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↳ A SURVEY OF ELECTRIC POWER DEVELOPMENT IN
THE ECAFE REGION

by the Economic Commission for Asia and the Far East ↴

NOTA: This text is subject to editorial revision.

CONTENTS

	<u>Page</u>
1. Introduction.....	1
2. Organization.....	4
3. Finance including foreign exchange.....	7
4. Technical personnel.....	15
5. Planning and coordination.....	17
6. Rural electrification.....	19
7. Problems and progress of some of the countries of the region.....	20
(a) China (Taiwan).....	20
(b) Federation of Malaya.....	23
(c) India.....	24
(d) Japan.....	30
(e) Pakistan.....	31
(f) Philippines.....	33
8. Bibliography.....	36

1. Introduction

The countries of the ECAFE region have been engaged since the end of The Second World War, in strenuous efforts to improve their economic well being, despite innumerable handicaps. The extent to which a country has developed its energy resources (electricity in particular), is often regarded as an index of its economic development. Viewed in this regard, it will be noted that between 1950 and 1958, the public electricity supply industry in the ECAFE region (not including mainland China) has registered an increase of 92 per cent in terms of installed generating capacity and of 108 per cent in terms of energy generation. While these percentage figures are apparently encouraging, the fact that they operate on a small base in the case of most countries has to be borne in mind. In other words, in terms of absolute quantities, the development and utilization of energy resources by the countries of the region (with the sole exception of Japan) is extremely inadequate to sustain even the minimum living standards.

Table 1 gives a broad indication of the electricity supply facilities in the ECAFE region as at the beginning of 1959. Within the region, large differences exist; Japan, on the one hand, has achieved power development comparable with that of industrialised countries of the west, but on the other, there are countries such as Afghanistan, Nepal and Laos where the present development is almost insignificant. The countries of the region recognize the importance of developing the energy resources as a means of economic progress and are therefore anxious to augment the electric power supply facilities, but several handicaps and difficulties have hampered rapid progress.

Table 1

Country	Population (thousands)	Area in sq. km.	Installed generating capacity (thousands of kw)	Energy generation (millions of kWh)	Per capita generation (kWh)	Installed generating capacity (kw/sq.km.)
Afghanistan	12 450	650 000	34.4	52.1	4.18	0.055
Brunei	77	5 765	2.2	6.6	85.70	0.38
Burma	20 000	681 170	94.1	178.6	8.93	0.14
Cambodia	5 001	175 000	18.5	46.3	9.26	0.11
Ceylon	9 000	66 300	87.5	220.4	24.50	1.3
China(Taiwan)	10 039	35 961	582.2	2 880.3	286.90	16.2
Federation of Malaya	6 515	131 049	257.9	936.1	144.0	1.97
Hong Kong	2 806	1 013	245.2	929.1	331.0	242.0
India	398 279	3 262 874	3 512.0	13 029.0	32.63	1.08
Indonesia	86 900	1 491 564	262.5	1 304.7	15.0	0.176
Iran	19 677	1 648 000	156.0	339.8	17.0	0.095
Japan	92 500	369 765	15 777.0	74 615.0	806.60	42.67
Korea(Republic of)	22 655	96 929	366.7	1 514.0	66.80	1.7
Laos	1 887.5	236 800	3.6	4.1	2.18	0.015
Nepal	8 500	128 000	7.0	12.7	1.50	0.055
North Borneo	411	76 112	5.8	8.5	20.70	0.075
Pakistan	84 450	945 314	267.3	962.0	11.40	0.28
Philippines	23 122	299 404	424.2	1 756.1	76.0	1.42
Sarawak	650	125 000	6.3	14.1	21.70	0.05
Singapore	1 514.9	745	152.0	541.2	357.0	204.03
Thailand	23 908	514 000	150.4	408.1	17.1	0.29
Viet-Nam	13 000	170 800	83.8	244.4	18.8	0.49
Total	843 342	11 111 565	22 496.6	100 003.2	118.6	2.02

Electric power development cannot be pursued independently of the growth in other sectors of economy. After all, electricity is only a means to an end and not an end in itself; power supplies have to be closely coordinated with other economic development schemes.

With the exception of Japan, agriculture is the basic economy of the countries of the region. Apart from the fact that the present methods of agriculture are inefficient and need to be improved, the populations are increasing at a rapid pace and agriculture alone cannot sustain the economy of these countries at reasonable standards of living. Industrialization on an extensive scale, large industries wherever possible and also small scale and cottage industries, are essential to ensure a balanced economic development. It is sometimes suggested that provision of power supply facilities, no matter at what cost, is the way to industrial development. In certain special circumstances, such a statement may probably be correct, because electricity supply undoubtedly influences and promotes increased productivity, particularly in the case of dispersed small scale industrial establishments. Nevertheless, sound and economic planning of large electric power schemes requires careful coordination with programmes of industrial development.

Generally speaking, the financial resources of these countries for development schemes are very limited and having regard to the competing demands for financial allocations from various sectors of economy, each of which, undoubtedly, has its own importance, the funds that are being made available for electric power are generally inadequate.

With the exception of Japan, countries of the region have to import almost all their requirements of electric plant and equipment involving substantial expenditure in terms of foreign currency. The bulk of the foreign trade of most countries is based on a few agricultural commodities which are also subject to wide fluctuations in availability, demand and price. Consequently, the foreign exchange position of the countries is by no means satisfactory.

The lack of technical know-how and an acute shortage of managerial and technical skill in many countries of the region have also had their effect in slowing down the rate of progress.

/Briefly, the

Briefly, the major problems of the countries of the region in regard to electric power development can be classified as 1) Organization, 2) Finance including foreign exchange, 3) Technical personnel, and 4) Long term planning and coordination with industrial development.

2. Organization

Electric power supply is a highly capital-intensive industry; in proportion to the volume of capital employed, the gross and net revenues are comparatively low. Being a public utility industry, it is subject to over-all direction and control by the Governments - including control of the rates charged to the consumers. Private enterprise in many of the countries of the region have, as a result, shown relatively less interest in electricity supply than in other industries. Direct or indirect participation by the state in the electricity supply industry is a common feature in all the countries of the region.

The Afghan Electric Co. in Afghanistan, which is responsible for the management and operation of all power stations having a capacity of 500 kW and above, is jointly owned by the state and certain private financiers, the former having the majority interest. Besides, the execution of various large hydroelectric schemes is undertaken directly by the Government with the help of foreign agencies. These projects, after the construction and commissioning are handed over to the Afghan Electric Co. for operation and maintenance.

Burma has the State-owned Electricity Supply Board which is responsible for all power development in the country. The electric supply facilities in Rangoon, the capital city, formerly owned by a private company have been taken over by the Electricity Supply Board.

The Department of Government Electrical Undertakings in Ceylon is responsible for all the major power development schemes in the country. Some municipalities and local authorities have also installed small diesel power plants for power supply within their respective areas.

Again, in China (Taiwan) the only organization responsible for the power development and power supply is the Taiwan Power Company a state undertaking established by statute.

/The situation

The situation in the Federation of Malaya is somewhat similar to that in the United Kingdom before 1947. The Central Electricity Board established by statute, (the entire capital stock is owned by the Government) is responsible for all major power development schemes. The Board also exercises general supervision and control of the various private companies holding licences to undertake power supply in different areas.

The State undertakings in India are playing a predominant part in power development, though there are a number of private companies also working in close cooperation with state undertakings. The Constituent States of the Indian Union have set up State Electricity Boards charged with the responsibility of promoting electric power development on sound and rational lines, with particular regard for the electrification of rural areas.

Indonesia has recently nationalized the Electricity Supply Industry.

In contrast with several other countries of the region, private enterprise has a major role in electricity supply in Japan. The country is divided into nine regions, in each of which a power company is licensed to operate exclusively. The participation by the Government in the industry takes the form of partnership in the Electric Power Development Co. This company, jointly established by the nine power companies and the Government, undertakes the execution of the very large and expensive hydroelectric projects which are normally beyond the resources of the individual power companies. The Electric Power Development Company does not undertake supply of energy to the ultimate retail consumers, but only makes available bulk supply to the power companies at appropriate locations in the inter-connected grid system.

The Republic of Korea has three electric power companies - Korea Electric Co. (a purely generating company) and the Seoul Electric Company and the South Korea Electric Company (distribution undertakings). The first named company is wholly owned by the Government and the majority of the stocks of the other two companies are also held by Government.

The Government of Pakistan participates in a large way in the electricity supply industries, particularly in view of the large capital outlay needed for the hydroelectric projects.

/Except in

Except in regard to the generation of hydroelectric power and the trunk transmission lines to the consuming centres, the Government of Philippines have left the field of electricity supply industry entirely to private enterprise. In regard to hydroelectric development, however, the Government have established by Statute, the National Power Corporation which has built several hydroelectric schemes and transmission lines and makes available bulk supply to private companies and in some cases to municipalities for local distribution.

In Thailand, the electricity supply industry is almost wholly owned and managed by various agencies of the Government - viz the Metropolitan Electricity Authority, the Yan-hee Electricity Authority and the Provincial Electricity Authority.

Again Government departments take care of electricity supply in Cambodia, Laos, and Viet-Nam. The industry is publicly owned in Singapore and British Borneo as well.

Perhaps, the only country in the region in which the Government has not so far entered the business of electricity supply is Hong Kong. But recently, the Government of Hong Kong appointed a committee to enquire into and report on the methods of improving the working of the two companies operating in the Colony. This committee has recommended the setting-up of an Electricity Board to take over the two companies.

Participation by Governments in the electricity supply industry may take various forms; it may be in the nature of a direct departmental administration, or the Government may establish a separate Government controlled company, or it may be an autonomous Board or Corporation. Examples of all these various types of organization are found in the ECAFE region.

In the present state of undeveloped or underdeveloped economy of most countries of the region, it is perhaps inevitable that the state had to take the initiative and accept the responsibility for all nation-building activities including electric power development. The question is not whether public ownership of electric power utilities is preferable or private ownership. In the almost total absence of managerial and technical skill and in view of the shortage of private capital resources, the state necessarily had to step in and endeavour to find ways and means of overcoming the handicaps
/and promoting

and promoting essential nation building schemes. There is no doubt that even the little progress that has been achieved by ECAFE countries in the field of electricity supply would not have been possible, without state participation in the industry.

3. Finance including foreign exchange

As already indicated, one of the chief reasons why Governments of the region have to accept the responsibility for electric power development is the very heavy capital outlay involved. A complex of factors has deterred investments in the industry by private investors both domestic and foreign. Apart from the low level of private savings, the electric utility industry offers less attraction than other unregulated industries. The tariff rates for electricity supply, generally controlled by the Governments in favour of the consumer, are said to be uneconomically low, which discourages investments in the industry.

The financing of the electricity supply industry has been equally difficult for the Governments. The scope for raising additional revenues by taxation is rather limited. With inadequate resources available for national development schemes, the Governments are faced with competing demands from various sectors of economy calling for an equitable distribution of the resources and allocation of appropriate priorities.

Except in the case of Japan, the countries of the region are largely dependent on industrialized countries for the supply of plant and equipment. Some countries like India and Pakistan have, in recent years, started the manufacture of several lines of light electrical equipment such as electric motors, transformers, conductors and cables, etc. India has, besides, recently established a new factory for the manufacture of heavy electrical equipment and two more heavy electrical plants are proposed for the third five-year plan (1961-66). However, the region as a whole, will need to import substantial quantities of plant and equipment for several years. Thus apart from the limited domestic savings, the large import of capital goods calls for foreign exchange resources which is one of the critical shortage for several countries.

Uncertainties in the availability of adequate financial resources, particularly foreign exchange, prevented most of the countries of the region from undertaking long term planning of the power resources, which is most important for a sound and rational development. As a result, several countries took recourse to small and sometimes uncoordinated schemes as short term measures to meet the essential and unavoidable demands for power.

India provides an effective illustration as to how the shortage of financial resources restrict the size of the power development programme which in turn will have its repercussions on the economic development of the country. At the time of formulating the Second Five Year Plan, it was estimated that an additional generating capacity of 4.5 million kW together with the connected transmission and distribution lines, involving a capital outlay of about Rs.6,000 million would be required to ensure reasonably adequate power supply in all parts of the country and to avoid the chronic shortages in power availability which had been the past experience. However, having regard to the need for an equitable allocation of the limited resources, the plan outlay for power projects was limited to Rs.4,500 million only, the target for the additional generating capacity being reduced to 3.4 million kW. Subsequently, a further 5 per cent cut brought the final provision to Rs.4,270 million, the foreign exchange component of which was estimated at Rs.1,500 million.

It soon became evident that even this restricted programme could not be implemented because of the lack of foreign exchange resources. The projects included in the Second Five Year Plan were reviewed again and only those projects which were considered most essential and unavoidable and therefore falling within "the Core of the Plan" were allotted foreign exchange for the purchase of plant and equipment. The result was that the completion of several power projects was delayed; as against the original plan target of 3.4 million kW of generating capacity, to be installed between 1956 and 1961, the present expectation is no more than 2.4 million kW. Such a substantial short fall (1.0 million KW) in the installed capacity will cause a serious set back to planned economic development.

/Even if

Even if the restricted target of 3.4 million kW had been realised, the demand for power would be ahead of the supply capacity in most parts of the country. The anticipated short fall will further aggravate the difficulties. For instance, the State of Mysore in which a large number of heavy and light engineering industries have been established, has been experiencing acute power shortage for the past three years. This situation could have been remedied, if the Sharavati Valley hydroelectric project (178MW - Rs.229.7 millions or US\$48.3 million) had been completed and commissioned in time. Inadequate financial provision, particularly foreign exchange has unavoidably delayed the completion of this project. Several other States, particularly Punjab, Bombay, Delhi and Madras are passing through the same experience.

Similar difficulties arising from the lack of adequate financial resources have been experienced by several countries of the region; but these were partially mitigated by the generous assistance from industrialized countries of the West and international agencies. The International Bank for Reconstruction and Development has made a substantial contribution to the post-war reconstruction in the ECAFE region. Till March 1960, the Bank had authorized a total amount of \$1,508,320,000 to the ECAFE countries, of which a sum of \$446,110,000 relates to power development projects. The power projects of the region which have received or are receiving assistance from the Bank involve a total generating capacity of 2,552,500 kW together with transmission and distribution systems in some cases. Table 2 gives the particulars of the loans authorized by the Bank for the various power projects in the region:

/Table 2

Table 2

LIST OF LOANS AUTHORIZED BY THE INTERNATIONAL BANK
FOR RECONSTRUCTION AND DEVELOPMENT FOR POWER PROJECTS
IN THE ECAFE REGION

Country	Date of Loan	Authorized amount (dollars)	Amount disbursed as of end 1958-59 (dollars)	Particulars of the power projects covered by the loan
Ceylon	9 July 1954	19 110 000	12 867 810	Stage IIA - Laksapana Hydro Scheme - 25 MW.
	17 Sept. 1958	7 400 000	89 064	Steam driven thermal station at Colombo - 25 MW, (to be interconnected with the Laksapana hydro project).
India	18 April 1950	18 500 000	16 720 500	Bokaro thermal power station (150 MW) of the Damodar Valley Corporation.
	23 Jan. 1953	19 500 000	10 500 000	Maithon (60 MW) and Panchet Hill (40 MW) hydroelectric stations of the Damodar Valley Corporation.
	23 July 1958	25 000 000	10 350 904	Fourth 75 MW unit at Bokaro and Durgapur (150 MW) thermal power stations of the Damodar Valley Corporation.
	8 April 1959	25 000 000	...	Koyna Hydro Electric Project (240 MW).
	19 Nov. 1954	16 200 000	12 806 498	Tata Power Co's thermal station at Trombay (125 MW).
	29 May 1957	9 800 000	6 558 181	Second Stage Trombay Station (62.5 MW).
Japan	15 Oct. 1953	21 500 000	20 577 571	Kansai Electric Co. - thermal station.
	15 Oct. 1953	11 200 000	10 450 320	Kyushu Electric Co. - thermal station.
	15 Oct. 1953	7 500 000	6 456 389	Chubu Electric Co. - thermal station (total capacity under three loans = 291 MW).
	13 June 1958	37 000 000	23 804 310	Kansai Electric Co. - Kurobe river project - (258 MW).
	10 Sept. 1958	29 000 000	4 696 264	Chubu Electric Co. - Hatangi hydro stations, No.1 and No.2 (170 MW).
	27 June 1958	25 000 000	19 674 011	Hokuriku Electric Co. Jagonji river project (261 MW).
	17 Feb. 1959	10 000 000	2 294 280	Electric power Development Co. Miboro H.E. project on Sho river (215 MW).
Malaya (Federation of)	22 Sept. 1958	35 600 000	263 270	Cameron Highlands hydro scheme (75 MW).
Pakistan	2 June 1954	14 000 000	14 000 000	Pipeline project for transmission of Sui gas.
	20 June 1955	13 800 000	13 686 901	Karachi thermal station (30 MW).
	23 April 1958	14 000 000	343 877	Karachi thermal station (60 MW).
Philippines	22 Nov. 1957	21 000 000	12 578 516	Binga Hydro Station (100 MW)
Thailand	12 Sept. 1957	66 000 000	7 686 380	Yanhee Hydroelectric Project (140 MW).
	Totals	446 110 000	206 404 052	2 552.5 MW

The Bank does not regard itself as an institution dispensing international subsidy. On the other hand, the Bank subjects the loan applications to a great deal of scrutiny. The Bank ensures itself that the loan would be used for an economically sound and productive purpose. Wherever necessary, the Bank undertakes on-the-spot investigations of the economical and financial aspects of the projects concerned, makes its own independent appraisal of the merits of the projects and satisfies itself that adequate technical and administrative talent is available for the execution of the projects etc. The Bank ensures that the purpose of the loan is of sufficient importance to the economy of the country to warrant the expenditure of foreign exchange. Obviously, therefore, before an application for a loan can be made to the Bank, the details of the projects have to be carefully worked out and a full assessment of the costs and benefits made. These preliminary efforts are of value not only to the Bank, but to the project authorities as well.

In the course of its investigation, the Bank has had occasions to suggest to the Governments modifications in their financial policies and administrative arrangements etc. For example, Governments of the region often take the view that the aim should be to sell electricity as "cheaply" as possible and accordingly the tariff rates are worked out on the basis that the revenues will be just adequate to meet the interest and depreciation charges as well as the working expenses. On the other hand, the Bank has felt that what is required is not cheap electricity, but plentiful electricity at economic rates. The objective in rate construction should be that on the one hand it is reasonable and economic to the consumer and that on the other, it would generate enough revenue not only to meet the amortization charges, but also to finance at least in part, future expansion of the power facilities. Judicious application of this policy would, without injuring the consumer, help to make the electricity supply industry self-financing to some extent.

It will be seen from table 2 above that only seven out of the nineteen countries of the ECAFE region have had benefits of loan advances by the Bank for power projects and of these Japan has received the maximum share of the total advances. This is because of the declared policy of the Bank -

/(a) it

(a) it offers assistance only for those projects for which credit is not available from any other sources, (b) the project should have been worked out in detail so as to permit a reasonably accurate assessment of the cost and benefits, (c) the Bank also desires to ensure that the project will be administered by an organization having adequate administrative and technical talent. Obviously, therefore, only those countries of the region which are relatively well equipped are in a position to take advantage of the Bank's loans.

Also, under the Colombo Plan Technical Cooperation Scheme, in which twenty of the twenty-four member-countries of the ECAFE participate as members, power projects have received substantial assistance. Unlike other international organizations, the Colombo Plan has neither a central administrative authority nor a large Secretariat. Economic assistance rendered under the auspices of the Plan is negotiated bilaterally by the countries concerned, the Secretariat or the Colombo Plan Council having no responsibility for the negotiations of the details of the aid programme.

Under the Colombo Plan, Canada aided India by supplying plant and equipment required for the Mayurakshi H.E. project in West Bengal (4,000kW), the Umtru H.E. project in Assam (8,400kW) and the Kundah H.E. project in Madras (180,000kW), the total value of the aid for the last named project alone being \$25 million. Similarly, Canada has also assisted Pakistan on the Warsak hydroelectric project (150,000kW), Shadiwal Canal hydroelectric project (12,000kW), Goalpara thermal power station project (16,400kW) and Sidhirganj-Chittagong transmission line project. The approximate value of the Canadian aid for these projects amounted to \$27 million plus Rs.48 million. Australia extended assistance to Thailand by designing plant layout and supplying equipment for lignite mining in Mae Moh, the total value of the aid being £90,000.

Under its massive aid programme of the International Cooperation Administration (ICA), the United States has made the largest contribution to the ECAFE countries in the shape of capital equipment, expert assistance and training facilities. The ICA programme naturally covers all fields of economic activity; but power projects have covered a substantial part of the total aid.

The First Development programme of China (Taiwan) - 1953-57 visualised augmentation of the installed generating capacity of island by 296,550kW (thermal - 126,000kW and hydro-170,550kW) involving a total capital outlay of about US\$38,051,000 and local funds of 1,088,596,000 N.T.Y. It is understood that a large part of the foreign exchange was obtained either as loans or grants from the ICA. Part of the local funds required were also obtained as loans from the counterpart funds of United States aid.

As of 31 December 1956, the Republic of Korea received total aid amounting to 55.0 million dollars for power projects out of which 52.0 came from ICA sources, the balance being the assistance by the United Nations and Korean Reconstruction Agency. This aid enabled the construction of three thermal stations with an aggregate installed capacity of 100,000kW and the augmentation of a hydrostation by a 27,000kW unit.

The ICA assistance to Philippines included the supply of 40-50kW and 16-25 kW diesel generating sets valued at over 300,000 dollars to be utilized for building up loans in various townships in Luzon island prior to the extension of the grid system. Indonesia secured diesel generating plants for augmenting power supply in Djakarta and also for the electrification of 30 communities.

Other major power projects for which capital equipment were or are being supplied under the ICA programme are 50MW thermal power station in Delhi, 280MW thermal power station in Chandrapura, Sharavati hydroelectric project (178MW) in Mysore State, Ahmedabad thermal power station (60MW), Barauni thermal power station (30MW), all in India, Karnaphuli hydroelectric project (80MW) in Pakistan, Mae Moh thermal power station (12,500kW) and remodelling and reinforcing of the Bangkok distribution system, both in Thailand.

Apart from direct Governmental help through the ICA, the Export-Import Bank of the United States has also granted loans to several countries for power projects.

Japan has offered financial assistance to some of the countries in the shape of yen loans. Also under reparations payments, she has built the Baluchaung (84MW) hydro-electric project together with transmission lines

/in Burma.

in Burma. Negotiations are understood to be in progress for utilising the reparation funds for the Marikina multipurpose project (68.6MW) in the Philippines.

The Soviet Union has also extended financial assistance to some of the countries of the region for the construction of power projects. Among these are the Neiveli thermal power station project (250MW) and the Patharthu thermal station (100MW) both in India and the Pol-i-Chomri (9MW) and Nagloo (60MW) hydroelectric stations in Afghanistan.

Undoubtedly the foreign financial assistance detailed in the preceding paragraphs have gone a long way in promoting electric power development in the ECAFE region; nevertheless, these form only a fraction of the foreign exchange needs of the area. Moreover the problem of finding the resources for the necessary local capital remains. These have necessarily to come from the domestic savings and from depreciation accruals etc. In some cases, where foreign assistance is received as grants, the counterpart local funds created have also been utilized.

Precise information on the investments made by the ECAFE countries on electric power projects is not available; but rough computation based on available data shows the following position in respect of some countries:

Table 3

<u>country</u>	<u>average annual expenditure in the last few years on Public Electricity Supply Projects in US\$ 000</u>
Brunei	225
Ceylon	6,765
China (Taiwan)	27,550
Hong Kong	2,211
India	255,000
Japan	884,000
Korea (Republic of)	26,578
North Borneo	479
Sarawak	315
Singapore	5,833

On the assumption that the figures in table 3 can be used to assess the representative capital outlay per kW of installed capacity in the ECAFE region, it can be roughly estimated that the total capital outlay on all public utility power projects in the ECAFE region between 1951 and 1958 was of the order of 7,000 million dollars.

4. Technical personnel

Finance is only one of the several handicaps faced by the countries of the region. There exists in most countries (exclusive of Japan) an acute shortage of managerial and technical skill without which progress will not be possible, even if financial resources are made available in an adequate measure. Technical education, training of technical personnel and acquisition of experience in modern technology etc. are undoubtedly matters which cannot be hurried through beyond certain limits; but it is imperative that the countries of the region advance in (say) a decade over a field which it took the industrialized west well nigh a century. The need for accelerated development of these under-developed countries is all the more urgent because the present gap between the developed and under-developed nations, which is already very large, tends to become larger still.

One of the most significant developments in the post war world is the keen interest shown by the industrialised countries to assist the under-developed and undeveloped nations towards economic betterment and progress. The technical assistance programmes organized under the United Nations, the Colombo Plan and also by various individual countries have gone a long way in providing the much-needed technical know-how to the countries of the ECAFE region. These technical assistance programmes include the provision of expert services to the countries in various fields of economic activity and also the grant of fellowships to their nationals for study, training and observation in the industrially developed countries. In view of the obvious advantages to them, the ECAFE countries have been participating enthusiastically in these programmes.

Under these technical assistance programmes, expert services were made available to the ECAFE countries in all the fields pertaining to

electric power development and power supply e.g. hydrological surveys and assessment of hydroelectric potential, investigation of schemes, planning and design, construction, operation and maintenance of power supply facilities etc. The large number of fellowships granted to the nationals of the ECAFE countries enabled them to learn at first hand and critically observe the working of the power supply facilities in the advanced countries.

To the extent that its resources would permit, the ECAFE is also contributing to the technical assistance to the member-countries. By virtue of the Commission's close contacts not only with the member countries, but also with the countries outside, the Secretariat of the Commission is in a position to transmit and disseminate useful technical information to the member countries. The Commission identifies the special problems of the ECAFE countries and tries to organize regional assistance programmes wherever possible in cooperation with the BTAO etc. Within its limited staff resources, the Secretariat of the Commission investigates problems referred to it by the member countries and tenders technical advice.

In 1956, ECAFE in co-operation with TAO organized a study tour under which a group of electric power experts nominated by the various member countries visited electric power plants and electrical manufacturing industries in Europe, the USSR and the United States. The group made observations on hydroelectric power stations, thermal power plants and transmission and distribution systems and submitted a comprehensive report which contains several useful recommendations on the methods and practices which the ECAFE countries might consider for adoption. Earlier in 1953, a group of engineers of the region visited Australia to study methods of mining and utilization of lignite.

If the countries of the region are to undertake rapid development of the natural resources for power development, it is important that the nationals of the countries equip themselves with the 'know-how' and accept responsibilities for the planning, design, construction, operation and maintenance of the projects. The ultimate and continuing success of all the economic development programmes depends to a large extent on the

/ability of

ability of the countries themselves to mobilise all their resources - both material and manpower - and use them to the best advantage. It may be necessary to secure help from foreign technicians in the initial stages of development; but at the same time, accelerated programmes of technical training should be instituted to build up an adequate local supply of skilled personnel. While they may gratefully accept such assistance as is made available by foreign countries, it is necessary that they should endeavour and develop the capacity to take independent responsibility on various matters as quickly as possible.

In order to build up and develop the technical 'know-how' and to promote the ability and experience in the preparation and execution of power schemes, several countries have established strong technical organizations for the planning and coordination of all power development schemes. Such organizations are essential, if full benefits are to be derived from the various technical assistance programmes comprising fellowship and expert services. By assimilating the benefits of the services rendered by foreign experts and by fully utilizing the training under the fellowship programmes of the nationals of the country, these organizations are in position to help retain and further build up the technological 'know-how'. Examples of such organizations are the Central Water and Power Commission in India, the Central Engineering Authority in Pakistan, the National Power Cooperation in Philippines, etc.

5. Planning and coordination

The technique of development programming consists essentially of making an inventory of the sum total of the resources available and then deciding the order in which the various development projects should be undertaken within the resources. The inventory and the priorities must also take into consideration the needs and possibilities of expanding facilities for training and services. In the context of limited resources of the ECAFE countries, a well-formulated overall economic plan is of vital importance. Power development has necessarily to be related to the agricultural and industrial development programmes. An essential test of the economic value of a power project involving large capital outlay will

be to determine how soon the power generated will be utilized. The provision of power capacity much in advance of the industries would result in locking up valuable capital, whereas power shortages arising from delays in the implementation of essential projects will be equally detrimental to the economy.

Most countries of the region, have experienced acute power shortage conditions since the end of the Second World War. Development programmes based on economically sound and rational plans would necessarily involve considerable time, but in view of the urgency of the power demand, short term measures which are not necessarily the most economical (such as installation of local diesel generating units etc.) were resorted to in the early stages. In this context, it is pointed out that the planning and the execution of large power projects, have to be initiated much in advance of the need for power. A large thermal power station might take about 3 years to build, whereas a hydroelectric station may involve 5 years or more. On the other hand, it may be possible to establish manufacturing industries in most cases within 2 years. Advance planning of power projects on a long term basis is therefore very important.

By and large, it can be stated that the concept of advance planning for coordinated power development has been accepted by many of the ECAFE countries. But planning is a painstaking and lengthy process requiring considerable amount of basic data. In under-developed countries, the task of planning is very difficult partly because of the lack of technical and administrative skill and partly because the basic data required is usually not available and such data as can be procured are often fragmentary and unreliable. In many countries of the region, there were practically no statistical data concerning the generation, transmission and distribution of electricity supply some ten years ago; in fact, no efforts had been made to collect and compile such information. One of the earliest tasks to which the ECAFE secretariat addressed itself was to invite the attention of the countries to the importance of maintaining vital statistical data on public electricity supply. During the last few years, most of the ECAFE countries have commenced the systematic collection of various essential statistical data on electricity supply, which are

published annually by the ECAFE secretariat as the Electric Power Bulletin. Even now, some of the countries are not in a position to collect and compile information on all aspects of the electricity supply industry; but it is hoped that in due course the position will improve.

As stated earlier, most of the ECAFE countries have attempted to work out reasonably long term programmes for power development. To the extent practicable surveys of the available natural resources for power development are undertaken. Attempts are being made to investigate and forecast future demands for power and to work out in advance an over-all coordinated power development programme; and then efforts are made to secure the necessary resources for the execution of the programme.

In one respect, the under-developed countries of the region have an advantage; they are in a position to profit from the errors which may have been made by the industrialised countries in the past. In other words, in planning the future power programme, they could take guidance from the past experience of the developed countries. They are in a position to adopt appropriate and economic "standards" for equipment and practices which have stood the test of experience.

6. Rural electrification

With the majority of the populations living in rural areas, rural electrification is naturally of much interest to the ECAFE countries. This problem, which has posed many difficult financial questions even in the economically advanced countries, is of great importance to the countries of the region, but nevertheless, electrification will be incomplete in these countries without a measure of progress in electric supply facilities in the rural areas.

The problems of rural electrification in this region are different in several respects from similar problems in Europe and North America. Generally speaking, rural people in the ECAFE countries do not live in individually owned large scale farms, but in compact and well-knit villages. Apart from the fact that the villages are few and far between which makes the cost of extending electric supply to the villages somewhat high, the purchasing power of the villagers is so low that they are often unable to make use of electricity, even if the supply is made

/available at

available at prices comparable with the rates in urban areas. In other words, under the present economic conditions in the rural areas, the villager cannot afford to pay for the comforts and amenities of electricity supply such as electric lighting, fans, heating, radio, refrigerators etc. On the other hand, he particularly needs electricity to increase his productive capacity and thus improve his economic condition. The various productive purposes for which electricity is used in many countries of the region are: lifting water from wells for irrigation, processing of agricultural products (such as rice husking, and flour milling, oil pressing, cotton ginning), power looms small scale and cottage industries and village workshops etc.

Several western countries have found it necessary to subsidise financially rural electrification schemes. Considering the fact that nearly 80% of the populations of the ECAFE countries live in rural areas, it is evident that it will be well nigh impossible for Governments to do full justice to this problem by means of subsidies. Among the various measures taken by the countries to promote rural electrification are:

- a) integrated development of rural and urban electrification schemes,
- b) dispersal of small scale industries to rural areas, c) design and development of cheap methods of construction of lines and services, and
- d) the introduction of economies in the operation and maintenance of rural systems.

7. Problems and progress of some of the countries of the region

The following paragraphs contain a broad survey of the salient aspects of the problems and progress of electric power development in some of the countries of the region.

(a) China (Taiwan)

The present Taiwan Power Company which is responsible for electric power development throughout Taiwan, was established by the Government in November 1945 to take over the electric power facilities from the former Japanese-owned utility. Almost all the stock of the new company is owned by the Government, leaving only a small portion in the hands

/of private

of private persons who were formerly the stock-holders of the original Japanese undertaking. While the Taiwan Power Company functions like any other private company under the Chinese law, the Government, by virtue of the majority of shares held by it, ensures that the policy and the programmes of the company are in national interest.

The electricity supply system in Taiwan had a total installed capacity of 321,135 kW under the Japanese management; but by the end of the World War II, the system had suffered very extensive damages and could meet a peak demand of no more than 33,000 kW. The first attempt, therefore, of the Taiwan Power Company after it took over the responsibility of electric power supply, was to launch on a programme of rehabilitation and reconstruction. The reconstruction programme was spread over a four-year period between 1946 and 1949. Thereafter the Company undertook new power development projects to meet the increased demands for electric power. By the end of 1952, the installed generating capacity of the electric power system was raised to 332,000 kW. In the following year, the Company launched its first Five-Year Development Programme (1953-1957) aimed at an addition of 296,550 kW (170,550 kW hydro electric and 126,000 kW thermal). The second programme of electric power development (1957-1960) visualized a further addition to the installed capacity of the electric power system of 292,800 kW, (comprising 92,800 kW of hydro electric and 200,000 kW of thermal units). On completion of the present programme of construction, the electric power system capacity is expected to reach 922,631 kW (539,965 kW hydro electric and 382,666 kW thermal).

The hydro electric power potential of Taiwan is reported to be very substantial. Nearly 60 per cent of the area of the island of Taiwan are mountainous; a central range of mountains runs longitudinally from North to South with several high peaks of 3,000 metres or higher. The annual rainfall of the island is 2,500 m.m., although some areas have an intensive rainfall as much as 5,000 m.m. A detailed survey of the theoretical power potential of the 65 main rivers of the island shows that these rivers have a total electric power potential of about 12,000,000 kW. However, only 17 of these rivers are considered to be relatively more important. The power potential of these 17 rivers above /an elevation

an elevation of 200 m. is estimated at 8.8 million kW. These figures clearly indicate the magnitude of possible hydro electric power development in the island.

As of December 1958, the Taiwan Power Company had about 400,000 kW of hydro electric power plant in operation and had in hand the construction of several hydroelectric projects. Along with hydro electric power development, the Taiwan Power Company has also built up several thermal power stations. In the initial stages, the purpose of the thermal plants was largely to firm up the seasonal variations in the output of hydro plants. However, in the recent years, it was found necessary to construct thermal stations not only to supplement the output of hydro stations, but to take the base load as well. The demand on the electric power system has been increasing very rapidly in the last few years. Hydro electric power projects involving extensive civil engineering works take considerable time for completion. In this circumstance, the quickest and the most practicable means of meeting the increased power demand is to install adequate thermal generating capacity. A characteristic feature of the recent electric power development programme in the island of Taiwan is that substantial additions of thermal generating capacity comprising large units, operating under high pressure and temperature to ensure high thermal efficiency have been installed.

The Taiwan Power Company has also built up an integrated transmission system, inter-connecting all the hydro electric and thermal power stations. The main transmission line on the western half of the island is at 154 kV, while the eastern half has a 66 kV transmission system. The two regions are inter-connected at 66 kV.

Considerable success has been achieved in Taiwan in the matter of rural electrification. The Joint Committee on Rural Rehabilitation, a Sino-American Organization was established in 1954 for the explicit purpose of improving rural conditions in the island. In co-operation with this Committee and with the help of the Government, the Taiwan Power Company has extended the integrated grid system to cover 700 villages during the last six years. It is estimated that 70 per cent of the villages in Taiwan enjoy electricity supply at present. The finances required for rural electrification are provided from various sources:-

/Contributions by

Contributions by the Central Government, 22.5%; Taiwan Power Company, 30%; Local Government, 25%; Joint Committee on Rural Rehabilitation, 7.5%; and loan advanced by the Joint Committee on Rural Rehabilitation 15%.

Analysis of the energy sales show that nearly 80 per cent of the electricity consumption is accounted for by various industries indicating that electrical energy is by and large used for productive purposes. In the matter of the per capita consumption of electrical energy, China: Taiwan is exceeded only by Japan and Singapore within this region.

(b) Federation of Malaya

Under the Electricity Ordinance, 1949 (No.30 of 1949), the Federation of Malaya provided for the establishment of a corporation to be known as the Central Electricity Board which has assumed control of all electrical installations formerly owned by the Federal Government. Among the functions of the Central Electricity Board are:

- (i) to manage and work the electrical installations transferred to the Board under the Ordinance and such other installations as may be acquired by the board,
- (ii) to establish, manage and work such electrical installations as the Board may deem expedient,
- (iii) to promote and encourage the generation of energy with a view to the economic development of the Federation,
- (iv) to secure the supply of energy at reasonable prices,
- (v) to make regulations in accordance with the provisions of the Ordinance governing the generation, transmission, distribution and use of electrical energy, and
- (vi) to advise the Federal Government on all matters relating to the generation, transmission, distribution and use of electrical energy.

The Board is authorized to borrow maney, from time to time, with the approval of the Federal Government by issue of debentures or raise capital by issue of shares or stock. At present, the Federal Government holds all the stock issued by the Board and besides, the Board has borrowed moneys for financing its projects from the Government, International Bank for Reconstruction and Development as well as other organizations.

The responsibilities of the Board are much larger than those of the Electricity Boards in certain other countries of the region such as India.

/Besides being

Besides being responsible for electric power supply, the Board is also empowered to grant licences to persons or firms to operate electrical installations for the supply of electrical energy for private or public purposes and to exercise direction and control of the licences in accordance with the provisions of the Ordinance.

As of 1958-59, the Board distributed 56 per cent of the total energy sales in the Federation, the balance being the share of the Penang Municipal Council and private licensees. There are about 324 public electricity supply stations (generating stations as well as bulk supply substations) indicating that the country has a fairly extensive development of electricity supply. The per capita generation of 144 kWh is comparatively high among the countries of the region.

(c) India

In India, before 1930, the Central and Provincial Governments had taken little interest in electric power development. A few private companies were operating thermal power stations of medium and small capacities, chiefly in urban centres. The few industries which were in existence had installed power plants for their own use. In the subsequent years, largely with a view to harness the hydroelectric power resources (which were considered to be beyond the financial resources of private enterprise) and to promote rural electrification, some of the Provincial Governments - Madras, United Provinces, Punjab etc. established electricity departments and entered into the business of Public Electricity Supply. During the early years, the activities of the Provincial Governments were confined to the development of hydroelectric resources only, leaving the field of thermal power to private agencies.

It was only after the Second World War that systematic and concerted efforts were taken by the Provincial (now State) Governments to promote electric power development throughout the country. Almost all the State Governments established Electricity Departments which undertook the execution of large projects both hydro and thermal and endeavoured to extend supply to the rural areas also to the extent practicable. The private companies which had taken out licenses for public electricity supply

continued to operate in their respective licensed areas; the Government departments concerned themselves in other areas only. In areas where the State Governments had harnessed cheap hydroelectric power sites, the licensees purchased energy in bulk from the Government for distribution in their licensed areas.

Having regard to the imperative need for developing rapidly the power resources of the country and also to the importance of extensive rural electrification as a means to sustain the rural economy, the Central Government gave serious consideration to the problems of organization of the electricity supply industry. It was felt that the state could not leave the industry entirely to the private enterprise. Nevertheless, the administration of the electricity supply business directly through a department of Government suffers from several handicaps. The Administration and Account Codes of the Government are not quite suited to a commercial undertaking. Procedural delays and "red tape" usually associated with Government departments had to be avoided, in order to ensure efficiency and economy in a commercial undertaking. Based on these considerations, the Central Government enacted the Electricity (Supply) Act 1948, which provided for the setting up of State Electricity Boards and a Central Electricity Authority.

The establishment of the State Electricity Boards is designed to ensure that while the over-all control of policy and direction rests with the Government, the Boards are autonomous as regards routine and day to day work. The Chairman and members of the Boards are appointed for specified terms by the State Governments. The principal duties of the State Electricity Boards are to rationalise the production and supply of electricity in their respective areas and towards this purpose to plan and execute a technical and economically sound programme of power projects including hydro and thermal generating plants, transmission systems and distribution lines. The Boards are empowered to regulate and control the development programme of the existing licensees in public interest. The sources of finances required by the Board include: a) loans and subventions by the State Governments; and b) public loans with the previous sanction of the State Governments. While the Governments

do not exercise any day to day control on the expenditure and other activities of the Boards, the latter are required to submit an annual financial statement which is placed before the state legislature for discussion. The budgets of the Electricity Boards are not subject to vote by the legislature, but naturally the Boards would take note of the comments of the legislature on the financial statement.

Under the Electricity (Supply) Act 1948, the Central Government has also constituted a Central Electricity Authority, the broad functions of which are:

- (i) to develop a sound, adequate and uniform national power policy, and particularly to coordinate the activities of the planning agencies in relation to the control and utilization of national power resources;
- (ii) to act as arbitrators in matters arising between the State Governments or State Electricity Boards and a licensee or other person;
- (iii) to carry out investigations and to collect and record the data concerning the generation, distribution and utilization of power and the development of power resources; and
- (iv) to make public from time to time information secured under this Act and to provide for the publication of reports and investigations.

The State Electricity Boards are required to submit to the Authority all schemes costing more than Rs.10.0 millions for their approval. The Authority examines the schemes from the point of view of a coordinated and planned programme of development and utilization of the country's natural resources before according approval.

Besides State Electricity Boards, the Damodar Valley Corporation, a body created for developing the resources of the valley of the Damodar river flowing through Bihar and West Bengal States also participates in the business of electricity generation and supply. This Corporation, established by an act of the Parliament is authorized to build hydro and thermal power stations, within the Damodar river valley and to sell energy at voltages of 33 kV and above. The Corporation does not undertake retail distribution but is mainly interested in the creation of generating facilities and building transmission lines to load centres.

India has not nationalised the electricity supply industry as such; but with the establishment of the Central Electricity Authority and the State Electricity Boards, the state plays a predominant part. At the present time, the state has a 63 per cent share in the generation in the public utility sector. While the private company-owned undertakings have a share of only 37 per cent of generation, many of the licensees purchase energy in bulk Electricity Boards for distribution to the ultimate consumers. The share of private undertakings in the distribution of electrical energy may be well over 50 per cent.

Thus the present organizational picture in India is one of joint partnership between the state and private enterprise, the former having an increasingly predominant share. The State Electricity Boards and the Damodar Valley Corporation are responsible for sound and rational development of the natural resources for power generation. The Central Electricity Authority attempts to coordinate the activities of the State Boards in over-all national interest.

The successive five-year plans form the basis of all economic development in India. The plans accorded a high priority to power projects which received an allocation of about 10 per cent of the total outlay. Nevertheless, judged from the point of view of the actual requirements, the financial provision was inadequate. The anticipated demand for power could not be fully met on the basis of the limited provisions made available.

The first plan covering the period 1951-56, provided for a total outlay of Rs.2,400 millions on power projects. Against the anticipated target of 1.3 million kW, there was a short-fall of 0.2 million kW in the total additions to the generating capacity. This short-fall, however, was not considered very serious, because several schemes were in an advanced stage of execution at the end of the plan period.

But the progress of the second plan had been far from smooth. An outlay of only Rs.4,270 million (against the estimated need of Rs.6,000 million) had been provided out of which about Rs.1,500 million would represent foreign exchange expenditure. Initially, the Suez crisis caused some delays in the receipt of plant and equipment as also some

/increase in

increase in prices. Moreover, the extremely difficult foreign exchange situation which set in from early 1957, called for a review of the Plan, particularly those projects which involved large foreign exchange expenditure. The Governments were forced to place severe restrictions on foreign exchange expenditure on all power projects except those concerned with the production of steel and coal and with transport. Wherever possible, efforts were made to tie up foreign aid schemes with specific projects, but despite all the efforts to secure increased foreign exchange, several power projects in the Second Plan had to be slowed down.

Against the target for 3.4 million kW of additional generating capacity for the Second Plan, the present indications are that the net capacity which will be commissioned by end of March 1961, when the plan ends, will be no more than 2.4 million kW. Needless to point out that this substantial drop from the earlier target would increase the gap between the demand and supply of electricity.

The Third Five-Year Plan commencing April 1961 visualises a total outlay of Rs.102,000 million of which the share of power projects would be Rs.9,250 million. In terms of installed capacity, this provision represents 6 million kW bringing the total installed capacity to 11.8 million kW by March 1966. The power development programme in the Third Plan includes the construction of a nuclear power station with a capacity of about 300MW.

India's hydroelectric power potential is tentatively estimated at 40 million kW at 60 per cent load factor. Detailed surveys and investigations may perhaps show even an increased potential. At the present time, the total installed generating capacity of all hydroelectric plants has hardly reached 1.5 million kW.

India's proved reserves of coal are now estimated at over 16,000 million tons. Apart from the fact that most of the reserves are localised in the eastern and central regions of the country, a large percentage of the reserves are of the low grade variety. Recent explorations for oil appear to hold out hopes of finding substantial reserves of oil fuel as well.

India is attempting to pursue a programme of integrated development of the hydro and thermal resources with a view to ensure adequate power supply at economic rates to the consumers. Subject to other relevant considerations, large generating units are being accepted to take advantage of the economy of size. For thermal power plants, highest possible steam pressures and temperatures are being specified to derive the maximum fuel economy. As a general policy, thermal power stations are required to use low grade coals having an ash content of 35 per cent or more. This is with a view to reserve better quality fuels for metallurgical and chemical purposes. It will be uneconomical to transport coals with large percentage of ash content over long distances; and therefore large thermal power stations are located in the neighbourhood of collieries.

Based on the experience in the recent past, certain cost coefficients have been worked out for general guidance in future planning. The average capital costs for different types of facilities are as given below.

Table 4

<u>Type of facility</u>	<u>Approximate cost per kW of installed capacity (rupees)</u>		
	<u>Foreign exchange component-per cent</u>	<u>Range</u>	<u>Representative average</u>
Hydro power stations	15	500-1,700	1,100
Steam power stations	64	800-1,000	900
Diesel power stations	50	570-1,200	800
Transmission systems	25	320-450	380
Distribution systems	2	450-550	500

It is somewhat difficult to work out representative figures for the actual cost of generation, because of its dependence on several factors including the nature and pattern of load demand. Nevertheless, it is believed that the cost of generation in hydroelectric power projects are of the order of 1.2 to 1.8 nP per kWh (equivalent to US cents 0.265 to 0.38).

As regards thermal power stations, the average thermal efficiency

/of all

of all the power stations in the country was only 19.5 per cent in 1958, but the more recent installations have recorded much higher efficiency, the maximum thermal efficiency achieved being 31.62 per cent. In the case of a large steam power station located in the colliery area and operating at a plant factor of 75 per cent, the approximate generation cost would be of the order of 2.5 nF per kWh (equivalent to US cents 0.525).

(d) Japan

The Electricity Supply Industry in Japan is owned and operated almost entirely, if not exclusively by private enterprise, the role of Government being confined to over-all co-ordination and general direction. Thanks to the progress achieved in industrial and technological development, there is usually an adequate availability of technical and managerial skill and the country is less dependent on foreign assistance than many others in the region.

The activities of the various electricity supply companies are supervised and controlled by the Ministry of International Trade and Industry in accordance with the provisions of the "Law Concerning Temporary Measures for Electricity".

The five year development plan of Japan 1958-62, provides for an annual outlay of over 300,000 million yen on power development. The long term requirements of power visualised under the plan are indicated in table 5.

Table 5

Long-term forecast of power development in Japan

<u>Particulars</u>	<u>Fiscal year 1956 (Actuals)</u>	<u>Fiscal year 1962 (Estimated)</u>	<u>Fiscal year 1975 (Estimated)</u>
Requirements:			
Energy (millions of kWh)	62,022	102,900	191,000
Demand (MW)	10,365	17,900	33,000
Supply capacity to be provided:			
Hydro (MW)	8,714	13,000	22,880
Thermal (MW) (coal and oil)	4,367	9,850	18,020
<u>Total</u>	13,081	22,850	40,900
Fuel requirements in terms of coal (1,000 tons)	9,966	23,000	45,300

Till recently, hydroelectric plants were the major sources of power supply in Japan, the thermal stations serving largely, as peaking stations. With the exploitation of the more economic hydroelectric sites, most of which are of the run of the river type, the future pattern of power development is gradually changing. Thermal power plants in larger numbers and capacities are being installed and these are expected to take the base of the load curve, the hydro stations taking the peak. As indicated in table 5, although hydro power capacity is also being augmented substantially, the rate of increase of thermal power plants is much higher than that of hydro plants.

The substantial additions to the thermal power stations calls for the supply of increased quantities of fuel. It is not expected that the indigenous coal production will be able to meet the entire demand. The Energy Committee of the Economic Deliberation Council which prepared the 1958-62 economic plan has estimated that fuel has to be imported to meet 33 per cent and 48 per cent of the energy requirements of the country in 1962 and 1975 respectively.

(e) Pakistan

The Central Engineering Authority co-ordinates the development programmes under irrigation and power. The first five year plan (1955-60) provided for a total outlay of about Rs.1,100 million for all power projects which were expected to increase the installed generating capacity from 278 MW to 849 MW or by 571 MW together with the necessary transmission and distribution systems.

As in many other countries of this region, the Government of Pakistan is increasingly participating in the electricity supply industry. The Karachi Electric Supply Corporation was established as a joint stock company in 1913. The rapid growth of the city of Karachi after it became the Federal Capital of Pakistan (the capital has since been shifted to Rawalpindi) led to very large increase in the demand for electric power and as it was felt that the resources of the Karachi Electric Supply Corporation were inadequate to meet the increased demands, the Government purchased the majority of shares of the company (Rs.17.5 million) and thus

/acquired the

acquired the controlling interest in its management. The management of the Corporation is now under a government controlled agency, in which the managing director, (who is also the Chairman of the Board of Directors of the Corporation), is appointed by the Central Government.

In the years following the participation by the Government in the affairs of the Corporation, substantial progress has been recorded in the generation and sales of energy, in the number of consumers connected and in the revenues realised. It is also pointed out that the operating costs which were 89.7 per cent and 93 per cent in 1951 and 1952 respectively of the gross revenues of the undertaking was brought down to 69.7 per cent in 1954. This figure increased to 73.9% in 1957, the increase being attributed to rise in the cost of imported fuel on the devaluation of the Pakistan rupee.

Apart from internal resources such as depreciation fund, the finances required for the expansion of the Karachi Electric Power System were obtained from the following external sources:

- (1) Debenture loan at 4 per cent per annum for Rs.3,573,000.
- (2) Loan from Pakistan Industrial Finance Corporation of Rs.1.4 million.
- (3) First loan from the International Bank for Reconstruction and Development for Rs.65,035,721 primarily for the purpose of installing a 30 MW steam power plant.
- (4) Second loan from the International Bank for Reconstruction and Development for Rs.66,500,000 for the purpose of installing a 60 MW steam power plant.

The discovery in 1952 of natural gas at Sui in Baluchistan was an event of considerable significance to the economic development of Pakistan. The estimated reserves of the gas are 4,800,000 million cubic feet equivalent to 200 million tons of coal. The known reserves of oil are expected to be 2.24 million tons, but prospecting for fresh sources is continuing. The reserves of coal in West Pakistan, estimated at 165 million tons, are mostly of inferior grade with high proportion of ash and sulphur. In view of their poor quality, indigenous coal is used only for such purposes as brick kilns, cement plants and other small establishments. Thermal power stations operate either on Sui gas or oil or on imported coal.

/Several thermal

Several thermal power stations, designed to utilize the Sui natural gas are now under construction in West Pakistan: Karachi - 60,000 kW, Multan - 140,000 kW, Sukkur - 30,000 kW, etc. The hydro electric projects under execution are the Warsak multipurpose project (160,000 kW) and the Shadiwal Canal power station (12,000 kW).

The power projects undertaken in East Pakistan are the Karnafuli hydro scheme (80,000 kW), Sidhirganj and Goalpara steam stations (30,000 kW and 16,400 kW respectively) and diesel stations at Sidhirganj, Chittagong and Goalpara.

In the decade between 1948 and 1958, the installed generating capacity in Pakistan increased nearly four times and the energy generation, nearly 6.5 times.

(f) Philippines

Prior to 1936, public electricity supply was in the hands of a few private power companies who had established thermal power plants chiefly in urban centres. It was only after 1935, when the Philippine Commonwealth Government was established that the state began taking an active interest in the development of electric power. In view of the country's relatively poor fuel resources, the Government realised the importance of the planned development of the hydroelectric resources and towards this purpose established a Government Agency. Under the Commonwealth Act No. 120, enacted in 1936, the water-power resources throughout the country were nationalised and the National Power Corporation, a body created under the provisions of the same Act was required to take appropriate measures to survey and investigate the hydroelectric resources and to plan and construct facilities for the generation, transmission and supply of power.

The management of the National Power Corporation vests in the National Power Board comprising a chairman and four members who are appointed by the President of the Philippines. The Government have advanced loans required by the Corporation for the investigation as well as the construction of the various projects. The Corporation is also empowered to borrow moneys with the approval of the President.

The special position enjoyed by the National Power Corporation is that all public waters unappropriated at the time of the passing of Commonwealth Act No. 120, are reserved for the use of the Corporation. The Corporation may, however, release these rights in respect of any stream, if investigations show that the stream will not be of use to the Corporation.

The Corporation confines its activities to the generation of hydro-electric power and its transmission to load centres. It does not undertake retail distribution but makes available bulk power supply to authorised distributors and in some cases to large industrial establishments. The Corporation is empowered to fix rates for the supply of energy, which unlike in the case of privately owned companies are not subject to a review by the Public Services Commission.

Besides NPC, there are several private companies engaged in the business of public electricity supply among which the most important is the Manila Electric Company. Most of these companies including the Manila Electric Company purchase energy in bulk from the National Power Corporation.

The National Power Corporation has the over-all responsibility of evolving a sound and efficient plan for power development in Philippines. With its very poor fuel resources, Philippines naturally depends on an intensive development of the hydroelectric power potential which is estimated to be of the order of 2.25 million kW. Apart from several small hydroelectric plants, the major hydro stations being operated by the NPC are the Caliraya-Lamot (36,000 kW), the Maria Cristina (50,000 kW) and Ambuklao (75,000 kW) plants. The Binga hydroelectric project (100,000 kW) is under construction. Future projects to be undertaken are the Marikina (68,600 kW) and the Angat (146,000 kW) multipurpose projects estimated to cost 36,000,000 and 126,000,000 respectively.

In pursuance of its objectives, the National Power Corporation has been conducting hydrological surveys and investigations to obtain a reliable assessment of the total water power potential of the whole Archipelago. In view of the time and expense involved, the NPC is naturally concentrating its attention on the streams in those areas where

power needs are relatively more acute and insistent.

To ensure economic and orderly development of the natural power resources of the country, the Corporation gives careful and continuous attention to power market studies. Early development of local distribution net works, (sufficiently in advance of the completion of the major power projects) are promoted, so as to provide a reasonable quantum of load demand immediately the major project or projects are commissioned. Recently, funds were made available to the Corporation by the United States International Cooperation Administration, for procuring 40-50 kW and 16-25 kW diesel units which were to be leased to franchise holders in the Central Luzon area, where the Corporation is planning to develop extensive high voltage transmission net works.

The largest load centre in Philippines, at present is the Manila area, served by the Manila Electric Co., a private utility. The peak demand of the area in 1958 was 272 MW and the energy distributed 1,281 million kWh. The company has its own generating facilities with a total installed capacity of 174,500 kW and supplements its requirements by purchasing energy from the Corporation grid. The hydro stations at Caliraya and Ambuklao supply a demand of about 96,000 kW to the Manila area. The economic success of the large and expensive hydroelectric schemes undertaken by the Corporation was mainly on account of the availability of the Manila load centre to absorb a sizeable quantum of the power output from the NPC hydro stations which provided the economic justification for those projects. Subsequently, the availability of power in adequate quantities and at economic rates in the areas traversed by the transmission lines attracted industrial establishments in these areas and in turn helped to increase the demand for power.

A typical instance of the coordinated development of electric power and industry is provided by the Maria Cristina project in the Mindanao island. The island is sparsely populated and there has been little economic and industrial progress. The Agus river, taking off from Lake Lanao, has, in its short course of about 35 km to the sea a power potential of about 750,000 kW! However, as the prospects of power demand were poor, this large power potential could not be used.

The Corporation provided an interesting solution to this problem. They planned to create not only the power facility, but also an industry to absorb the power output. To begin with only one 25,000 kW generating unit was installed at the Maria Cristina power station. Simultaneously a fertilizer factory (initial production capacity of ammonium sulphate - 50,000 tons per year) was also built by the Corporation at the site. The capacity of the power plant was increased to 50,000 kW subsequently and plans are in hand for adding two more 50,000 kW units. In due course, other sites on the Agus river will be developed. It is of significance to point out that arising from the availability of electric power at the site of Maria Cristina Falls, a steel re-rolling mill, and a calcium carbide factory were established. Besides, several additional industries, including cement factories and iron ore mines are expected to be connected in the future. The load demand expected in a ten-year period in the area is about 370,000 kW.

8. Bibliography

Electric Power Bulletin - 1951 to 1958 inclusive, issued by the ECAFE Secretariat.

Annual reports of the Colombo Plan Council for Technical Cooperation in South and South East Asia - 1952/53 to 1958/59 inclusive.

Annual Reports of the International Bank for Reconstruction and Development, 1947/48 to 1958/59 inclusive.

First Five Year Plan of India, 1951-56.

Second Five Year Plan of India, 1956-61.

Press Reports on Third Five Year Plan for India, 1961-66.

First Five Year Plan of Pakistan, 1955-60.

New Long-range Economic Plan of Japan, 1958-62.

Country reports.

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