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PROGRESS MADE IN THE IMPLEMENTATION OF THE WORK PROGRAMME

INTEGRATED ENERGY PLANNING IN SELECTED ESCWA COUNTRIES

Note by the Secretariat

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I. INTRODUCTION

Developing countries face many development constraints including the increasing needs for energy resources. Many developing countries experienced a decrease in their rates of economic growth when energy prices rose in the seventies and the importance of efficiently allocating scarce energy resources to promote the fastest possible rate of growth is now clear. Energy planning is a means of promoting the best use of energy resources and should be an integral part of an overall development plan. Emphasis on the promotion of certain productive sectors will affect the type and amount of energy required making the co-ordination and integration of energy plans in the overall development plan of utmost importance. Furthermore, because of the opportunity cost incurred when energy resources are wasted or inefficiently used, energy planning is important even in countries with large amounts of energy reserves.

The complexity of an energy plan depends, to a large extent, on the structure of the economy under consideration. A centrally-planned economy requires a great deal of planning in general and for energy use in particular. A totally free market economy, on the other hand, might require less direct planning, but at least some supervision of pricing policies and taxes. Most countries in the ESCWA region have at least some degree of control by central authorities and general economic planning with an integrated energy plan is appropriate. Energy plans are actually tools which enable the policy-maker to make appropriate energy choices. A comprehensive plan should include different scenarios to reflect different overall development planning options. Energy needs for various growth levels, differences in emphasis on productive sectors and type of energy used should be clearly outlined in a comprehensive energy plan.

The energy needs of the ESCWA region raise interesting problems due to the inclusion of high income oil-exporting countries, least developed oil-importing countries and countries in between these two extremes. Institutional and political factors in the ESCWA region make a country by country approach most appropriate. The countries selected for this study, Jordan, Kuwait and Syria, reflect the diversity in economic development, energy use and energy supplies found in the region as a whole. Jordan has a diversified economy and is currently stressing the importance of private sector involvement in its development plans. Nonetheless, the government is involved in major economic decisions and will undertake large-scale projects deemed too risky by the private sector. Until very recently, it relied totally on imported oil, but newly discovered oil reserves may replace some oil imports in the future. Kuwait's economy is dominated by the oil sector and recent diversification efforts have been financed by substantial oil revenues. The government is heavily involved in the oil industry and thus has considerable influence over the entire economy even though private sector involvement is encouraged in non-oil sectors. Energy planning is important in a country such as Kuwait with large oil and gas reserves due to the significant opportunity costs of wasted energy. Syria has a diversified, centrally-planned economy and produces some oil, but still needs to import some of its energy, thereby making energy planning very important.

Energy planning in the countries of the ESCWA region, including the countries examined here, is hampered by the lack of available and consistent statistics. Currently, relevant data are gathered by institutions on international, national and regional levels and greater efforts must be made in overall co-ordination. Where duplication exists, efforts can be redirected to gather data currently unavailable as a first step in alleviating this problem. Ultimately the establishment of energy planning units to gather, process and analyse energy data may be advisable.

II. METHODOLOGY

Methodologies used for energy planning purposes range from very general macroeconomic models to highly sophisticated microeconomic models. Econometric forecasting techniques can be used to analyse present energy use and to predict future needs for most of these models. The macroeconomic models are usually more general and easier to use. A simple model, where energy use is a function of GNP, is an example of such a model. It is easily understood, expensive computer facilities are not needed for its use, and the data required are generally available. Its ability to forecast long-run changes in energy use, however, is questionable since changes in economic structure are not taken into account. Also, its usefulness to the policy-maker is limited since no disaggregated information is provided. For example, a policy-maker considering policies to promote one industry over another receives no guidance concerning the energy effects of such a choice from these simple macroeconomic models. At the other extreme, a highly sophisticated econometric model provides disaggregated energy projections, but is very expensive to conduct and, more importantly, sufficient data is unavailable in most developing countries including those of the ESCWA region.

The methodology developed here utilizes an approach that provides as much information as possible in a framework that is relatively easy to use. The energy supply and demand balance methodology enables the planner to identify the flow of energy from the energy sources to transformation centres and to final users of energy. Planners are able to clearly identify important sources of energy and their current uses. A policy-maker will find energy balance information extremely useful in analyzing effects of economic policy on energy use and availability. A decision to encourage industrial development rather than the production of, for example, traditional agricultural products in a developing country might be costly in terms of energy. Energy resources might have to be reallocated from other uses. The decision itself and, once made, the reallocation of energy resources, together with analysis of the effects of such an action on the economy, can be facilitated with the use of energy balances. The energy balance methodology provides disaggregated information which illustrates the energy interdependencies in the economy for which it is used. Figure 1 shows the general structure of energy sources and uses typically found in ESCWA countries. This diagram is a kind of energy flow chart which illustrates the interaction between the supply and the demand of energy and the dependencies between them. It is the basis for the energy supply/demand balances.

Technical, economic and social factors common to the ESCWA region are taken into consideration in the formulation of energy balances. They are reflected in the parameters which determine the supply and consumption of fuel. These parameters have been generally classified into three groups:

(a) Lifestyle parameters;

(b) Technical parameters; and

(c) Household parameters.

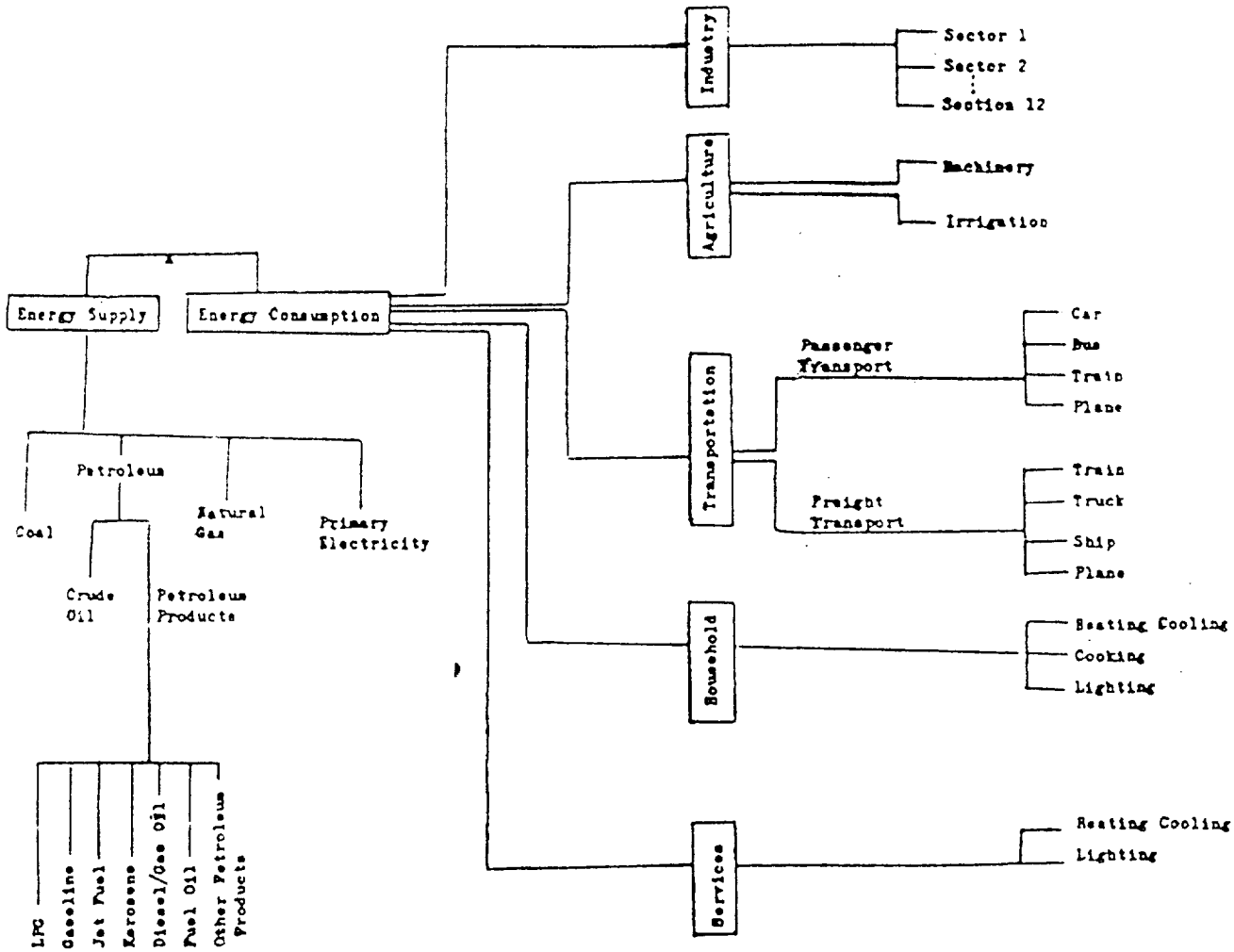
Transportation systems are important energy users and special emphasis has been placed on the determinants of transportation systems, their use and their energy use. The household sector is another significant factor in total energy consumption and consideration has been given to popular heating and cooling systems, sizes of dwellings, weather, insulation efforts and efficiency of methods. In view of the lack of available data on household practices, demographic and macroeconomic variables such as number and size of households, disposable income and share of commercial fuels have been substituted to approximate household behaviour. The agriculture, industry and service sectors are also important energy users and have been considered here as well.

Use of the energy balance methodology in the planning process requires a thorough knowledge of overall planning targets and evaluation of both currently used and potentially available resources. Alternative choices open to policy-makers can be analyzed with the use of different scenarios for potential economic effects. Various development scenarios, as well as energy system scenarios, are relevant in energy planning and forecasting.

The energy balance methodology developed here is applied to three ESCWA region countries. These cases are meant to provide examples of the application of the methodology and its uses for energy planning. The lack of available data has posed a problem in developing comprehensive energy balances in some cases.

Figure 1

General structure of the energy supply and demand in ESCWA countries



III. CASE STUDIES

A. Jordan

The framework for energy planning in Jordan encompasses analysis of demand and supply determinants as components of an energy balance. The Jordanian economy is in the process of developing and, as it grows, will increase its energy use at a rising rate. This is currently reflected in changes in product mix produced by Jordan and changes in general lifestyle.

1. Demand for energy in Jordan: A definite trend in favour of industrial activity can be found in labour statistics during the 1970-81 period. A greater percentage of the labour force was employed in the industrial sector in 1981 than at the beginning of the period. Since the industrial sector tends to be energy-intensive, this has important implications for energy planning. Furthermore, energy input and product output for the cement and phosphate industries, two of the major Jordanian industries, have steadily increased during the 1970-82 period.

Agriculture is another important sector for energy planning. As modern farming methods are adopted over traditional, non-energy-intensive methods, more energy will be required. More information on the adoption rate of mechanized farming is needed for a thorough examination of energy use in the agricultural sector of Jordan.

The transportation sector is also a heavy user of energy and transportation patterns in part reflect the lifestyle choices of the population. The occupancy ratio (total population divided by the number of automobiles) of the automobile is an indication of economic and social development, as well as energy demand. The occupancy ratio changed slightly in the early seventies and was 130.9 by 1973. Rapid economic development since then, however, has resulted in a decline in the ratio to 40.4 in 1978 and 27.3 in 1981. The increase in the use of the automobile has important implications for overall economic planning and energy planning specifically. Railway transportation is not an important mode of transportation in Jordan especially for passenger services. The New Aqaba Railway Line mainly serves the phosphate industry. The airline system is comprised of one national carrier, Alia, The Royal Jordanian Airlines, which has been growing steadily since it began operations in 1964. It grew at an overall rate of 30.3 per cent during the 1970-82 period.

Lifestyle changes affect energy use as has already been noted by the increased use of automobiles. Jordanians also seem to prefer larger homes. Average floor area in the early seventies was 105 m^2/home. By 1980 the average floor area had increased to 173 m^2/home. This phenomenon has important implications for residential heating and cooling energy uses. Jordanians have also changed consumption habits and have significantly increased their use of heavy, energy using appliances such as washing machines, refrigerators and television sets.

Changes in consumer preferences and purchases of the Jordanian population can in part be attributed to the rise in income levels experienced in the seventies. Growth in per capita income occurred as the economy grew and as skilled Jordanians left to work temporarily outside of Jordan. Although census figures show a slight shift from urban to rural areas from 1979 to

1982, it was not significant enough to be called a trend. If such a trend were to occur, however, energy use would not increase as fast since rural areas typically use less energy. All other indicators indicate an overall trend of economic growth and increased energy use for Jordan.

2. Supply of energy in Jordan: Until recently, Jordan was totally dependent on imported crude oil. Newly-found oil fields though may change the long run situation for Jordanian oil needs. The extent of Jordanian oil reserves are currently believed to be quite limited and Jordan will continue to import large amounts of oil. Other non-oil energy resources are unlikely to contribute significantly to the future supply of energy and the current oil find is not thought to be large enough to make Jordan self-supplier in its energy needs.

Electrical energy capacity has been growing steadily in recent years. Efforts to make electricity available to the entire population have helped to spur the growth in the demand for energy consuming appliances.

3. Energy prices: Energy prices are government controlled and during the first half of the seventies were held constant, with the exception of regular gasoline. Constant prices to consumers were maintained despite the tripling of crude oil prices after 1973. Substantial subsidies were required by the government as a consequence. From 1975 to 1978, only slight price modifications were made by the government in an attempt to protect consumers from economic hardships. The oil price increase in 1979, however, prompted the government to adjust the internal price structure and all fuel prices increased considerably. The government, though, still bears some of the burden since the price is below market level. Although this policy may be meritorious on equity grounds, it results in an overuse of fuel by consumers since they do not pay the full price. With below market prices, energy is not used efficiently.

4. Energy balances: Energy balances for Jordan are presented in document E/ESCWA/NR/85/WG.7/3/Add.2. The energy balance methodology used here allows for a clear presentation of sources of energy and uses of energy. The 1982 energy balance indicates that the bulk of Jordan's energy is imported crude oil which is processed by the local oil industry into various sectors with the transportation sector consuming almost half of the total energy used. By identifying the sources and uses of energy currently consumed, the energy balance can aid the general economic planner and policy-maker. For instance, because of the transportation sector's extensive use of fuel oil, incentives to decrease the reliance on automobiles would have a substantial impact on energy use. The energy balance shows that gasoline accounts for 211 TOE (tons of oil equivalent) out of a total of 682 TOE consumed in that sector.

B. Kuwait

Although Kuwait is an oil-rich country, careful planning of energy use is recommended due to the high opportunity cost of energy waste and the fact that, because of world demand conditions, oil and other primary fuels are its most important source of wealth.

Due to substantial world oil price increases during the seventies, Kuwait experienced larger oil revenues and higher per capita incomes. Rapid economic growth and change in lifestyles ensued causing increases in amounts

and changes in the type of energy consumed. The early eighties, brought lower oil prices and a general economic slowdown, but a corresponding change in lifestyles and decrease in energy use did not occur.

1. Demand for energy in Kuwait: GDP grew at annual average rate of 15.4 per cent in nominal terms and 1.2 per cent in real terms during the 1970-82 period. The higher oil revenues and resultant higher per capita incomes caused increases in aggregate demand and ultimately demand-pull inflation. The booming economy during the seventies attracted expatriate workers and the total population grew by 6.3 per cent per year with the non-Kuwaiti population increasing faster than the Kuwaiti national portion. Energy demand increased during the seventies due to higher income levels and greater numbers of people living in Kuwait.

Household demand for energy is reflected in energy use which grew from 2,661 GWh in 1970 to 12,016 GWh in 1982. This represents an average annual growth rate of 13.4 per cent. Although these figures reflect overall electricity use, the industrial sector is quite small and the bulk of electricity is used by the household sector.

The transportation system was greatly improved during the 1970-82 period, with an emphasis on highway and road transport even though the population is largely concentrated in Kuwait City. The private occupancy ratio for automobiles fell steadily from 7.1 in 1970 to 5.1 in 1975 to 3.3 in 1982 indicating that, by 1982, one out of every fourth person owned an automobile. The absolute number of privately-owned vehicles increased by 30,000 per year during this period. Public transportation consists mainly of buses and taxis and is more than adequate for the population. Trucking is used for commercial purposes and the fleet increased by an annual rate of 11.2 per cent during the same period. Airline transportation also increased during this period with the number of passengers increasing at a rate of 13.5 per cent per year. The rapid rate of growth in private vehicles, public period transportation, commercial trucks and airline services during the 1970-82 period has had a substantial impact on the overall demand for energy.

The agricultural sector is quite small due to the limited availability of arable land. Out of a total of 17.8 thousand km^2 only 1.1 per cent is arable and not all arable land is cultivated. Energy requirements for agriculture have been quite small. Recent investments in the agricultural sector though, have tended towards capital-intensive energy-using machines. The cultivated land area, for instance, has increased due to the introduction of irrigation machinery but the agricultural sector does not consume a large proportion of total energy. The more recent introduction of greenhouse farming is energy-intensive and has potential for further development in Kuwait.

2. Supply of energy in Kuwait: Kuwait has large reserves of oil and natural gas. At 1982 production rates crude oil would last 223 years with no new oil findings. Since 1982, though, searches for natural gas have turned up new oil findings. Natural gas, at 1982 production rates, would last 223 years. Production of primary fuels during the 1970-82 were subject to OPEC agreements, and even though oil revenues rose, actual output declined during the 1970-82 period. The production of natural gas generally followed the same pattern as crude oil production during this period. Until recently much of the natural gas output was flared. The incidence of flaring has decreased and

local consumption, which was 36 per cent of total consumption in the early seventies had jumped to almost 60 per cent in 1982. Liquified petroleum gases are also produced as a refined product, but the bulk of this type of energy is exported to Japan.

Another primary source of energy available in abundance in Kuwait is solar energy. However, current technologies and the relatively inexpensive supply of oil and natural gas in the past have worked to discourage the utilization of solar energy.

3. Energy prices: Although substantial energy price changes occurred internationally, during the 1970-82 period, energy prices in Kuwait are controlled by the Government and generally remained the same. Slight increases in the prices of kerosene and gasoline occurred in 1973 and 1974, but were rescinded in 1975. Government subsidies were required throughout this period rising from practically zero in 1970 to KD 104.5 million in 1980. A further ramification of such artificially low prices is an overuse of energy by consumers.

4. Energy balance: Kuwait's energy balances for the 1970-82 period are presented in document E/ESCWA/NR/85/WG.7/3/Add.2. Data used are primarily from publications of the Ministry of Oil, Ministry of Electricity and Water, Ministry of Planning, Kuwait National Petroleum Company (KNPC), Kuwait Oil Company (KOC), Kuwait Petroleum Corporation (KPC) and the Enlarged Shuaiba Industrial Area. These sources provided enough information to calculate the energy balance but some data had to be estimated. Therefore, these figures should be considered as a representation of energy supply and demand patterns in Kuwait in general.

The energy balances show that primary production consists mostly of crude oil and a large proportion of that is exported. Local refinery operations use most of the remaining crude oil for processing into liquified petroleum gas, gasoline, jet fuel, kerosene, gas/diesel oil and fuel oil. Out of a total of 44,620 TOE of primary energy production in 1982 only 3,026 TOE was consumed locally, mostly processed into gasoline, gas/diesel oil and electricity. The household and transportation sectors consume the bulk of energy in Kuwait.

C. Syria

Syria's economic growth, as measured by GDP, during the 1970-82 period in real terms averaged 9.5 per cent annually. Real per capita income increased by 6.1 per cent per year during the same year indicating a general improvement in the standard of living. The impressive growth rates, however, occurred along with substantial trade deficits, deficiencies in capital formation (especially in agriculture and transportation) and reconstruction efforts required in the aftermath of the 1973 Arab-Israeli War.

1. Demand for energy in Syria: Syria experienced an increase in population during the 1970-81 period. Population rose by an annual average rate of 3.3 per cent, though some of this increase can be attributed to a movement of population from Lebanon to Syria. Census data also show a trend towards urban living. The percentage of population living in rural areas dropped from 56.5 per cent in 1970 to 52.9 per cent in 1983, though a

preference settlement in urban areas by expatriot Lebanese may partly account for this apparent shift. The increase in population and trend towards an urban lifestyle both imply increases in overall energy demand.

Prosperity during this decade brought increased use of private automobiles. The car occupancy ratio fell from 333 in 1974 to 192 in 1983 indicating an increase in automobiles both in absolute terms and relative to the population. Mass transportation is also utilized with a large number of microbuses serving the urban and suburban areas. Registered buses increased from 1,731 in 1970 to 10,711 in 1982. Microbuses accounted for 30 per cent of this total in 1975 but had increased to 60 per cent in 1983. Increased vehicle use in Syria has contributed to increases in energy demand. The significant increase in bus transportation, though, indicates that energy conservation efforts exist in Syria.

Railway transport is not a significant means of transport in Syria, but the rail system was enlarged during the past decade. The network increased from 833 km in 1970 to 1,745 km in 1983. The airline system is another mode of international and national transportation. The 1972-82 period witnessed increases in the international passenger-kilometre, but decreases in the national figure. The same trend is observed in the air transport of goods.

Syria has a well-established agricultural sector and 33 per cent of total land area is cultivated land. During 1970-82, land under cultivation remained stable and agricultural output increased. Energy use in agriculture increased during the period due to the increased mechanization of farming methods including heavier reliance on tractors, insecticide motors, combined harvest threshers, water pumps and motor sprinklers.

Syria has a relatively diverse industrial base which produces products ranging from processed foods to aluminium. Since the economy in general grew during 1970-82 it is reasonable to assume that the energy requirements of the industrial sector also increased.

2. Supply of energy in Syria: A major source of energy for Syria is oil and it has proven reserves of 215 million tons which at 1982 levels of production should last about 27 years. Natural gas reserves are also quite extensive and conservative estimates indicate that these reserves will last for 169 years. Syria has a well-developed refinery system and produces liquified petroleum gas, gasoline, jet fuel, kerosene, gas/diesel oil and fuel oil. Imports of crude oil are required for blending with its own heavy oil production. Syria also exports a portion of its own production.

3. Energy prices: Prices for secondary energy products including electricity vary from one governorate to another. Prices increased considerably during the 1970-82 period reflecting the substantial worldwide increases in energy costs. Regular gasoline, for instance, increased from 33 piasters per litre in 1972 to 330 piasters per litre in 1982. Significant price increases lead to voluntary restrictions on energy use by consumers and a more rational allocation of an increasingly scarce resource.

4. Energy balance: The energy balances for Syria are presented in document E/ESCWA/NR/85/WG.7/3Add.2. It is apparent that crude oil is the most important form of energy produced. The imported oil is a different quality

oil and is used in combination with Syria-produced oil for the production of refined products. Exports of Syrian-produced oil are slightly greater than its imports. Given the substantial amount of natural gas reserves, it is surprising that only 40 TOE of this product was produced in 1981 and this is certainly a potential area of energy development for Syria.

The bulk of energy is consumed by the transportation sector, which is not surprising given its rapid growth during the seventies and early eighties. The household sector is a distant second in energy consumption and uses mainly kerosene, electricity and liquified petroleum gas.

IV. CONCLUSION

Energy balances for Jordan, Kuwait and Syria provide illustrations of applications of energy planning methodology in the ESCWA region. Sources and uses of energy are clearly illustrated and potential exploitation of available, but untapped, energy can be evaluated. While energy balances provide useful information in themselves they are more appropriately used as an integral part of an overall planning effort.

Drawbacks to the use of energy balances in the ESCWA region arise from lack of adequate and consistent data. Efforts to co-ordinate data currently gathered on the national, regional and international levels should be made along with attempts to gather data currently unavailable from any source.

Energy pricing policies are only implicitly considered in energy balance methodology, but are important nonetheless. Energy prices will effect the amount of energy consumed and must constitute an important part of overall energy planning.

It goes without saying that energy conservation and efficiency are among the main issues to be taken into consideration by authorities responsible for energy planning.