a German company for the construction of an experimental solar power station. But long-term fundamental (i.e., "pure") research in solar energy of this kind will inevitably face severe difficulties in Kuwaiti circumstances which require serious consideration. Such research has a slow "pay-off". The results will only appear long into the future. Thus it requires a long-term deep commitment from the research workers and as well as a long-term serious commitment from the Government which provides the finance and infrastructure. For years to come the majority of the research workers in KISR will have to be expatriates, as now. These workers are on relatively short-term contracts and are not expected to consider themselves, even eventually, as Kuwaitis. Thus, they must look on themselves as transients unable to integrate into the local community; this must inevitably influence their commitment to long-term research work in Kuwait. The present solar research programme has reached a high level of competence, but it may need more positive and longer-term support if it is to survive at an international standard.

Another major difficulty the programme faces relates to the problem of procuring research equipment. The staff find that the procedures are slow and clumsy and take far too much of the scientists' time. Urgently needed new developments are often unobtainable when they are required, thus leading to frustration and inefficiency. These problems are, of course, by no means peculiar to research programmes, but in view of the fact that delays in research programmes do not have the "public" consequences of such things as water shortages or electricity failures, they may be given less attention.

4. Summary

The chief organizations concerned with the supply of domestic energy are the Supreme Petroleum Council (a Cabinet committee chaired by the Prime Minister), the Ministry of Oil, which is responsible for the export of crude oil, the Kuwait National Petroleum Company (KNPC), which supplies products to the domestic market, runs refineries, and exports products, the Kuwait Oil Company (KOC), which is primarily concerned with crude oil and natural gas production, and the Ministry of Water and Electricity, which produces water and electricity as joint products and distributes electricity.

The consumption of oil products has been increasing rapidly, especially since 1973, but there has been little difficulty in expanding distribution facilities to meet demand and any product shortages can be met by imports. Prices for products for the domestic market have not been increased since 1971 and crude oil is made available to KNPC at subsidized prices. A study of the level and structure of prices is now under way since the low prices are believed to encourage wasteful consumption, not only of oil products but also of electricity since cheap gas sold to electric power stations supports excessively low electricity prices.

The expansion of electricity capacity has fallen behind the rise in peak demand and power failures are not uncommon in the summer when demand is highest, since air conditioning accounts for some 70 per cent of the total. The large investment programme in projects under construction and planned is, however, expected to remove the remaining supply difficulties in the near future. Subsidies are high since the price of electricity is very much below cost and prices provide no incentive to economize on either electricity or water. Even pricing designed to discourage peak consumption when failures occur and encourage off-peak consumption has not been introduced. The Ministry of Planning has sponsored a number of studies which, it is hoped, will eventually provide the basis for a reformed electricity tariff, but so far the political authorities, who fix prices, have been unwilling to accept them.

There is some co-operation between Iraq and Kuwait with respect to electricity and water supplies and with respect to technology exchanges with other Arab countries.

The chief problem in addition to a rigid and uneconomic pricing policy relates to the supply of skilled manpower. The Ministry of Electricity and Water, in particular, has trouble retaining its skilled people since Ministry salary scales are uncompetitive with those of both Government companies and the private sector. Financial incentives are also inadequate to attract the desired supply of Kuwaitis into employment with the Ministry.

Research is to a considerable extent concentrated on the use of solar energy for the generation of thermal power but there is some concern that the long-term commitment required for the support of pure research, which cannot be expected to produce results in the short-term, may be inadequate. The Kuwait Institute for Scientific Research (KISR). seems to be reasonably well staffed and its solar research programme seems to have reached a high level of competence.

5. Recommendations

It is suggested that the Kuwaiti Government consider:

1. Ways of overcoming the difficulties preventing the raising of the prices of oil products to more economic levels;

2. The restructuring of electricity tariffs to introduce greater economic rationality;

3. Further extension of co-operation with neighbouring countries in the area of energy supplies, especially electricity and refining;

4. The desirability of giving greater autonomy in procurement to the Kuwait Institute for Scientific Research with respect to energy research.

B. Saudi Arabia

1. Petroleum

In 1978, before the Iranian crisis, Saudi Arabia produced nearly 8 million barrels per day (Mb/d) of crude oil from its estimated capacity of some 12 Mb/d. Of this, domestic consumption (including sales of bunker and jet fuels to international carriers) accounted for some 0.4 Mb/d, nearly half of which was on the West Coast. Domestic consumption has been rising especially rapidly since 1973. Between 1966 and 1973, fuel oil consumption rose by some

62 per cent, i.e., a compound rate of 7 per cent per year, whereas between 1973 and 1976 it rose some 115 per cent or at a rate of 29 per cent per year. In 1977-1978, consumption of diesel fuel alone increased by 75 per cent. Similarly, gasolene consumption increased by only 85 per cent between 1966 and 1973, but by 110 per cent in the following three years; and kerosene and jet fuels increased by 78 per cent in the first seven years, contrasted with 85 per cent in the following three. Such rates of increase clearly must put a strain on processing and distribution facilities for the local market in spite of the fact that products can be imported.

The highest petroleum authority in Saudi Arabia is the Supreme Advisory Council for Petroleum and Minerals, drawn from the country's political leaders and including the Minister of Petroleum and Mineral Resources. Under the Ministry comes the General Petroleum and Minerals Organization (Petromin), at present the only national oil company. (At the time of writing, the formal arrangements for the take-over of Aramco by the Government were not yet complete although in practice Aramco was being operated as a Government-owned company). In addition to its international responsibilities as a direct seller of oil on behalf of the Government, Petromin is responsible for the supply of oil products for the domestic market (including bunker and jet fuels). It was set up by royal decree in 1962 with headquarters in Riyadh and is wholly owned by the Government. Its Governor is a Minister of State. Since Petromin must maintain close relations with many Government ministries, its Board of Directors includes, in addition to the Minister of Petroleum and Mineral Resources and the Petromin Governor, the Governor of the Saudi Arabian Monetary Agency, senior officials of the Ministry of Petroleum and Mineral Resources, the Deputy-Ministers of Finance and of National Economy for Economic Affairs, the Deputy-Minister of Planning and the Deputy-Minister of Industry. It also contains a representative of the private business, financial, or oil community. The corporation has considerable autonomy, particularly with respect to its internal administration and the control and remuneration of its employees. It is empowered to operate not only on its own account but also in joint ventures with foreign, private or other Government enterprises or institutions. In the 1978-1979 budget, the allocation for Petromin was increased more than three and a half times to 260 million Saudi riyals (SR)[1/].

1/ US$ 1 = SR 3.356 (February 1979).

Petromin is responsible for the operation of refineries in Jeddah and Riyadh, for bulk storage facilities throughout the country, and for the local distribution of products, on the West Coast through the Jeddah Oil Refining Company, and in the rest of the country through its marketing subsidiary Petmark. It also runs a lubricating oil plant and a blending plant on the West Coast.

The Jeddah refinery has recently been expanded from 69,000 b/d to 95,000 b/d, and it is planned to expand the Riyadh refinery from its present 20,000 b/d to 120,000 b/d by 1980. A new 170,000 b/d refinery is planned in Yanbu on the West Coast. In addition, a refinery run by Aramco in Ras Tanura, on the East Coast, which also supplies the domestic market, has a capacity of 500,000 b/d. The chief products of the Jeddah refinery are fuel oil and diesel oil. Gasolene, naphtha, asphalt and liquified petroleum gas (LPG) are also produced. The Riyadh refinery produces largely gasolene, followed by diesel oil, asphalt and LPG. Petromin's 70 per cent owned lubricating company Lubref, of which Mobil owns 30 per cent, opened in May 1978 and produces lubricating oils for gasolene and diesel engines using imported base stocks and additives. Its blending plant has a capacity of 75,000 barrels per year. It sells its products directly to wholesalers and retailers on the West Coast, or to Petromin's marketing company (Petmark) for sale in the Central and Eastern Provinces. This plant, too, was to be substantially expanded during 1978 and, together with an associated lubricating base stock refinery project, it will provide an overall two-shift capacity of 509,000 barrels per year of blended lubricating stocks.

Petromin's marketing operations are also being rapidly increased to meet the fast growing local demand. It was engisaged when Petromin was established that the company would eventually take over from Aramco the marketing and distribution of oil products in the country. Accordingly, in 1964 Petromin purchased Aramco's bulk plant in Jeddah and established its own products distribution department to run the plant. With the completion of the Jeddah refinery, it merged the two operations into one company. Subsequently, Petromin also bought from Aramco its main storage facilities in the rest of the Kingdom and its refueling operations at the airports. At present, Petromin through its subsidiaries sells over one-half of the products consumed internally (including jet fuels and bunkers), the remaining local and bunker sales being made by Aramco in the Eastern Province.

The country is divided into 16 petroleum centres for pricing and distribution purposes (with three more centres being created), and the same price for a given product is charged in each of the centres. In other words, Petromin subsidizes transport costs to each entre. In order that the more distant consumers do not feel discrimininated against, the company thus absorbs the higher costs of distribution to outlying centres.

The transportation network for oil products to the various centres includes product pipelines (in Dhahran) and intercoastal tankers from Ras Tanura to Jeddah since the Jeddah Oil Refining Company cannot meet the product demand on the West Coast from its own output and must import from Ras Tanura. There is also barge transport between Jeddah and Jizan on the West Coast. Petmark owns a fleet of trucks for the supply of its bulk plants in the North East region and in the South Central region. The fleet is based in Dhahran for the former and in Riyadh for the latter, but some of the trade is also handled by private transport. Both Petmark and the Jeddah refinery only deliver to the bulk plants from which private transport is required to deliver the products to end users. In addition to the pipeline, marine, and road traffic, a small amount of products is also delivered to some centres by rail.

No attempt is made in Saudi Arabia to use the price mechanism to discourage any form of oil consumption and thus to encourage conservation. Sales are made at prices considerably below international prices and transport costs are subsidized. Nevertheless, products are not on the average sold below cost and increases in domestic fuel and petrol prices were announced early in 1978. Petrol prices were almost doubled to about US$ 0.28 a gallon in June 1978, which was, however, the first increase in five years. The end of subsidies for the operation of filling stations, for which SR 155.6 million had been paid since 1975, was also announced. However, crude oil is supplied to Petromin at less than international prices and in this sense the Government subsidizes the domestic oil industry. As we shall see, similar subsidization is accorded to the electricity industry.

The company therefore, makes good profits and can finance normal capital expenditure on its plants from its own retained earnings. For new investment projects it calls on the Public Investment Fund, and if the investment is considered to be genuine infrastructural investment, the company can get the funds from the State budget. The projects of Petromin are part of the Government's Second Five-Year Plan 1975-1980 (hence forth referred to as the Plan) but its own planning lags behind the Five-Year Plan since it must take account in its planning of the oil requirements for the projects proposed in the national plan. These, according to Petromin's calculations, would imply a domestic consumption of 1.5 Mb/d by 1988, or a compound rate of increase of around 14 per cent per year for ten years. Petromin itself plans to spend nearly US$ 10 billion on domestic fuel projects in the next five years, including storage and pipelines.

Petromin also supplies bulk gas from its refineries to bottling centres, for domestic consumption of LPG is rising rapidly, but the National Gas Company is responsible for its distribution. For 1977 the National Gas and Industrialization Company announced a 26 per cent rise in sales of LPG over 1976. Automatic storage and filling stations are being completed in Riyadh, Medina, Jeddah, Dammam and Taif. We should mention here, but will not discuss in any detail, the enormous gas-gathering project, reputed in its original form to be one of the largest investment projects ever undertaken, now being implemented in Saudi Arabia. The original estimated cost of the project as included in the Plan was SR 16 billion. But in the light of continually escalating cost estimates and of changing world economic conditions, the scope of the project has been substantially reduced, and the cost of even the much smaller project is now estimated to exceed US$ 20 billion. The project is designed to utilize the very large supplies of natural gas produced in association with oil. It is primarily export-oriented and related to the planned development of the East Coast petrochemical industry, but it will also provide increasing LNG supplies for the electricity industry and for domestic manufacturing. Aramco has been entrusted with the management of the project.

As with other activities in Saudi Arabia, an inadequate supply of trained manpower is the most serious bottleneckinhibiting efficient development. Petromin is in a privileged position compared to many other organizations in the country, for it can, and does, pay higher wages than permitted by normal civil services standards and draws workers from other areas and from other parts of the Arab world, which are also desparately short of trained manpower. We shall come back to a discussion of this general problem later since it will be necessary to call attention to it for every single country discussed. In Saudi Arabia, extensive efforts to expand the scope of training facilities have been made. One of the most important institutions being the University of Petroleum and Minerals in Dhahran, which produced over 300 graduates in June 1978, primarily engineers of various kinds. Its 1978-1979 budget was SR 612.6 million. In addition to the company's own training department, there is an existing industrial training centre in Jeddah, which was especially set up to train workers in a number of skills needed in Petromin's projects, and a new model industrial institute is to be built there. An institute of public administration in Riyadh supplies administrative personnel. Foreign companies operating in association with Petromin are also required to train local workers. Finally, management seminars and short summer programmes for college and secondary school students all make their contributions to increase the supply of the skills required.

2. Electricity

Within Saudi Arabia electricity is still supplied by a large number of different institutions since the effective development of a national electricity system got underway only a few years ago. The Ministry of Electricity and Industry is the primary body responsible on a national scale but there are important institutions which have been established independently of it and do not at present come directly under it, notably the Saudi Consolidated Electric Company (SCECO) in the Eastern Province and the Riyadh Electricity Corporation for the city of Riyadh. In addition, most of the industrial establishments have their own generating facilities and even new industrial estates tend to establsih their own generating facilities.

The total installed capacity of the Kingdom is around 4,000 megawatts (MW) (Riyadh alone accounting for some 500 MW of this). The actual load on this system is some 2,500 MW. Thus the expansion and integration of the transmission network is the immediate priority. However, effective demand for electricity is undoubtedly very much higher than actual consumption. Officials believe that if adequate production and transmission capacity were available, consumption would be at least 6,000 MW. This large element of suppressed demand compounds the inherent difficulties of estimating future requirements as a function of future industrial development and rising household incomes. Domestic households and buildings rather than industry at present account for the bulk of consumption.

Moreover, the standardization of cycles and voltages necessary for the development of an integrated system is still far from adequate and there exists a variety of voltages and both 50 and 60 Herz (Hz) frequencies. The Council of Ministers decided in 1972 that the system should gradually be standardized on 60 Hz and 120/220 volts.

The rapid development of electricity supplies is given a very high priority by the Government and in addition to providing cheap finance, the Government has exempted from import duty a wide range of capital equipment needed for the construction of power plants and electricity systems.

Power had previously been available only in the big cities while in other areas small generating plants run by small private companies had been relied on. There were, and still are, literally hundreds of these companies and the Government decided that the replacement of the heterogeneous collection of institutions and the unco-ordinated and unstandardized services should be pushed as rapidly as possible. The necessary steps towards this end were outlined in the Plan which called, among other things, for early action and extensive studies to develop and approve standards, including standards for appliances and equipment; for the extension of interconnexions among power stations and, therefore, a reduction in their number; for a large expansion of rural electrification, and for a "Quick Programme" of electrification of villages along the pilgrims' routes; and for the integration of new industrial, institutional and agricultural demands into the system, such as Petromin's industrial development project at Jubail, hospitals, public facilities, water projects, etc.

The Ministry of Electricity and Industry is responsible for the overall development of the national electricity programme but the Government is well aware of the undesirability of attempting to deal with such an extensive problem on a centralized basis, and hence some of the major areas have been put under separate authorities, as indicated above. In addition, there is a large private sector in this field which is not yet effectively integrated into the national system. The Ministry supervises the private companies which operate under franchises in many areas and cities and in smaller towns, but so far the supervision consists largely of receiving the reports of the companies. However, since electricity tariffs are controlled, all expansion plans and project budgets of the private companies must be approved by the Ministry and, in particular, the amount of the subsidy that will be paid. Subsidies are made necessary since electricity tariffs are set by the Government which do not cover costs and a fortiori do not cover the return on capital guaranteed by the Government. The private companies are not nationalized, it was explained, for two reasons: first to avoid discouragement of private initiative in this sector and to avoid raising any doubt regarding the attitude of the Government towards private enterprise generally; and second, because the Government is well aware of its inability to take on and directly run the companies. The shares of the companies are no longer freely marketable, being "frozen" by the Government, but the shareholders are guaranteed a 15 per cent return on capital. They elect their own board and chairman but the Ministry has the power to dissolve the board of directors of any private power company if it is not doing its job properly. For example, the Riyadh Electricity Company's Board was dismissed in 1977, and the Board of the Jizan Electric Power Company more recently, and new boards were appointed by the Ministry. Coming directly under the Ministry of Industry and Electricity is a public authority, the Electircity Corporation, which is, in effect, the executive arm of the Ministry and is charged with the implementation of the Ministry's projects. The chairman of its board of directors is the Minister and its members include, in addition to the Governor of the Corporation, the Undersecretaries of the Ministries of Electricity and Industry, of National Economy (for Budgetary and Administrative Affairs) and of the Ministry of Municipal and Rural Affairs, and two businessmen.

The Electricity Corporation is primarily concerned with towns and villages, rural electrification, and with central projects where local initiative is not feasible. It operates directly in areas which cannot support a private company and indirectly as a major shareholder in companies in other areas. Small towns wanting electric projects are encouraged to raise their own money and put in an application for the desired project. The Corporation may then put up the rest of the money needed and take a shareholding, thus making the project possible. It may also build transmission lines from a village where electricity is supplied by a small private company to a nearby village without electricity, selling the line for a nominal sum (one Riyal) to the private company, which thereupon will supply power at the controlled price, accepting the profit guaranteed by the Government. Electrification for villages and along the pilgrims' roads has a very high priority and a phased long-term plan is under implementation. A number of projects have been transferred from the Ministry of Municipalities and Village Affairs to the Ministry of Industry and Electricity. Altogether there are projects under execution in over 1,300 villages covering 100,000 households.

In addition to the village programmes, the Electricity Corporation is responsible for the establishment of central power networks on a scale inappropriate for private enterprise. There are four such projects now being implemented under contract to consultant contractors. The Al-Baha Central Project covers areas exceeding 600 square kilometres (km^2) south-east and north-west of Al-Baha city, including over 400 cities and villages and around 22,000 families. From a 60 MW diesel generating station, 132 kilovolts (kV) power lines will extend to central transformer stations from which lower voltage lines will distribute electricity. The contractor is the Taiwan Power Company. Another project, further south-east of Jeddah in the Asir region around Abha city, covering a similar number of villages and families, is being undertaken by the Hyundai Company (South Korea). It consists of a 90 MW station and associated high voltage power lines and distribution lines. A third major project, the Jizan Central Project is being constructed by the Bharat Company (India) in the South and covers an area of some 900 km^2 and will serve a population of around 60,000 from a 42 MW diesel generating station and associated power and distribution lines. Finally, the Kharaj Central Project, covering the whole of

the Kharaj region south-east of Riyadh with around 30 villages and 83,000 people involves the construction of a 40 MW gas-fueled generating station and associated distribution lines and transformer stations. The Pakistan Construction Establishment is contractor for this project. The cost of the four projects is estimated at well over SR 1.6 million. An additional project is being planned at Al-Qasim, north of Riyadh.

The long-term plans envisage over the next 20 years or so the division of the country into 16 regions, each with a central project, which would be unified into one grid with major 500 MW power stations in the Central, North-east and South-west provinces. In view of the prospect that large supplies of gas will be forthcoming, the stations will be dual fired, capable of using either oil or gas. There are also tentative plans for two nuclear power plants one on the East Coast and one on the West Coast.

As indicated above, there are some major activities which are not directly supervised by the Electricity Corporation, notably the Riyadh Electricity Corporation and the Saudi Consolidated Electric Company.

The Riyadh Electricity Company (REC) is an autonomous institution with a direct remit from the King to provide the electricity requirements of the city of Riyadh and its suburbs, which may extend from 90 to 100 km around the city itself, no definite area being defined. Before 1977 Riyadh was supplied by a private company which proved incapable of meeting the rapidly growing demand and interruptions of supply and other difficulties were becoming acute. In 1977 the Government dismissed the existing board of REC, appointed a new one with the Deputy-Minister for Electricity as Chairman of the Board. All existing shares were frozen, but the shareholders were given the 7 per cent guaranteed return in force at that time (this has subsequently been raised to 15 per cent), and a contract was made with British Electric International to reorganize and operate the company. REC is still a private company but the Board is not appointed by the shareholders.

The first priority was to reinforce the transmission and redistribution facilities to meet so far as possible the expected 1978 peak. Suppressed demand was very great but the company was able in 1978 to meet a peak load of some 322 MW which was nearly 69 per cent above the peak of 1977. The task was enormous and the investment funds involved were very large, but the Government had been

prepared to give REC all the resources it could use to meet the need. Cable was ordered by the 100 km, the electricity supply had to be converted to a common basis, many overhead wires had to be put underground, and a 500 MW power station established. Supply is being extended 90 km from Riyadh to Al-Hail, two pipelines for an oil-fueled power station are being built from the refinery in the south, and a 800 MW gas-fired steam turbine is being installed.

The city of Riyadh is itself extending north and pipelines have to be built from the refinery to the power stations. The load is expected to increase anywhere from 50 to 75 per cent in the next year or two depending on the extent to which the company can increase its capacity, and it is planned to build a ring system around the city into which power stations can feed. The system may eventually be linked with a cross-country 450 to 500 kV power line, but the more immediate needs must be met first. REC is also using 14 MW mobile power stations to reinforce the distribution system in the suburbs.

The Saudi Consolidated Electric Company (SCECO) was established in August 1976 with a thirty-year franchise to provide electric power in the Eastern Province. In January 1977, a five-year operating agreement with Aramco came into effect under which management would be provided by Aramco; and in December Aramco's electrical facilities and 26 licensed private power companies in the Eastern Province were merged to create an integrated company for the generation, transmission and distribution of electricity throughout the Province. The Chairman of the SCECO Board of Directors is the Governor of the Electricity Corporation and among the Directors are the Deputy-Minister of Industry and Electricity for Electricity Affairs, the Assistant Deputy-Minister of Finance for Budget Affairs and the Assistant Deputy-Minister of Planning for Sectoral Planning. The Managing Director is from Aramco. The authorized capital of SR 5 billion is represented by 50 million common shares, of which the Government owns 40 per cent in return for a SR 2 billion cash contribution and Aramco owns 32 per cent representing the SR 1.6 billion value placed on Aramco's contributions in kind resulting from the merger of Aramco's assets, the final value being subject to audit and verification. SCECO shares were also issued to the holders of shares in the merged franchise-holding companies in exchange for the shares of these companies at a rate (in value) of one for three.

SCECO's operating area extends from the borders of Kuwait and Iraq in the north-east to Hafar Al-Batin and Qaisumah in the north-west to the border of Qatar in the south-east, and south-west to 129 km east of Riyadh. Over this vast area SCECO has embarked on an extensive and impressive series of investments in power plants and generating stations, transmission lines, switch-yard and distribution systems designed to supply not only the needs of the industrialization programmes, the gas gathering and treatment programme, and Aramco's oil and other operations, but also the needs of the villages and household consumers in the area as well. The plans are very large and the investment programme formidable. In 1977, the first full year of integrated operations, SR 1.19 billion of capital funds were spent, about 51 per cent of which for generation projects, 41 per cent for transmission projects, 3.5 per cent for distribution projects, and the rest for general plant and miscellaneous projects. Aramco itself is the heaviest user of power, normally having consumed about 70 per cent of the total.

Electricity is supplied to consumers at prices very much below operating costs and is therefore heavily subsidized by the Government. A Council of Ministers Resolution of 1973 set consumer and industrial tariff rates at 7 and 5 halalahs[1/] per kilowatt-hour (KWh) and stipulated a return on investment of 7 to 10 per cent. Before 1973 the electricity tariffs were different in the various regions of the country and were much higher than they are now. It was desired to enforce a uniform price throughout the country and the actual tariff was apparently determined in the light of what it was thought the people could afford. The 7 per cent guaranteed return on capital was subsequently raised to 15 per cent, but an attempt to raise prices to consumers was met with loud protests and resistance and was abandoned.

The extremely low prices are believed to encourage wasteful use of electricity and to place an unnecessary demand on the already strained existing transmission and distribution network. Most companies have to report losses, as for example did the Saudi Electric Company of Mecca and Taif with a loss of more than SR 38.6 million in 1977/1978. If the price of oil rises further and

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1/ One Saudi riyal is divided into 100 halalahs.

inflationary pressures continue to mount, the gap between costs and the prices charged will widen, leading to increasing demands on budgetary subsidies and increasing wasteful consumption on the part of those to whom electricity has been supplied. Since there is always considerable public resentment at any substantial increases in prices over a short period, the unwillingness of the authorities to accept measures to bring prices somewhat closer to costs now only postpones a problem which is very likely to grow more and more difficult to deal with as time passes.

In common with all other activities, the electricity institutions have difficulty obtaining the skilled manpower they need, especially at the supervisory levels. The administrative staff of the Electricity Corporation is subject to civil service regulations as to salaries but the technical staff is not and for the latter the Corporation pays higher salaries in order to attract the people it needs. An active and aggressive recruitment policy is pursued. Representatives of the Corporation go directly to the colleges and other training institutions to encourage young men to apply to the Corporation. However, the Civil Service Bureau does allocate quotas for this kind of manpower among the different demands in the economy and the Corporation cannot exceed its quota. Similarly the Riyadh Electricity Company has its own salary scale with guidelines laid down by the Chairman but it cannot poach from Government or pay very much higher salaries. In REC the technical engineers are largely Pakistanis and the labour is Korean, supplied through a government arrangement with South Korea. The Company, with government help, supplies land on which the workers can build their own houses.

3. Research

Perhaps the most significant area of genuine energy research in Saudi Arabia lies in the variety of projects concerned with development of solar energy, most, but not all, of which are being carried out in co-operation with United States institutions. In 1974 a joint commission on economic co-operation was set up by the United States and Saudi Arabian Governments. It deals with a wide and growing variety of projects, at present costing over US$ 750 million including solar energy research. In October 1977, under a five-year US$ 100 million agreement, the project "Solaris" was launched to

fund solar energy research and applied development. The finance is divided equally between Saudi Arabia and the United States. In addition to research into the use of solar energy for heating and cooling, other less conventional areas will also be examined including biomass conversion, wind and ocean energy, and photovoltaics. An insolation survey of Saudi Arabia is also envisaged. Projects so far announced include a solar-powered air conditioner to be developed for Riyadh University in co-operation with an American institution, continued Saudi financed research on heating and cooling systems being conducted in American schools and institutions, and work on a project to provide solar power for electricity generation and water desalination and heating and cooling for a village near Riyadh.

In April 1978 a US$ 1.4 million contract was also signed with the French Société Française des Recherches Thermiques et d'Energie Solaire (Sofretes) for the construction of the first solar-powered electricity plant in Saudi Arabia to be used for lighting and for pumping water. A Saudi-Swiss joint venture (Sotec) is building an experimental solar-powered desalination plant at King Abdul-Aziz University and a solar-powered prefabricated house is being shipped to that University from Australia for research purposes. A Saudi prince has also given the Science Foundation for Physics of the University of Sydney SR 14 million for research into solar energy.

4. Summary

There has been a very large increase in the consumption of electricity and oil products in Saudi Arabia in the past decade, especially since 1973. The major institutions dealing with petroleum are the Supreme Advisory Council for Petroleum and Minerals whose members are drawn from the country's political leaders and include the Minister of Petroleum and Mineral Resources. Under the Ministry comes the General Petroleum and Minerals Organization (Petromin), which not only sells oil abroad on behalf of the Government but is also responsible for the supply of oil products to the internal market through its subsidiaries. It operates on its own account and in joint ventures. Since Saudi Arabia has very large supplies of oil, the Government sees little need to restrict domestic consumption and makes no use of prices as a means of discouraging wasteful consumption. Domestic prices are below international prices but price

concessions are not given on exports to other Arab countries. By and large the operations of its internal petroleum institutions seem to be reasonably efficient but suffer from an inadequate supply of trained manpower in spite of considerable training efforts, including the creation of a University of Petroleum and Minerals in Dhahran.

Demands on electricity supplies have been extremely heavy since the acceleration of the development programme. The Ministry of Electricity and Industry is the primary body responsible for electricity on a national scale, but there are many other electricity institutions, some operating under the Ministry and some independently of it. There are numerous small private companies operating under franchise in local areas and supervised by the Ministry but the most important institution is the Electricity Corporation, which is the operating arm of the Ministry and is responsible for the execution of its projects. The Corporation is primarily concerned at present with towns and villages, rural electrification and central projects where local initiative is not feasible. There are four major projects of this kind now under implementation. The two most important institutions operating independently of the Corporation are the Riyadh Electricity Company (REC) managed under contract with British Electric International, and the Saudi Consolidated Electric Company (SCECO), operating under a five-year agreement with Aramco to supply electricity in the Eastern Province. This is a large project with an authorized capital of SR 5 billion, of which the Government owns 40 per cent and Aramco 32 per cent; the rest is owned by the shareholders of the numerous small franchise holding companies which were merged into SCECO. Prices of electricity are extremely low and most companies report losses. The low prices are believed to encourage wasteful consumption.

Suppressed demand is high since the authorities have been unable to increase supply to keep up with the rising demand. Finance has not been a constraining factor, but skilled manpower is in very short supply and heavy reliance has been placed on labour imported from abroad, especially from Pakistan and South Korea.

The research efforts of Saudi Arabia are heavily directed towards solar energy where a very large programme has been launched in co-operation with the United States. A number of smaller projects are also being implemented or planned with other countries. Most of the energy research projects are concerned with solar heating and cooling but there is also some research dealing with other non-conventional sources.

5. Recommendations

It is suggested that the Saudi Arabian Government consider:

1. The desirablity of gradually raising the domestic prices of petroleum products towards the international price in order to encourage conservation and make its domestic, Arab, and international oil pricing policies consistent;

2. The desirability of gradually removing the subsidy on electricity consumption and of establishhing schedules for an electricity tariff which would bear a closer relation to marginal costs of different kinds and times of service and would encourage a less wasteful use of electricity;

3. Means of making its electricity system compatible with that of its neighbours in order to assist interconnexions;

4. Means of co-operating in a programme affecting the training and use of skilled labour in order to reduce the adverse impact of its own requirements on labour supply in other countries and to increase the benefits of training for the area as a whole.

C. United Arab Emirates

This is a country so recently created that it has only had time to take a few of the first steps on the way to a reasonably integrated nationhood. Partly for this reason, the discussion here of the United Arab Emirates will inevitably give inadequate attention to each of its individual parts. It was not possible to visit all of the Emirates in the time available, and there is no question that a brief visit to the capital is inadequate. A large number of the country's activities have not yet been sufficiently integrated to enable one to obtain even the basic information from a visit to Abu Dhabi alone. This is certainly the case with respect to energy institutions and time precluded a more extensive visit.

In the field of energy, the most important federal ministries are the Ministry of Electricity and Water with a total budget in 1978 of 400 million dirhams (Dh) 1/ 256 million of which was for development, and a Ministry of Petroleum and Minerals with a budget of only Dh 18.5 million. In view of the preponderance of the Emirate of Abu Dhabi in petroleum production, and the fact that, under the constitution, oil and minerals are in the domain of the individual Emirates, it is not surprising that the Federal Ministry has little development responsibilities. The Federal Ministry of Planning attempts to act as an intermediary between Emirate departments and outside agencies, especially the United Nations, and the UNDP Country Programme is important to them. There are objectives for electricity and water developments in their plans. The Department of Technical Co-operation of this Ministry has prepared a document which has been sent to the individual Emirates with a number of proposals. These include the creation of a National Centre for Technology and Science in the Ministry of Planning which would be concerned, inter alia, with energy research, and the establishment of a technical organ for co-ordination in the field of water and electricity. So far, no action has been taken on these or any of the other proposals put forward for technical co-operation.

At the federal level, also a ministerial committee has been established including the Ministers of Oil, Electricity and Water, and Planning to draw up a programme for atomic energy and set up a national agency for atomic energy to co-operate with the International Atomic Energy Agency (IAEA). No reports have been published on the progress of their work. In the Ministry of Foreign Affairs, an energy committee was set up in 1977 to monitor developments in the oil industry of the Emirates.

1. Petroleum

According to the constitution of the United Arab Emirates, oil and minerals are in the domain of the individual Emirates. However, the Federal Ministry of Oil does represent the Emirates on the board of the organization of Arab Petroleum Exporting Countries (OAPEC) and other organizations, since they are not accepted individually, and it helps to develop their mineral resources. A British consultant firm has made a minerals survey and is now in the process of sample drilling.

1/US$ 1 = Dh. 3.838 (February 1979)

The Department of Petroleum of Abu Dhabi represents the Government of Abu Dhabi in the oil industry, and in 1971 the Abu Dhabi National Oil Company (ADNOC) was created to represent the Government in the participation agreements when these were signed with the international companies operating the concessions. ADNOC now has 60 per cent of the equity in the operating companies and 51 per cent of the LPG operations. The ADNOC refinery, with an output of some 15,000 b/d, supplies 40-50 per cent of local demand in Abu Dhabi, with imports from the Kuwait National Petroleum Company supplying the balance. The marketing department of ADNOC is responsible for supplying the domestic market.

When ADNOC was created, it inherited, as it were, the prices of the foreign concessionaires, but when the refinery came on stream in July 1976, the Ruler decided to reduce prices in view of the fact that both crude oil and products were now produced domestically. The marketing business was soon making heavy losses. Local demand had been doubling about every three years, and large investments were needed in distribution. At the end of 1977, the ADNOC marketing department was able to get an increase in prices to meet rising costs. To the ex-refinery price which, from the point of view of the marketing department, was taken as fixed, distribution costs were added and, with some regard to prices in the other Emirates, a price was obtained which, with some increased efficiency and reductions in cost, enabled the marketing department to make a slight profit.

Since then, the main product prices have been frozen. Although gasoline demand is still growing at 20 per cent per year, there has recently been some reduction in the increase of demand for oil products as a whole, as a result of the fact that power generation is increasingly relying on natural gas instead of gas oil. This, together with the introduction of new products-aviation fuels, lubricants, marine bunkers and LPG - on which higher prices could be put, has permitted the marketing sector to remain profitable. Products for the domestic market are, however, heavily subsidized in relation to international prices.

In addition to the refinery, ADNOC has commissioned a new lubricating oil blending plant to produce a large variety of lubricants. Dubai has already inaugurated a similar plant with a capacity of 250,000 barrels per year, which is owned by Caltex Al-Khalij.

The marketing of petroleum products in Ras Al-Khaimah is being handed over to a new company, the Gulf Company for Marketing Oil Products, which is to be jointly owned by the Ras Al-Khaimah Oil Company (RKOC), and the Kuwait National Petroleum Company (KNPC), the capital of the new company will be Dh 50 million, of which 60 per cent will be owned by RKOC. A 25-year monopoly is being granted to the company for the importation, storage and distribution of oil products in the Emirate. It will be required to establish the necessary distribution facilities, and preference will be given to the importation of products from KNPC. A joint refinery between Ras Al-Khaimah and Kuwait is also being planned and tender documents are expected to be issued soon.

An example of co-operation between Emirates is the one with respect to natural gas between Umm Al-Qaiwain and Dubai. Dubai will help finance and develop Umm Al-Qaiwain's offshore gas field which will supply not only a planned power plant in Umm Al-Qaiwain, but some 60 million cubic feet a day to Dubai. It is hoped to begin production from the gas field in 1979.

2. Electricity

There is a real need for the establishment of an integrated electricity network for the United Arab Emirates, and in 1978 the first phase of a federal electricity and water project was announced. Projects for the east and north have been approved, reportedly costing some Dh 300 million. They include power plants for Ajman, Umm Al-Qaiwain, Al-Zaid, Fujairah, Diba and Masfout, and there have been calls for a gas-fueled central power station for the country as a whole. In November 1978, a Swiss company was given a contract to make a report on the electricity needs of the Emirates over the next twenty years, including the question of a national electricity network. For the present, however, each of the Emirates seems largely responsible for ensuring its own supplies.

It has been reported that Dubai's generating capacity would reach 400 MW in 1978 (the peak summer demand in 1977 was 280 MW and there was dangerously little spare capacity). New 132 kV substations are being constructed, one in Jebel Ali which has already had its trial runs. In Jebel Ali also the first steam power generating plant is expected to be commissioned in 1979 according to the Dubai Electricity Company, and a 25 MW power plant is to be installed at the liquified natural gas (LNG) plant now under construction there.

Sharjah's electricity department is also building a steam power station, the main contract for which has been given to a large Italian firm.

The Abu Dhabi Electricity and Water Department has a three-year plan for the joint development of electricity and water, the allocations for which exceed Dh 1,500 million. Finance is not a restraint on the expansion of supply but adequately trained manpower is. Some power stations in Abu Dhabi City and other towns are supplied by gas available from ADNOC. There are many small generating plants and at present supply has been adequate but, as elsewhere, the consumer is heavily subsidized. The Electricity and Water Department estimates costs at 16-17 fils/kWh, but prices are between 7 and 12 fils, industry paying 12 fils unless special arrangements are made. This has been done, for example, for a water desalination plant producing a concentrated brine which in turn can be used to produce salt for a chemical plant. Until July 1975, the price for electricity was 2 fils/kWh for local people and 4 fils for foreigners.

3. Summary

Although there is a Federal Ministry of Electricity and Water and a Ministry of Oil and Minerals, the energy supplies of the individual Emirates are almost entirely the responsibility of each Emirate separately. There is also a federal ministerial committee to look into the prospects for atomic energy, but at the time of writing there were no reports on its work. According to the constitution of the Emirates, oil and minerals are within the domain of each Emirate but the Federal Ministry represents the Emirates on the board of OAPEC and other organizations and helps with the development of minerals.

In Abu Dhabi, the only major oil-producing Emirate, the Abu Dhabi National Oil Company (ADNOC) represents the Government in the joint ventures with international companies and supplies products to the local market, some 40-50 per cent coming from its own refinery and the rest imported from KNPC. In the other Emirates, products are imported for local distribution, although Dubai has inaugurated lubricating oil plant and a joint venture refinery is being planned in Ras Al-Khaimah with Kuwait. There is some co-operation among the Emirates, one of the most interesting of which is that between Dubai and Umm Al-Qaiwain with respect to the offshore gas field of the latter.

Each Emirate is responsible for ensuring its own supplies of electricity, and supplies appear to be adequate for the moment in both Abu Dhabi and Dubai, and expansion programmes are underway in both. Sharjah also is building a new steam power station. Projects eventually leading towards the development of an integrated network for the Emirates as a whole have been announced, but the availability of skilled manpower is a major constraint on expansion. Electricity prices are below cost. In Abu Dhabi, for example, costs are estimated at between 16 and 17 fils/kWh, with prices between 7 and 12 fils/kWh.

4. Recommendation

It is suggested that the Federal Government give greater attention to the organization of electricity and domestic oil supplies on a federal basis, with the federal ministries being given powers to ensure adequate supplies throughout the Emirates.

II. MINOR OIL-EXPORTING COUNTRIES

Of the minor oil-exporting countries in the ECWA region (countries with production of less than one million b/d), Qatar (445,000 b/d in 1977), Egypt (417,000b/d), Oman (359,000 b/d) and the Syrian Arab Republic (169,00 b/d) are the most important. Of these, the two with the largest populations and most developed economies are Egypt and the Syrian Arab Republic. The latter, with much less population pressure, has less difficulty than Egypt in ensuring that its energy istitutions are able to serve adequately its growing economy.

A. Egypt

The ministries chiefly concerned with Egyptian energy supplies are the Ministry of Petroleum and the Ministry of Electricity and Energy. Prices are set by the Ministry of Finance. Consumption projections are sent to the Ministry of Planning from the various other ministries (Agriculture, Industry, etc.) which examines them in the light of the needs of the economy as a whole and, in principle, determines priorities. In practice, however, this does not seem to have a great deal of influence on supply or distribution. There is a Ministerial Co-ordinating Committee on which the Ministries of Electricity and Energy, Petroleum, Planning, Industry, and Finance are represented and which takes most of the policy decisions. The Egyptian General Petroleum Corporation (EGPC) is the most important Government operating institution dealing with oil supplies and distribution, and the Egyptian Electricity Authority is the central organization for the supply and distribution of electricity.

1. Petroleum

Egypt is itself a considerable producer of crude oil, output reaching 525,000 b/d at the end of 1978, and supplies a large proportion of the country's domestic own requirements. Because of the quality of domestic crude, the country exports oil as well as imports oil and products in order to balance the structure of product supply with that of demand, but is on balance a net exporter. The development of the oil industry has a high priority and desirable projects do not have much difficulty in obtaining the required finance, especially since foreign capital is welcomed in joint ventures. 73 per cent

of Egypt's oil comes from the fields of the Gulf of Suez and is produced by GUPCO, a joint venture of EGPC with AMOCO. Domestic refining output is some 11 million tons a year (while capacity is around 16 million). A pipeline from the oil fields is being built to Suez and to Cairo and is scheduled to be completed by 1980.

A major difficulty facing the efficient development of the industry, especially in the implementation of refining projects, is the shortage of skilled technical manpower, particularly at the supervisory level; the exodus of skilled workers to the Gulf oil-producing countries has reached significant proportions. In one of the major operating divisions of EGPC, for example, the manager stated that he had lost 80 per cent of his technical people in the past year. The effect is to reduce productivity of projects, increase costs and extend the time it takes for implementation. Nevertheless, oil products are not at present in short supply even at the extremely low prices charged by the authorities.

Oil products, like a number of other commodities deemed socially important or politically sensitive by the Egyptian Government, are heavily subsidized. Domestic prices are set in the Ministry of Finance and the marketing division of EGPC simply arranges the distribution at the prices set.

As a result, conservation is not encouraged and there is no attempt to discourage wasteful consumption, while the implicit subsidy to all industries using energy is very considerable. Exports are of course made at world prices.

2. Electricity

One-third of Egypt's total power is produced from thermal generators nearly all of which use heavy fuel oil. Electricity generated from hydroelectric power stations has grown steadily since 1960 when the Aswan Dam began production, and after 1967 when the High Dam power station began operations. Hydroelectricity reached its peak as a percentage of total electricity generation in 1974 when it accounted for 72 per cent of the total. Since then thermal has been increasing in relative importance to meet the rapidly increasing industrial demand but new hydroprojects are envisaged which will substantially augment the existing supply.

There are now 13 electric generating stations in Egypt which are connected to form an impressive national grid, the Egyptian Unified Power System, with a capacity of 4,000 MW. A 500 KW transmission line runs from the High Dam to Cairo and 220 kV system from the Aswan Dam to just short of Cairo. Branching 220 kV transmission lines serve the country north of Cairo.

Within the Ministry of Electicity and Energy there are six authorities: the Electrical Authority responsible for generation and transmission, employing some 60,000 people, the Rural Electrification Authority with 4,500 employees, the Qattara Depression Authority responsible for the development of hydropower using the Qattara Depression, employing 300. There are three nuclear authorities: for nuclear power, nuclear materials and nuclear energy research. Research is also conducted into non-conventional sources of energy: solar, wind, wave, biomass, and thermal. Each authority has its own board and chairman.

In spite of the rapid increase in electricity generation, the annual rate of increase exceeding 10 per cent in the last ten years and reaching 16 per cent in recent years, investment has not been sufficient to meet/keep up with demand and the power cuts, especially in peak periods but at times even at offpeak hours, are beginning to have serious effects. When cuts have to be made, industry is the first to suffer while the general public is protected as far as possible.

The primary reason for the inadequate rate of investment is given as inadequate financial allocations. In the past the electricity authority did not have the power to raise its own funds, but in 1976 it was given this power and is now also trying to get permission to retain its profits for reinvestment and to obtain exemption from the 50 per cent profit tax. It does not have to distribute profits to the workers.

The Authority has a large investment programme in hand under a five-year plan drawn up with the help of outside consultants. The lead time in the construction of a normal power plant station is about five years, but several are now coming on stream. Extensive foreign finance has been offered at almost all levels from planning and finance to joint ventures in operations. Of the total investment envisaged in the 1978-1982 plan for the electrical

sector, about 60 per cent is expected to come from foreign sources. The Authority has just recently organized three electrical and mechanical construction companies to participate in joint venture with international groups, the share of each joint company to be held 30 per cent by the Egyptian company, 20 per cent by Egyptian private shareholders, and 50 per cent by the foreign group. The new joint companies will undertake the actual construction of the power stations and will benefit from the technology, management techniques, scheduling, control and training supplied by the foreign company. Up to recently construction had been done for the Electricity Authority by the Minister of Construction and since the priorities of this Ministry were not always the same as those of the Ministry of Power, building was frequently excessively slow. This arrangement, has now been abandoned.

Over the next five years an energy control system is expected to be installed in Cairo which will consist of a computer system to monitor and control the generation and transmission of electricity. It will be installed by American companies and financed by the United States Agency for International Development. US AID has agreed to provide a number of long-term loans to rahabilitate and expand Egypt's electrical distribution network. West Germany is providing loans to finance rural electrification projects and India is co-operating in the same areas. A technical co-operation energy protocol has been signed with Sweden and Egyptians will get training in gas, steam and nuclear power station maintenance.

In general, the modernization of Egypt's electricity system, the control and monitoring of its operations, and the extension of its facilities are planned to go ahead very rapidly with heavy reliance on foreign finance, technical assistance, operational control and training. Under the Qattara Depression project, a canal is planned from the Mediterranean Sea to the Qattara Depression in the western desert, which is from 50 to 60 meters below sea level and covers an area of some 30,000 Km^2. The hydroenergy created when channelled to a power station could in principle produce ten times the electric energy produced by the High Dam. At present the best method of digging the canal is still under study. As for the nuclear programme, none of the planned nuclear plants has been started. A major reason for this is reported to have been the unwillingness of the United States Government to supply resources because of its nuclear non-proliferation policies.

A central problem for the Electricity Authority is the rigidity and inappropriateness of its tariffs. Only once in the last 15 years have prices been raised, and that was in 1976 when they were increased by about 10 per cent on the average. As a result, most tariffs are below cost. Studies of the tariff structure presented to the Ministry in 1977-1978 indicated deficits from 25 per cent to over 75 per cent below cost depending on the tension supplied. Differentials in the tariff were originally related to differentials in cost but the inflexibility of the structure has not permitted appropriate changes.

Some of the very largest industrial consumers are the most heavily subsidized. The Kima fertilizer works near Aswan, for example, was able to use electricity with no other outlet when it was first constructed because tension incompatibilies made it difficult to feed the surplus from the Aswan Dam into the integrated network. Hence a very low tariff was set. When it became possible to feed the power surplus into the integrated system, an increase in prices was justified and in 1976 Kima was billed at 5.1 millemes[1/] per KW which was lower than any other tariff except that for the aluminum smelter. But Kima refused to accept this increase and after negotiations it was finally agreed to charge the project only 3.3 mill/KWh. Similarly the aluminum smelter has a below-cost tariff (2.6 mill/KWh) which was originally insisted on by the Russians (who built the plant) on the grounds that it was very near to the source of power and such a heavy user that a low price was important for its economic operation.

Decisions of this sort are made at the Cabinet level by ministerial committees. In principle, tariff differentials are determined in accordance with the tension supplied and the amount used, but political considerations have tended to dominate. There is no attempt at variation of prices according to the daily cycle of demand and therefore no incentive for consumers to increase their use of offpeak electricity and to economize on peak supply.

1/ One Egyptian pound (LE) is divided into 1000 millemes.

The use of prices as a device for encouraging conservation has so far been ruled out. Hence, not only do prices fail to reflect rising costs of inputs and of alternative sources of energy, they also fail to take into account elasticities of demand, substitution possibilities, and differential marginal costs of supply.

With the new approach to economic policy adopted in Egypt in recent years more flexibility is expected to be permitted, although the tariff structure will remain a political decision at cabinet level. The French electricity authority and a French consulting firm have been asked to study the problem and to propose revised schedules. However, it seems clear that in this field as in others in the Egyptian economic system, the long period of rigidly held prices has created a situation in which any substantial effort to bring prices anywhere near an economic level would result in politically unacceptable increases. The serious distortion of prices is a severe handicap to an efficient use of energy in Egypt. Many of the responsible technically qualified officials in Egypt's energy institutions know this and are pressing for change.

Another area where price distortions are a serious problem is the salaries of managerial and technical personnel in the public sector. In an industry as important as electricity that is almost inescapably in the public sector, this may have adverse implications for the economy as a whole. Very recently, however, the importance of the problem has been appreciated and certain measures are being taken.

3. Research

Research on sources of renewable energy is one of the five areas in which the National Research Center in Cairo concentrates its efforts. Research into solar energy has been going on since 1957 and now comprehends a number of joint projects with foreign countries as well as strictly Egyptian projects. West Germany supports a 5 million Deutsche marks solar project which includes the construction of a 10 KW power plant; Canada supports research into solar energy for the dehydration of agricultural products; and the United States supports a large co-operative programme, which includes biogas research. Egypt has built the first refrigerator to work on solar energy and has an advanced programme for small-scale solar heating and desalination of water.

It is expected that within five years family-size solar water heaters made in Egypt and costing between LE 130-150[1/] will be available commercially. Research into wind energy is also in process in co-operation with United Kingdom intermediate technology groups. A co-operative solar programme between Mansoura University, and the University of Science and Technology in France has also recently been announced.

In the villages, experiments are being conducted to explore the possibilities of introducing solar energy. One of the best known is in Basaisa, the "solar village", where a photovoltaic cell panel is used to provide electricity for lighting, television and a microphone in a communal guest house and for amplification in the mosque. A solar-powered irrigation pump, which will provide water to around one and a half feddan a day, has also just been introduced on an experimental basis. The village project is financed by the U. S. National Science Foundation and is conducted by faculty from the University of Cairo in co-operation with the University of New Mexico. It has a very strong sociological input, and attempts to ensure that the villagers themselves are associated with the planning and design of activities at every stage.

It has also been proposed that solar energy experiments be associate with the housing programme in the village of President Sadat, which is being financed by the proceeds donated by the President from his Nobel Prize and the sale of his book.

A supreme council for Renewable Energy under the chairmanship of the Ministry of Electricity and Energy was set up in 1978 and held its first meeting in April 1979. The purpose of the Council is to co-ordinate energy research. On it are representatives from the relevant ministries, the Academy of Science, the universities, the National Research Center, and other research bodies. A draft budget of about LE 50 million is reported to have been drawn up to support a five-year research programme.

1/ US $ 1 = LE 0.70 (February 1979).

In general, Egypt has developed an impressive integrated infrastructure designed to harness the country's hydropower and, in conjunction with thermal stations, to provide a flexible system of supply. The operation of the system, however, is handicapped by an economically irrational system of prices and subsidies which is unable to adapt to changing conditions. The social and political difficulties can be easily understood and appreciated but the burden on the economy and on the state finances is becoming increasingly serious. Fortunately, there is a widespread awareness whithin the Ministries, strogly encouraged by the World Bank, that something must be done to alleviate the situation.

A joint U. S./Egyptian expert committee is reviewing the country's energy requirements. It seems clear that it will be difficult for Egypt to meet even the "low demand" projections associated with low rates of economic growth in view of the restraints on the rate at which investment projects can be implemented and brought on stream. Egypt's energy problem for the coming few years before new investment can yield its output will undoubtedly be extremely difficult and supplies are likely to become uncomfortably tight.

4. Summary

A number of institutions are concerned with the planning, pricing, financing and co-ordination of domestic energy supplies, of which the most important are the Ministry of Finance, which sets prices, and the two major operating institutions, the Egyptian General Petroleum Corporation and the Egyptian Electricity Authority. Egypt is now on balance a net exporter of oil products and its domestic output of both crude and refined products has been expanding rapidly. Of all the Arab countries, Egypt has been the chief supplier of skilled manpower to the oil-producing countries of the Gulf and has in consequence suffered from the loss of its own workers in certain key sectors, notably oil and electricity. In these sectors both the rate of project implementation and the efficiency of operations have been adversely affected by the inadequate supply of skilled labour, especially supervisory labour. Prices of oil products are set much below international prices for social reasons, but there has so far been little difficulty in meeting domestic demand, although even at the least optimistic rates of growth

projected for the medium-term future it seems likely that the economy will have considerable difficulty meeting the energy requirements implied.

Hydroelectric power meets about two-thirds of Egypt's total power consumption, having fallen from its peak in 1974 when it accounted for nearly three-fourths. Increments in demand now have to be met from thermal power stations nearly all of which use heavy fuel oil which is heavily subsidized, prices being barely ten per cent of international prices. The country is supplied through an impressive national grid, the backbone of which is a 500 kV transmission line from the High Dam to Cairo. In spite of an annual rate of increase in electricity generation of 10 to 16 per cent in recent years, demand has increase even more rapidly and power cuts have been frequent, with serious effects on industry. Finance has been a serious bottleneck, but a large investment programme is in hand and about 60 per cent of the finance is expected from foreign sources. A number of joint ventures with foreign enterprises have been formed, particularly for construction of power stations. Work is now proceeding on a major project to produce hydroelectric power through the construction of a canal between the Mediterranean Sea and the Qattara Depression in the Western desert, and plans are in hand to add to the hydrogeneration facilities on the Nile.

The most serious obstacles to efficient operation and adequate expansion are the rigid and inappropriate tariff schedule and the severe manpower shortages. Most tariffs are below cost and take little account of either cost or demand patterns. Consultant reports have been produced recommending far-reaching changes. Inadequate salary scales hamper the efforts of the electricity authorities to attract and retain the necessary qualified manpower.

An active research programme, especially in solar energy, is in process, with extensive collaboration and finance from abroad.

5. Recommendations

It is suggested that the Egyptian Government give urgent consideration to:

1. The structure of prices both of oil products and electricity;

2. The possibility of raising the levels of prices over time nearer to economic levels;

3. The costing of the amount and direction of subsidies in relation to the purpose served by them, including the desirability of the subsidization of particular industrial projects;

4. The level of salaries paid in the energy sector with a view to attracting and retaining skilled personnel in areas where higher productivity is urgently needed.

B. Syrian Arab Republic

1. Petroleum

Although oil production in the Syrian Arab Republic has increased nearly ten times in the last ten years and exports are now a useful credit item in the balance of payments, domestic consumption and imports have also risen rapidly. In 1975, crude oil production contributed 10.7 per cent to the gross domestic product (GDP). Domestic consumption tripled between 1968 and 1976, and imports rose almost as much. Until the spring of 1976, when a dispute over transit dues caused its closure, much of the Syrian Arab Republic's crude oil imports were supplied from the Iraq Petroleum Company (IPC) pipeline which ran through the country on its way to Banias and Tripoli on the Mediterranean. Late in 1978, Iraq and the Syrian Arab Republic began talks to make up their differences; and at the time of writing, an agreement had been announced to reopen the pipeline early in 1979. Feedstock for the Homs refinery would also be supplied. The Syrian Arab Republic also imports products, especially fuel oils but most of the domestic product consumption is met from domestic refineries, two at Homs and one at Banias.

At present, oil production is fairly constant with a reserve to production ratio of 25 to 1, but this is expected to decline quickly if there is no new discovery. Recently, service contracts have been made with two foreign companies for exploration. The exploration risk is taken by the foreign company but, if oil is discovered, a joint company will be formed and the foreign company will get a share of the oil. The Syrian Arab Republic plans to export about 50 per cent of its oil as crude and to refine the rest, the ratio being related to the quality of the crude and the technical specifications of the refineries.

The Ministry of Petroleum has overall responsibility for the oil industry, but the important decisions are taken at the Presidential level and by the Minister. On policy questions, the Ministry is in effect only an advisory organ to the Minister and its recommendations are not necessarily accepted. The execution of contracts for the export sales of crude oil is in the hands of a special bureau for export sales in the Council of Ministers. Investment takes place within the five-year plan but according to annual plans, in which the necessary modifications to the five-year plan can be made. Production levels and policies are proposed by the Planning Department of the Ministry. The Ministry's plans go to the State Planning Committee. After any desired modifications they are sent to the Higher Planning Council which is chaired by the Prime Minister and on which ten to twelve ministries are represented, including the Ministries of Planning and Finance. The Council makes the final decisions and allocates funds. In principle, there is a follow-up but officials are not satisfied that it is adequate.

The Ministry supervises and co-ordinates the activities of the operating companies which are organized in a vertical chain. Exploration, production and the actual import and export operations are undertaken by the Syrian Petroleum Company (SYPCO). Transport is carried out by another company, the Syrian Company for Oil Transportation, but SYPCO pays the transportation costs. The Homs Refining Company (with two refineries which are being extended) and the Banias Refining Company, with a 6 million ton refinery under construction, are also separate companies and sell their products to another company which is responsible for internal marketing. Close co-ordination on a daily basis is maintained between SYPCO and all companies in the chain.

Oil production has a high priority in the Syrian Arab Republic and, although SYPCO does not have the control of its own funds, as the primary production company its budget is usually approved by the Ministry of Finance which makes the required allocations and loans in accordance with the approved financial plans. The chairman of SYPCO's board is the General Director of the company and other members include the Technical Director, the Exploration, the Financial Director and a director representing the workers syndicate, who is not generally a technical man but whose task on the board is to represent

the interests of the workers. The board thus represents the heads of the various divisions of the company. It is alleged that politically motivated appointments have had some adverse effects on the efficiency of operations.

Prices for crude oil are determined by an interministerial committee, and sales to the domestic refineries are made at international prices. At the beginning of 1974, domestic prices of products were also set at international levels. It was not thought desirable, however, to raise domestic prices in line with the 1974 increase in crude oil prices, with the result that domestic consumers, especially of fuel oil, kerosene, jet fuel, gas oil and LPG have been heavily subsidized at around 1.5 billion Syrian pounds (LS)[1/] a year. In January 1978, a new policy was adopted which was designed to reduce the subsidy. Products were to be sold to the public sector (army, electricity organizations, other large industries, ministries etc.) at cost plus a one per cent profit for the refinery, the price of imports c.i.f. determining the cost. Gas oil to the public rose to about half the world price and the prices of other products were also increased, but to a lesser extent. Subsidies still remained high at an estimated LS 400 million a year. As elsewhere in the Middle East, the supply of skilled manpower is inadequate. The Government has training centres and SYPCO runs its own in-service programmes. The salary scales established by the Government are insufficient, and many of the qualified people are attracted by local private industry while others successfully leave the country in spite of Government efforts to prevent such emigration.

2. Electricity

Before 1952, the electricity companies in the Syrian Arab Republic were private, but in that year they were nationalized and the supervision of their operations was taken over by the Ministry of Public Works. In 1965, the Public Establishment of Electricity was created by decree and took over production, transmission and distribution. It was an autonomous organization under an administrative council. In 1967, a Ministry of Petroleum and

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1/ US $ 1 = LS 3.950 (February 1979).

Electricity and Mineral Resources was established, but in 1974 the Ministry of Electricity was separated from it. The Public Establishment for Electricity is supervised by that Ministry.

The Head Office of the Public Establishment is in Damascus and there are ten independent regions for distribution in each Mohafadhat, with branches in the towns. Power stations are in Homs, Hama, and at the Euphrates Dam, but Damascus has inadequate water for a big station and is served by many small power generating plants. There is a national grid of 220 kV, a connexion with Turkey is under negotiation, and a connexion with Iraq is being discussed. There are also connexions with Lebanon and Jordan: Lebanon helped to supply Syrian deficiencies earlier, and Jordan needs Syrian supply. A new steam power station at Hama is under construction, a 300 MW station at Banias is contracted for, and a third one is under study. At present very little more power can be extracted from the Euphrates Dam, which supplied some 800 MW or about 80 per cent of total production.

The electricity tariff has not been changed since 1969. It is a graduated tariff with some reference to marginal costs, with a higher price for higher voltages, 220 volts being the cheapest. There are high rates for consumption at peak periods. The first study of the tariff structure was made by Sofrelec Company in 1963 when a plan for the period up to 1985 was made. This is now updated every two to three years. Total tariff revenues covered operating costs and interests on loans up to 1977 when operations went into the red.

New studies are being made and an increase in tariffs has been requested. The increase for households will be very much less than for other consumers and especially than for heavy industry.

Finance for expansion comes from consumers, Government and foreign aid. The latter source is used as much as possible, and about 25 per cent of investment finance has come from outside, while consumers (who pay for meters, transformers, and connexions as well as supply) have provided about 10 per cent with the balance made up by Government loans which carry a 9 per cent of interest. Consultants prepare projects and make the feasibility studies which are then submitted to outside sources for financing. Among the more

ambitious programmes is one for the electrification of the countryside. Next year electricity is expected to be supplied to every village with over 1,000 inhabitants, and during 1979-1981 electricity will go to all villages. This programme is financed by the World Bank.

The most serious bottlenecks in the expansion of supplies lie in the transmission and distribution system which is not only expensive but is very labour intensive. Of the 12,000 people in the Public Establishment of Electricity, about 60 per cent are employed in distribution. There is a training programme, particularly for foremen, but the Establishment faces the same problem as other agencies in the country; people are attracted abroad by higher salaries in spite of the fact that the electricity authorities are allowed to pay somewhat higher than usual salaries and give better fringe benefits.

3. Research

Research in the field of renewable sources of energy is of interest to three institutions: the Ministries of Agriculture and of Electricity and the Supreme Council for Sciences. In addition, there is some work done in the universities by a few individual professors and students. At the beginning of 1979, the Supreme Council for Sciences set up a new committee for solar energy. A director has been appointed with a staff of three and they are just beginning to design a programme of research and decide priorities. It is hoped eventually to be able to co-ordinate the work being done in individual ministries and in the universities and to encourage collaboration. In the first instance, emphasis will be placed on thermal conversion, optical concentration, home heating, and practical demonstrations to the public in order to win interst and support. One of the major needs is to increase the supply of trained technical people and to expand the scientific capacity of the country, which is at present considered to be weak. To this end, it is hoped to develop an extensive training programme.

There is a Research Department in the Ministry of Electricity which was established some five years ago and has been primarily concerned with engineering aspects of electricity production, insulation, transmission, etc. A research station has been established for this purpose. The Ministry is also planning a 600 MW nuclear reactor which may be completed in eight years.

Recently, research on solar energy has also been initiated with a seminar held in April 1979. Activities considered involve the use of windmills and solar pannels in combination to charge batteries capable of producing a continuous supply of 400 W for ten days, with a peak capacity of 2.1 KW from wind energy and one KW from solar energy. The use of solar energy to supply power for repeater stations in high mountains where it is very expensive is of special interest as part of the Electricity Board's communication network. It is planned to experiment with photovoltaic pannels with an output of 400 W for each station.

Although hydroelectric power from the Euphrates has nearly reached capacity, it is planned to investigate the possibility of enhancing hydropower by harnessing the high run-off of rain water from the mountains in coastal parts of the country.

Energy training programmes for students have only recently been introduced in the University of Damascus and some work is also going on at Aleppo University. But it is in a very early stage and it seems that considerable concentrated effort and planning will be required to expand to the necessary extent the country's scientific capacity at the academic level. This should be an urgent priority in view of the time required to do so. A Society for Syrian Physicists and Mathematicians was established only six months ago which plans to set up a group on solar energy and thus may help to concentrate academic efforts.

4. Summary

Oil operations are undertaken under the supervision of the Ministry of Petroleum through a chain of vertically linked subsidiary operating companies. Overall, the Syrian Arab Republic is self-sufficient in petroleum products, the refining and distribution of which is conducted by the two domestic refining companies. Prices are determined by an interministerial committee, and sales of crude oil to the domestic refineries are made at international prices. Nevertheless, it was not thought desirable to raise the domestic prices of products to the level of the increased international prices in 1974, and subsidies were considerable. In 1978, prices were increased in order to reduce the subsidies, but the latter still remain high. Inadequate salary scales make it difficult for the oil companies to attract and retain qualified manpower.

The supply of electricity is under the control of the Public Establishment of Electricity which is supervised by the Ministry of Electricity. There is a national grid with connexions with neighbouring countries, and there are plans for considerable expansion of steam generation, since it is not possible to expand hydroelectric power from the Euphrates Dam, which supplies about 80 per cent of total production at present. Up to 1977, revenues covered costs but since then losses have been made and an increase in tariffs is under consideration.

An extensive rural electrification programme is now being implemented, financed by the World Bank. The expansion of the transmission and distribution system to keep up with demand is handicapped by the difficulties of attracting and retaining skilled workers, especially supervisory staff, in competition with higher salaries and benefits offered elsewhere.

Research in the field of renewable sources of energy is being undertaken by the Ministries of Agriculture and of Electricity and by the Supreme Council for Sciences. The main emphasis is on enhancing hydropower from the Euphrates, on solar and wind energy and on nuclear electricity. Energy training programmes have recently been introduced in the Universities of Damascus and Aleppo, but there is an urgent need to increase the supply of trained technical people and to expand the scientific capacity of the country.

5. Recommendations

It is suggested that the Syrian Government:

1. Continue with its efforts to eliminate subsidies on the use of energy except for very special and well-defined uses;

2. Consider the desirability of adopting salary scales for skilled workers which would permit the relevant operating authorities to attract and retain the necessary workers in view of the strategic importance of the energy sector;

3. Consider ways of giving more autonomy to the institutions dealing with the supply of oil products;

4. Examine the desirability of promoting in the universities a significant effort in training and research in renewable sources of energy, especially in solar and wind energy, and the prospects of adapting technology developed elsewhere to Syrian conditions;

5. Consider the possibility of co-ordinating the energy research work being undertaken in ministries and universities under the umbrella of the Supreme Council for Sciences, and to encourage co-operation.

III. COUNTRIES WITHOUT OIL RESOURCES

Among the poorest countries in the Arab world are two countries without oil production of their own, Democratic Yemen and Yemen. Both have relatively undeveloped agriculture and very little industry and their per capita consumption of energy is among the lowest in the world. Democratic Yemen is a larger consumer of energy and in some ways is more developed, particularly in the Aden Area, than Yemen, but the development of both is accelerating and demands on their existing energy institutions are rising accordingly. Yemen must import all of its oil products, for only Democratic Yemen has a refinery, which was inherited from British Petroleum. In both countries electricity supplies will be more difficult to develop and to maintain at an adequate level than the supply of oil products, for the latter can be imported while the former cannot at present.

A. Democratic Yemen

The indigenous energy resources of Democratic Yemen are confined to the fuels traditionally used by the local people which they gather themselves. Crude oil must be imported and electricity is generated using oil as the source of fuel. Unlike Yemen, however, Democratic Yemen has a domestic refinery which supplies its oil products, domestic consumption of which has now reached about 450,000 tons a year.

1. Petroleum

The two major national institutions dealing with the supply of oil products to Democratic Yemen are the Aden Refining Company (ARC) and the Yemen National Oil Company (YNOC). Both are under the Petroleum and Minerals Company (PMC) which was formed in August 1978, and also has under it a Petroleum Exploration Department, a Minerals Exploration Department and a Bunkering and Terminal Company (BTC). The Company has a working board of directors consisting of ten members who represent the directors of its various sections. The chairman of the board holds ministerial rank and is a member of the central committee of the ruling political party.

The director of each of the five organizations under the board's umbrella is appointed by the Government and reports to the chairman of the board. Two of the organizations, including YNOC and BTC, have a board of directors of their own; the other three have advisory committees to assist their director. BTC, a joint venture between Democratic Yemen (51 per cent) and Kuwait (49 per cent), was established to supply bunkers in competition with the international companies. The Exploration Department has made contracts on a production-sharing basis with two foreign companies under which two drills are working. It also has two drills of its own. Although geophysical surveys are reported to have yielded optimistic results, no oil has as yet been found.

When the refinery was handed over to the Government a management and technical services agreement was made with British Petroleum (BP) which at that time had some 40 people attached to the refinery, 12 in the refinery itself, including the general manager, the refinery manager, the chief engineer, and the tug captain, and the rest in auxiliary operations. At present there are six technicians, ten marine specialists and a medical team of sixteen throughput has turned out to be much less than the Yemenis had hoped in view of the changed circumstances in international trade following the closure of the Suez Canal and the decline of bunkering. Accordingly, the number of British personnel is being substantially reduced. By the end of 1979 there is expected to be only four British Petroleum people left in the refinery: The general manager, the chief engineer, the maintenance engineer and an inspector. Technical back-up will continue to be supplied from London and BP will continue to run a training course for Yemeni personnel.

YNOC was formed in 1969 to take over the local marketing of oil products after the Government had nationalized the distribution companies as part of its general programme of nationalization. Consumption then was about 150,000 to 180,000 tons a year and the distribution was carried out by many independent marketers throughout the country, as well as through the larger operations of the international oil companies who marketed under their own brands. There were two installations for the storage of white products, one in Aden and one in Mukalla.

The first task of YNOC was to attempt to organize and unify the distribution system. At the same time the Government itself was engaged in the attempt to forge one country out of the existing 28 states. Between 1969 and 1972, a skeleton organization was created under YNOC which now has developed into a reasonably unified system with numerous distribution branches and specialized outlets. There are however a number of distribution centres not directly under YNOC, notably co-operatives, which are serviced by YNOC. The major products are gas oil for diesel pumps, fuel oil for the power stations, kerosene for domestic lighting and cooking, and gasoline. YNOC is also making efforts to extend the use of LPG throughout the country. Gas has long been used in Aden but the company is encouraging its use for cooking instead of firewood and dung in the countryside. YNOC imports the cylinders, fills and distributes them. It anticipates a very rapid initial increase in consumption of 50 per cent to 75 per cent in the next two years.

The rate of growth in consumption of oil products has been around 12 per cent per year since 1972 and consumption outside the Aden Area has increased to about 40 per cent of the total, reportedly due to a very rapid growth in Agriculture since the land reform, and to the explicit policy of the Government to concentrate its development efforts on the rural areas, on agricultural development and on agro-industry. In order to conserve gasoline and to control the use of automobiles by Government officials, a system of rationing has been introduced. Monthly allocations of coupons are made to officials which enable them to obtain gasolene. When the coupons are exhausted, no further supplies are permitted.

Revenues of YNOC do not cover costs. As elsewhere prices of oil products, like those of other necessities, are politically sensitive issues. Not only do they affect industrial costs but they directly affect the standard of living of the people. After the rise in oil prices in 1974, product prices were increased by a flat amount. This decision was then taken by the Currency Board. Now decisions on prices are taken by the Petroleum and Minerals Board in conjunction with the Higher National Planning Council and, in the last analysis, at the Prime Minister level. Prices have not been raised since 1974 and the same price for a

given product is charged throughout the country. The total subsidy has been estimated at around US$ 7 million a year. Since, however, 75 per cent of consumption is by public enterprises, Government agencies and co-operatives, the subsidy is to a considerable extent a transfer from one Government supported agency to another. Nevertheless, it defeats the function of prices as a means of discouraging waste and the unnecessary consumption of a scarce commodity. The company does endeavour, to reduce costs and boasts that significant savings are made through the "mass initiatives" of the workers-voluntary initiatives undertaken by workers to increase output or reduce costs primarily by working overtime, on holidays, etc., without pay.

The formation of future plans is undertaken within the YNOC at the level of the board of directors, but there is also an energy section in the industrial department of the Ministry of Planning, and "Planning Units" are placed within YNOC as in other Government organizations. The units are technically related to the Ministry of Planning but report to the Ministry of Industry. Decisions about future investment and operations are made at ministerial level and some of the longer run objectives and desired projects have been set forth in the quinquennial Plan for Economic and Social Development (1974/75 - 1978/79) published by the Central Planning Commission. The projects included extended geological research, and further development of storage facilities.

Democratic Yemen suffers from a severe shortage of qualified manpower and there is apparently still considerable emigration, particularly to the Gulf, in spite of Government efforts to stop it. Employed workers are not allowed to leave without special permission and efforts are made to ensure that students sent abroad to study will return. Salaries in the oil industry are somewhat above the average and superior fringe benefits are available for refinery workers. Exploration personnel receive special allowances.

2. Electricity

The country's public electricity supply is the responsibility of the Public Corporation for Electric Power (PCEP). This company was established in 1969 as the successor to the Aden Electric Corporation (AEC) which, under the supervision of the Ministry of Public Works, had supplied power to Aden. In 1953, there was one steam power station with four steam turbines, three of 5 MW. Two of these are still in operation after 25 years of continuous use, are becoming increasingly inefficient and are urgently in need of replacement. In 1965 a 6.5 MW gas turbine was installed at Mukalla. Another had been planned to come on stream in 1971 but was cancelled after independence. On independence there was a network of four substations at four main towns. The army camps were supplied by small diesel stations and in Little Aden there was a steam power station of 3 x 7 MW at the refinery run by BP. This is still the only important generating plant outside PCEP. When the refinery was handed over to the Government, there was a contract between AEC and BP under which the latter supplied AEC with gas. PCEP is still connected with the refinery generating capacity and can buy surplus gas from it at favourable prices.

Over 85 per cent of PCEP's 69 MW generating capacity is in the Aden area. The newest large addition was in 1977 at Khormaksar when a 5 x 5 MW station was completed to run on heavy fuel. The corporation has taken over small diesel stations throughout the country and other existing Government power stations as branches wherever possible. There are many power stations so very small that they are unsuitable as branches and the PCEP gives technical advice to these. The corporation has branches in Abyan, Mukalla, Lawdar, and Modia and two in the Wadi Hadramout, where there are also a number of plants not owned by PCEP. The transmission network is now seven times what it was in 1969 and consists of nearly 100 km of 33 kV lines. A high tension line connects the first and third governorates and it is hoped to extend this to the second and fourth at a later date. Maintenance of the lines is very costly because of insulation pollution due to humidity, salt and sand and the absence of rain to clean the insulators.

PCEP has a board of directors which consists of the heads of the technical departments of the corporation and representatives of the workers, including a representative of the country's ruling political party. The chief executive of the corporation is also the chairman of the board. It has operating autonomy but policy is made at the ministerial level. The staff of over 1,000 people is heavily concentrated in Aden and is in need of considerable reinforcement if it is to cope with the expansion of the system necessary to meet the country's requirements. Some training is undertaken, but a systematic and enlarged programme is required. The Planning Department of PCEP is drawing up such a programme and the World Bank has agreed to help finance it when finally agreed and approved. It is planned to locate the training centre at the site of the new 60 MW diesel station expected to come on stream in Mansoura (Aden) in the summer of 1980. This will permit the closure of the aged steam station at Aden and it is hoped that it will be the beginning of a national network as well as provide a centre where the urgently needed junior cadres for PCEP can be trained.

Consumption is heavily concentrated in the Aden area but there has been a marked decrease in the peak demand since independence with the closure of the base and the departure of most of the expatriate population. Moreover, under an austerity programme the Government has prohibited the import of air conditioning units, which accounted for a very large part of the domestic demand. This contributed heavily to putting the 24 hour peak at night. The night peak, however, has increased at only 3 per cent while the morning peak has increased at 8 per cent and now exceeds the evening peak. Peak consumption is now 33 MW. The change is the relative position of night and daytime use reflects also the changing position of industrial, agricultural, and especially agro-industrial, use relative to domestic use.

Prices have gone up substantially since 1973 as a result of the increase in international oil prices. Tariffs had not been revised since 1953 when they were 9 fils/kWh 1/ for all consumers. In 1974, they were raised differentially:

1/ One Yemeni dinar (YD) is divided into 1000 fils US$ 1 = YD 0.345 (February 1979).

Yemen domestic consumers now pay 16 fils/kWh for the first 100 kWh and 27 fils after that; agro-industrial users pay 12 fils for evening consumption and 8 fils for other periods; commerce, Government and some industries have a single tariff of 27 fils/kWh; foreign residents pay 30 fils. The average cost of production is 22 fils/kWh. Although there are a number of fixed charges, including meter rentals which customers must pay, as well as a deposit of YD 5 as a part of the connection cost (on the first connection they receive free 60 feet of wire, but only on the first), total revenues do not cover costs and a subsidy is therefore required. This is provided from the Ministry of Finance. PCEP would like an increase in the tariff and an outside consultant is reviewing the question. Moreover, since the Government is approaching both the World Bank and AFESD for financial assistance for its electric projects, it is likely that some increases will be made since both organizations prefer to lend to profitable enterprises.

Only a few major towns have a continuous supply of electricity, the rest of the country receiving it only a few hours a day. Government policy is to concentrate resources on productive uses and to discourage household consumption except when associated with agro-industrial development. Even rural electrification, for which resources have not as yet been available, is expected to be associated primarily with the development of agro-industries.

The two areas which are expected to receive by far the greater part of new investment are the Aden system, where industrial and agro-industrial development is expected to develop rapidly, and the Wadi Hadramout, now the largest agricultural area in the country with a great potential for agricultural and agro-industrial development. The latter area is now served by two stations, one at Sayoun and one at al-Qatn owned by PCEP, and by numerous smaller diesel stations. An integrated system for the area is planned to provide power to pumps and generally to service co-operatives, state farms, villages, agro-industry and agricultural villages. The funds are expected to come from the World Bank and AFESD.

3. Summary

Oil products are produced from imported crude by the Aden Refining Company and local distribution is carried out by YNOC, both companies operating under the umbrella of the newly formed Petroleum and Minerals Company. Although the Aden area accounts for some 60 per cent of consumption, Government policy concentrates

on the development of the countryside where demand is growing rapidly, largely from co-operatives and agro-industrial enterprises. Product prices were increased in 1974 but revenues do not cover costs and the subsidy is estimated at around US$ 7 million a year, 75 per cent of consumption is by public enterprises, Government agencies and co-operatives. There is a severe shortage of qualified manpower and apparently considerable emigration, especially to the Gulf, in spite of the fact that the oil industry is permitted to pay salaries above the average and refinery workers obtain superior fringe benefits.

The public electricity supply is the responsibility of the Public Corporation for Electric Power (PCEP) which has taken over many of the small diesel power stations scattered throughout the country and gives technical advice to those that are too small to be absorbed as branches. The only major generating plant outside the PCEP is the Aden generating plant connected with the refinery, from which PCEP can buy gas at favourable prices. In the last ten years the transmission network has been expanded sevenfold. PCEP has operating autonomy but policy decisions are made at the ministerial level. Consumption is heavily concentrated in the Aden area, but since the closure of the British military base. The departure of the expatriate population and the recent prohibition of the importation of air conditioning units by the Government, peak demand has dropped markedly. Prices were increased substantially in 1974, but total revenues do not cover costs and a subsidy is required. The question of an increase in tariffs is being studied. Financial assistance for electrical projects is being requested from both the World Bank and AFESD. Emphasis will be placed on productive uses, and especially agro-industrial development, at the expense of household consumption. A large integrated system for the Wadi Hadramout is being planned.

4. Recommendation

It is suggested that the Government of Democratic Yemen expand as rapidly as possible its training programme and continue with its efforts to rationalize prices.

B. Yemen

1. Petroleum

The average annual increase of the demand for petroleum products in the period 1970-1975 was 19 per cent and demand exceeded 200,000 tons in 1976 according to the Yemen Petroleum Company statistics. Products are imported from Saudi Arabia and Kuwait through the port of Hodaida. LPG is also imported and there has been a marked substitution of LPG for firewood for cooking purposes.

Petroleum activities are now concentrated in the Yemen Oil and Minerals Resources Corporation (YOMINCO) which was formed only in 1978, taking over the then existing Yemen Petroleum Company, the Mineral and Petroleum Resources Authority (now re-named the Geological and Survey Authority), the State Corporation for Salif Salt (re-named Salif Salt Production and Distribution Company), and the National Company of Industrial and Construction Materials. Private shares in these companies were acquired by YOMINCO, which is an autonomous public company whose director is a minister of State. It has a budget of its own, is expected to make profits and is allowed to retain much of its own finance. It also is not subject to civil service regulations with respect to salaries and is thus able to compete for personnel on very favourable terms.

YOMINCO is responsible for oil distribution, which is entirely by road, and runs petrol stations. Oil exploration is conducted primarily offshore, where the prospects seem brightest, by foreign companies who take the exploration risk. Finance is a serious constraint on the implementation of the investment projects outlined in the five-year plan. These included, in addition to increased storage facilities, a plant for the manufacture of butagas containers, the extension of pipelines to Sanaa and Taiz from the port, improvements in the facilities at the airport. Attempts are made to attract foreign finance for these activities as well as for increased oil exploration and for the appraisal of other potential mineral and energy resources.

The structure and level of prices do not reflect the increased costs of imported oil. In particular kerosene and diesel oil, which account for two-thirds of the total imports of products, are sold below cost, the deficit for the company being met by subsidies from the Government. At the same time, oil products are also heavily taxed, but the relation between subsidies, prices and taxes seems to have no economic logic and the general problem requires a far-reaching re-appraisal.

At present there is no petroleum law governing oil concessions. It is argued by some that such a law should be passed as a means of making clear to potential foreign concessionaires what the Government expects of them and will in its turn offer them. This is held to be a way of encouraging the entry of companies by assuring them of inducements not only to enter but also to accept the risk of exploration in a country where prospects have not so far proved promising. But it is also argued, on the other hand, that any law risks being excessively restrictive. Since Yemen would probably have to offer companies especially favourable terms, and in particular terms more favourable than those advocated by OPEC in its recommended legislation, it might indeed be politically embarassing to the Government explicitly to adopt legislation which appeared too favourable by OPEC standards. On the other hand, if exceptionally attractive terms are offered to the companies and if oil were discovered in commercial quantities, formal legislation would undoubtedly then become necessary and the companies would not be convinced that the terms offered, whether by law or in specially negotiated contracts would remain unchanged. On balance, therefore, it probably makes little difference in these circumstances whether or not legislation is passed at this stage.

2. Electricity

The overall average annual increase in electricity consumption in the three main cities, Sanaa, Taiz and Hodaida was almost 25 per cent in the period 1971-1975, but this reflects the rate at which supply could be expanded more than it reflects the rate of increase of demand, in that "suppressed demand" - inability to connect potential customers - is very high. The responsibility for electricity is divided between the Yemen General Electricity Corporation, which is a Government-owned company responsible for the public supply of power, and

other private enterprises which have built their own generating facilities. These include the cement factory, cotton and ginning enterprises, and confectionary, soap, and edible oil factories. In addition there are a number of small privately built generating plants scattered around the country in the smaller towns and villages. Estimates of electricity production by such plants are not available.

The Yemen General Electricity Corporation (YGEC) was established in 1975 and took over the three existing utility companies, then owned 51 per cent by the Government, in the three main towns. YGEC comes under the Ministry of Economy, but has an independent chairman and considerable autonomy in its operations. Its budget goes to the cabinet for approval and it is legally required to make profits of 8 per cent as a minimum and 12 per cent as a maximum.

The three major power stations in Sanaa, Hodaida and Taiz are being developed to lay the basis for a triangular national grid system which according to the plan should be finished by 1985. At the time of the formation of YGEC an application for loans was made to the Arab Fund for Economic and Social Development (AFESD) to finance "stage one" of its expansion programme. Loans were obtained from Saudi Arabia and from AFESD for an increase in plant in Sanaa, an increase in the distribution network, and new power stations in Hodaida and Taiz. This stage is now 80 per cent complete. "Stage Two", for which Saudi and AFESD finance has been obtained envisages a large new steam generating station in Hodaida which will also serve Sanaa. Tenders are out and it is hoped to place contracts for the coming year. "Stage Three" involves another new power station at Hodaida. This city is the country's main port and is likely to become its major industrial centre; the new power plants will be located there, partly for this reason and partly because of the availability of sea-water for cooling. For steam generating plants bunker fuel will be used. The gas oil in use at present is bought from YOMINCO at less than the world price.

In the country's five-year plan there are proposals for extensive rural electrification, a considerable expansion of small generating stations and new power lines, and distribution networks. Financial, technical and manpower considerations are the major limitations on implementation.

Most electricity is consumed in the domestic sector but there are no good estimates of effective demand since connexions are discouraged. In Hodaida and Taiz no new connexions are being made at present. In 1977, 7.5 MW was connected to a suppressed demand. In 1978, 15 MW was supplied and demand was still unsatisfied. YGEC estimates that demand is now at least 20 MW. The peak load occurs at night when small welders, repairers, etc. are heavy users. The electricity is sold at a flat rate of 70 fils/kWh. 1/ Operations are not as efficient as YGEC would like. There are a large number of small engines and costs are very high. A new tariff structure is being proposed with the help of a foreign consultant which will bring increased prices as the amount consumed increases for all users. This should encourage conservation. It is also proposed to introduce higher charges for peak periods and thus discourage heavy use at night.

A training centre is now being established by YGEC and all foreign contracts include not only a period of operation by the foreign contractor but provisions for training. It takes three years to train for steam generation a student taken from the secondary school. Steam technology, which is being used in the new plants, is new to Yemen. YGEC has altogether less than 100 professionals (engineers, technical people, etc.) in all three of its areas but scholarships are available from dozens of countries. The differences in the language and type of training in the different foreign countries to which students are sent does create some problems but the need is so great at all levels, including office and secretarial staff, that aid is welcome from anywhere. Billing and accounting are computerized, however, the YGEC expects a considerable loss of people after training, especially to other countries and to foreign companies where higher wages are paid, but it is not allowed to take employees from other Government departments without permission. The greatest need is for on-site distribution foremen with basic electrical training in distribution networks and for people at the sub-professional level with experience. Training does not produce experienced people and therefore expatriates with experience are urgently demanded.

1/ One Yemeni Riyal (YR) is divided into 100 fils
US$ 1 = YR 4.563 (February 1979).

3. Summary

Petroleum activities are concentrated in the Yemen Oil and Minerals Resources Corporation (YOMINCO), an autonomous company whose director is a minister of State. It was formed only in 1978 through a merger of a number of other agencies and is therefore in the early stages of its organization and operation. All petroleum products are imported but finance is a severe constraint on the implementation of investment plans for the improvement of storage and distribution facilities. YOMINCO is required to operate at a loss since prices are set below import costs and the corporation relies on Government subsidies, while at the same time oil products are also heavily taxed.

Yemen has no crude production and YOMINCO encourages exploration by foreign companies and efforts are made to attract further foreign investment.

The consumption of electricity has been rising very rapidly but supply has not been able to keep pace with the underlying rate of increase of demand and suppressed demand is estimated to be very high. Public electricity supply is in the hands of the Yemen General Electricity Corporation (YGEC), a Government owned company but there are a large number of small private generating plants. YGEC is given considerable autonomy in its operations and is required to make a minimum profit of 8 per cent with a maximum of 12 per cent. A triangular grid system connecting the three main cities is being implemented in three stages, largely with finance from Saudi Arabia and AFESD, but manpower and technical considerations as well as finance limit the rate of expansion. There is an extensive training programme but badly needed foremen with experience are in very short supply.

At present the operations are fairly high cost due to the large number of small operations. Electricity is sold at a flat rate but a new graduated tariff is expected to be introduced soon.

4. Recommendations

It is suggested that the Government of Yemen:

(a) Reexamine the relationship between subsidies, prices and taxes on oil products in order to establish a more consistent structure and achieve greater economic rationality;

(b) Expand its training programmes as fast as possible.

IV. REGIONAL COMPARATIVE SYNTHESIS

A. Comparative synthesis

The most important points that emerge from this brief survey of the role and operation of energy institutions in the seven countries considered and which are common to most of all of them are the following:

1. The institutions charged with the supply of oil products and electricity in these countries have very little real autonomy and a very small role in the formation of any of the important decisions on policy. They are primarily operating institutions subject to decisions made by the political authorities.

2. They are required to accept sales prices determined on political or social grounds which often force them to incur losses. They thus have to rely on the fiscal authorities for funds to meet not only their operating costs but also the cost of investments required for the expansion necessary to meet the needs of the economy. Often the policies adopted with respect to the taxation, subsidization and pricing of energy seem to have little coherence or social rationale.

3. Similarly, the relative prices of different sources of energy, of different oil products or of electricity sold for different uses or at different times seem to have no clear rationale.

4. The structures of oil product prices and of electricity tariffs tend to be extremely inflexible in the face of changing external circumstances, and in some cases they have not been changed for many years or have been changed only slightly. The inertia imposed by the weight of the past and the pressure of present urgent demands on the time of exports and bureaucrats may account for some, but by no means all, of this.

5. Pricing policies designed to help low-income groups and hold down production costs in industry, agriculture or transport are such as to encourage waste and unnecessary consumption.

6. The low-price domestic policies of the oil-exporting countries which, at the moment, can afford extensive subsidies to their own populations, are inconsistent with the argument of their international policy that high oil prices should be accepted as a means of discouraging the consumption of oil as a fuel in favour of its more valuable uses. Moreover, these countries do not extend to the rest of the Arab world the argument that low domestic prices are desirable on social grounds. Indeed it may be appropriate that they do not do so since help of this kind is probably best given as a balance-of-payment or budget support, but the social case for lower prices at home is not stronger than the case for lower prices to poor countries.

7. In all of the energy institutions, the shortage of skilled manpower, particularly at the intermediate level, is the most serious constraint on their operational efficiency and on the implementation of their investment programmes. For the region as a whole, there is an inadequate supply of skilled people and the pressure of demand on the relatively inelastic available supply continually forces up wages and salaries in those sectors or countries where remuneration is subject to the least restraint. Thus, the richer oil-exporting countries attract workers from the poorer countries of the region, and because most governments remunerate government employees at levels below those obtainable outside the government sector, the private sector everywhere attracts people away from the public sector. Governments have adopted such policies because of budgetary restraints, or as part of general income policies, or in order to prevent the inefficiencies and strains arising where is a continual movement of personnel among departments or agencies in the government sector as people take advantage of more remunerative opportunities. Such partial restraints may inhibit movement, but will also tend to reduce the forthcoming supply of personnel to the government sector. Although the migration of workers from the poorer to the richer countries seriously reduces the availability of workers urgently needed to maintain the efficiency of local operations, there is some offset to this loss for the country of emigration because the remittances sent home by such workers are often a significant source of foreign earnings.

8. On the technical as contrasted to the economic side, the operation of the energy institutions of the countries surveyed seems to be reasonably successful. This is a general judgement based upon necessarily cursory and summary examination.

A more extended examination would undoubtedly uncover areas of weakness which would yield to appropriate action. Because the supply of energy has a high priority in government plans, the institutions supplying it have not been starved of funds, although some of the countries do not have the resources to support them on a really generous scale. Nevertheless, for the most part their officials do not feel that finance is their greatest problem. The distribution of oil products, the operation of refineries (where relevant) and the operation of electricity generation and distribution seem in general to be as efficiently conducted as the limited supply of skilled personnel and managerial cadres permit. The senior technical people are often very well qualified indeed. At the same time one does have the impression that accounting methods and financial control could be strengthened in a number of countries.

9. Political interference and corruption are extremely sensitive issues and it would not have been appropriate to enquire into them. Hence such issues are not discussed here, but the officials in the countries concerned are aware of the problems created, and it perhaps should be mentioned that from time to time clear evidence appeared that one or both of these had interfered with the efficiency of operations.

10. The countries do not seem to have had difficulty in acquiring the technology they needed from abroad except in the field of nuclear energy, where some countries have apparently encountered problems, particularly with the United Sates. As might be expected, research is not conducted on a very significant scale except in oil exploration (if that is to be classed as research). Modest programmes of research into solar energy and other non-conventional energy sources are underway in some countries, notably in Saudi Arabia.

B. Regional Co-operation

There is some, but very little, co-operation or co-ordination among the countries in the field of energy supply and research. There are a number of reasons for this. In all countries, the key policy-makers and the few effective operational personnel have their hands full with the immediate tasks of developing their own economies. In some areas, there is little scope at present for co-operation. For example, electricity networks may be insufficiently developed or possess

incompatibilities which it takes time and resources to overcome. In some cases, preferential treatment for Arab countries will be inconsistent with established policy. For example, most oil-exporting countries fear either that the granting of preferential discounts on crude oil to any country would sooner or later lead to an erosion of the price level or that such actions would create expectations and precedences which would be undersirable in the face of an expected "shortage" of adequate supplies over the next decade. On occasions, strong political differences have inhibited co-operation.

Nevertheless, there are possibilities of strengthening existing co-operative moves and of exploring the usefulness and viability of co-operation in other directions. Specific suggestions are put forward in the next section.

V. PROSPECTS FOR ACTION

It can readily be seen from the nature of the previous regional comparative synthesis that most of the really serious issues requiring examination and action are inextricably connected with the wider economic and social policies of the governments concerned. They are not, therefore, easily made the subject of recommendations within the context of the energy industries alone. Moreover, the issues are widely recognized by the governments. But even when there is virtual agreement that something ought to be done, and at the highest political levels, the obstacles in the way of any course of action seem so serious in the short run that action is often virtually paralyzed.

With these considerations in mind, the following suggestions are made:

1. A clear distinction should be drawn between the structure of prices (that is, the relative prices of different sources of energy, of different oil products, the schedule of electricity tariffs, etc.) and the general level of prices.

2. In all of the countries considered, a thorough-going review of the pricing structure together with an examination of the incidence and use of taxes and subsidies is required. In some countries, this is already underway or has recently been done with the help of outside consultants. The setting of electricity tariffs is a highly technical matter, and skilled technical consultants will usually be required. The pricing of oil products cannot easily escape the influence of international price structures since most countries must import, and many both import and export oil products as well as crude oil. Again, any country, whether it be a crude oil producer or not, may want to subsidize certain uses of oil on developmental or social grounds, but the case for a generally low level of prices even when oil is domestically produced needs careful evaluation. Relative prices should be closely related to differential costs and elasticities of demand.

3. Where subsidies are desired for social or economic purposes (to alleviate hardship or on developmental grounds), each case should be carefully evaluated, precisely defined, and costed.

4. In circumstances where costs can be expected to continue to rise, the eventual necessity of adjusting the level of prices should be recognized as early as possible in order to avoid the emergence of serious political, social or economic crises since eventually budgetary constraints are likely to become increasingly difficult to escape.

5. In circumstances where changes in the pattern of demand or supply can be expected, the introduction of some method of providing flexibility in the pricing system would be desirable in view of the distortions created by extreme rigidities over long periods.

6. The other really serious issue is the competition for manpower between countries and between sectors and is as difficult as the price issue. Direct controls over, and allocation of labour creates administrative problems, gives rise to favouritism and discrimination, and its results are often the opposite of what was intended since people find ingenious ways of getting around the controls. The alternative - competition in the market place among governments and between governments and the private sector - produces equally undersirable results in that it places the poorest countries in weak positions and leads to escalations of short-run salary and wage levels without any short-run increases in supply. In the longer run, of course, supply should increase as individuals and governments find it worthwhile to increase the desired qualifications. The dilemma is real and acute. However, some countries refuse to pay the wage necessary to keep their own people at home in activities where their productivity, and thus their contribution to their own economy, would justify very high wages. These countries should reexamine their policy. It may appear attractive on grounds of equity in income distribution but the cost in terms of economic development of the emigration of their most skilled people from areas as important as energy for the achievement of generally rising standards of living, may be excessively great.

The issue, however, is not confined to energy institutions and any solutions would have therefore to be applicable over a wider area. Much attention has already been paid to these general questions, and there is little point in making specific recommendations here.

7. There is very little significant regional co-operation among the States in the area, and in some fields this could be improved. A detailed study of possibilities for extending such co-operation would therefore be desirable. In particular, there is scope and an urgent need for more co-operation within the United Arab Emirates, and further outside collaboration, such as that extended by Kuwait, would be useful.

8. Co-operation could also be increased in the field of research, especially in the use of solar and other less conventional sources of energy at the village level and on the development and application of intermediate technology.

9. The desirability of extending the work of the Arab Organization for Standardization and Metrology (ASMO) to cover the relevant aspects of standardization in energy production, distribution and use (including certain aspects of electrical appliances) might also be worth investigation.

10. Co-operation in smoothing the incidence of surpluses and deficits in electricity supply, such as that already in operation between the Syrian Arab Republic and some of its neighbours, might also be possible.

11. It is in general suggested that not only should the joint efforts of the Arab countries, as exemplified by the activities directly or indirectly related to energy problems undertaken in Arab organizations such as OAPEC, the League of Arab States, etc., be continued, surveyed and monitored, but that additional activities in the areas outlined above be initiated by ECWA, in particular with reference to the structure of relative prices and the problems related to subsidies.

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