

UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL



48615.
Distr.
LIMITED

E/CN.14/EP/24
10 September 1963

Original: ENGLISH

ECONOMIC COMMISSION FOR AFRICA
African Electric Power Meeting
Addis Ababa, 21-31 October 1963

ACTIVITY OF THE UNITED NATIONS IN THE FIELD
OF RURAL ELECTRIFICATION

(Note by the secretariat)

The following is the secretariat's résumé of the work of the United Nations
on rural electrification problems.

63-5363
GE.63-13029

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CHAPTER I

ACTIVITY OF THE ECONOMIC COMMISSION FOR EUROPE IN THE FIELD
OF RURAL ELECTRIFICATION

1. At its eighth session held in October 1951 the Committee on Electric Power decided, at the request of the Economic Commission for Europe, to undertake a study of rural electrification problems. The purpose of the study was to make available to the less-industrialized countries the results obtained in countries which had been dealing with such problems for a long time, and at the same time to give European countries an opportunity of comparing their experiences in that field. To this end it drew up a plan for a study consisting of four separate sections. The first related to electric power production; the second to transmission and distribution; the third to the application of electric power to agriculture; and the fourth to economic, financial and administrative questions. On the basis of this plan, separate reports were compiled by certain countries. An analysis of these reports was published in 1954 in two volumes (E/ECE/173 and E/ECE/EP/137):

Volume I, dealing with: Electric power production, transmission and distribution, economic, financial and administrative questions;

Volume II, dealing with: The application of electric power to agriculture.

2. However, rural electrification raises many problems, which this study did not exhaust. Accordingly, the Committee on Electric Power set up, at its tenth session^{1/}, a Working Party for the Study of Rural Electrification, to examine some questions in greater detail and give governments an opportunity for a periodic exchange of views. The programme of work subsequently adopted by the Working Party was divided into the four sections mentioned above. The results of this work are contained in reports on specific subjects prepared by specially appointed rapporteurs.

3. A first of a series of ten reports was published in September 1956 under the title "Rural Electrification" - Volume I (E/ECE/260 - E/ECE/EP/178). A second series of six reports was published under the same title in 1957 (E/ECE/260 - E/ECE/EP/178, Volume II); a third series of eight reports in 1958 (E/ECE/260 - E/ECE/EP/178, Volume III); a fourth series of seven reports in 1959 (E/ECE/260 - E/ECE/EP/178, Volume IV); a fifth series of seven reports in 1961 (E/ECE/260 - E/ECE/EP/178, Volume V) and a sixth series of six reports in 1963 (E/ECE/260 - E/ECE/EP/178, Volume VI).

^{1/} Document E/ECE/133, circulated in 1953.

4. The programme of work adopted by the Working Party includes the study of further subjects, the reports on which will be circulated in turn when adopted.
5. A complete list of the reports published after adoption by the Working Party, and of reports still in preparation, is given in Annex I to this document.
6. At its twentieth session, the Committee on Electric Power requested participating countries to transmit to the Secretariat proposals for a five-year programme of work for the Committee and for each of its subsidiary bodies (E/ECE/EP/216, paragraph 13). In accordance with this decision the Working Party for the Study of Rural Electrification, at its tenth session, adopted in principle its long-term programme of work.
7. A complete list of the subjects proposed for the long-term programme of work of the Working Party is contained in Annex II.
8. At its fourteenth session, the Committee on Electric Power, instructed the Secretariat to prepare each year a report on rural electrification in Europe. In accordance with the decisions reached by the Working Party for the Study of Rural Electrification at its eighth session (EP/131), reports on "The State of Rural Electrification in Europe" are issued as follows:
 - annually, in a simplified form consisting mainly of statistical tables, the analytical part being shortened substantially;
 - triennially (more comprehensive study), which analyses not only the situation during the three-years under review but also future trends.
9. It can be seen from these reports that in many European countries the electrification of dwellings and agricultural undertakings has been completely or nearly finished. In the countries in which rural electrification is still far from complete efforts are being made for the fast extension of rural distribution networks. The use of electricity on the farm for heating, food preparation, steaming, provision of hot water, drying of grain and grass, and soil-warming for horticultural purposes is being increasingly developed. Now, the most important question is the reinforcement of existing rural networks due to the increasing power consumption.
10. It is difficult for the Secretariat to estimate from available data the economic advantages derived from rural electrification. It is clear, nevertheless, that the introduction of electricity to rural areas brings with it an appreciable improvement in the level of agricultural life and contributes considerably to increasing farm production. By using electric power it is also possible to improve the quality of farm,

vegetable and animal products; and the better regulated output thus achieved enables better prices to be obtained. Moreover, the social significance of rural electrification is also stressed by several countries as a means of improving the living and working conditions of rural populations, and also of slowing down the drift from the countryside to towns.

CHAPTER II

ACTIVITY OF THE ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST (ECAFE) IN

THE FIELD OF RURAL ELECTRIFICATION

1. Ever since its inception, the ECAFE Sub-Committee on Electric Power has been concerned with the problem of rural electrification in the ECAFE region. This subject was included in the agenda of almost all of its sessions and some of the technical, economic and financial aspects were discussed at the meetings. The development and use of indigenous materials for various purposes were recommended; attention was drawn to the importance of standardizing equipment and practices, and reports on various relevant aspects were published.

2. As a further measure towards promoting rural electrification, the Sub-Committee, at its seventh session (Tokyo, October 1959) recommended constituting a Panel of Experts on rural electrification. The Panel, consisting of three Electrical Engineers, visited on request fourteen countries in the region, and has submitted individual country reports which have been forwarded to the respective governments. An overall report of the Panel contains general observations, findings and broad recommendations on the problems of rural electrification in this region. The salient points of the Panel's report are brought out by the Secretariat of ECE, which will be found in Annex III of this paper.

CHAPTER III

A RESUME OF THE UNITED NATIONS CONFERENCE ON THE APPLICATION OF SCIENCE AND TECHNOLOGY FOR THE BENEFIT OF THE LESS-DEVELOPED AREAS ON THE PROBLEMS OF RURAL ELECTRIFICATION

1. The United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas was held in the European Office of the United Nations, Palais des Nations, Geneva, from 4 to 20 February 1963.
2. The purpose of the Conference was to explore the recent progress in science and technology which could benefit the less developed areas, to provide an opportunity of assessing how economic and social development might be affected thereby, to illustrate what research on such progress would be useful to the less-developed areas, to stimulate and promote scientific and technological development in the less-developed areas.
3. The discussions constituted an exchange of ideas and experience on how to carry out the purpose of the conference.
4. The following organizations and agencies were invited to attend the Conference:
 - a) All Member States of the United Nations or its specialized agencies;
 - b) The United Nations and its related agencies, and its specialized agencies;
 - c) Representatives of interested non-governmental organizations in consultative status with the Economic and Social Council of the United Nations.

Rural Electrification Problems

5. The agenda for the Conference contained many electric power problems.^{1/} The most interesting questions concerning Rural Electrification are found in the following papers contributed on items of the agenda for the specialized sessions on "Non-conventional sources of energy and nuclear power", and "Electric power".

^{1/} Document E/CONF.39/INF.3 contains all papers issued at the Conference.

<u>Symbol</u>	<u>Title</u>	<u>Author(s)</u>	<u>Contributor</u>
E/Conf.39/A/50	The Construction and Operation of Small Plants, Using Local Energy Resources in Isolated Areas	E.W. Golding	United Kingdom
E/Conf.39/A/53	Electrical Generating Plants (up to 100 kW)	M. Fathy	United Arab Republic
E/Conf.39/A/54	Training Cadres for Operations and Maintenance of Power Installations	E.H. Yonren	Nigeria
E/Conf.39/A/93	Local Sources of Energy, Micro-hydroelectric Stations, with Particular Emphasis on the Electrification of Agriculture	E. Gador	Hungary
E/Conf.39/A/152	Disadvantages of Single Phase Lines on Pioneer Rural Lines	A.A. Menzes A. Ferreira de Braganca Filho	Brazil
E/Conf.39/A/162	Local Power Systems in Rural Areas	A.G. Zakharin	USSR
E/Conf.39/A/201	Low Cost Electrical Installations for Less Developed Areas	V. Vives	Mexico
E/Conf.39/A/331	Generation of Electric Power and Pumping of Water Under Low Head in Irrigation Canals	C.T. Advani	France
E/Conf.39/A/333	Small Electrical Generating Plants (up to 100 kW)	M. Leskovar Ing. Stanislay	Yugoslavia
E/Conf.39/A/356	Rural Electrification and Rural Development	D.J. Hekhuis T.O. Paine F.L. Turner G. Street, Jr. E.G. Aldefer	USA
E/Conf.39/A/382	Training the Necessary Cadres for the Operation and Maintenance of Power Installations	E. Kironde	Uganda
E/Conf.39/A/161	Prospects for the Use of Solar Energy for Meeting Certain Power Demands of the Population of Economically Underdeveloped Countries	V. Baum	USSR
E/Conf.39/A/221	New Sources of Energy and Energy Development, A Resume of the United Nations Conference on New Sources of Energy	Dept. of Economic & Social Affairs	United Nations

It was pointed out at the Conference that world consumption of energy is expected to double and even double twice by the end of the century. On a per capita basis, energy consumption was shown to vary considerably throughout the world. The figures indicating low average consumption in the developing countries, however, conceal further disparities between urban and rural areas and the fact that about two-thirds of the world's population is living without electricity.

The use of electricity in rural areas can be divided into two classes: for domestic purposes such as lighting, ventilation, heating, cooking, etc. and, more economically, productive agricultural purposes. Four different purposes are served by connecting electric power to rural areas:

- to facilitate farm work and replace labour;
- to improve the quality and conservation of products;
- to facilitate domestic work and release field labour;
- to make rural life more agreeable.

In this connexion, it was noted that most of the less-developed areas of the world consist of a large number of isolated rural communities using animal power for farming and having no imminent prospects of enjoying the amenities of electricity. The use of electricity in various rural activities would help to augment economic output per worker. It was therefore felt that high priority and emphasis should be placed on the connexion of electric power to rural areas, mainly for productive purposes in agriculture.

The position regarding the use of small generating units in isolated power stations has been analysed in many papers. It was mentioned that a wide range of small generating units are available. Capital and running costs dictate the choice of any special type, taking into consideration factors such as location, size and character of power demand (base, peak or seasonal), type of fuel, technical personnel available, and whether the unit be required only for power generation or for combined production of heat and electricity.

Because of the low energy consumption, the long distances between villages and the low load factor, rural electrification is hardly a paying proposition. The position can be improved either by economising to the maximum extent feasible in the construction of rural supply networks, or by selling electricity at high remunerative rates to the few rural consumers. In this connexion, it was noted that attention should be concentrated on the former alternative.

The standardization and simplification of network construction can make a very important contribution to the necessary outlay. In some areas, economies have been effected by lowering safety factors, reducing ground clearances, and confining the use of safety and protective devices only to some vantage points.

The standardization of voltages, line construction practice and sub-station designs is another method of cutting down costs. This aspect is being considered attentively in many European countries and in non-European countries.

The poles used for carrying electricity in rural supply networks are generally a large item of construction costs which several countries are making efforts to reduce. The use of locally creosoted wood poles make substantial economies in construction costs. Reinforced and pre-stressed concrete poles have been tried and found to be economical in specific areas. In some parts of South India reinforced concrete poles are manufactured at several centres locally, wherever planned construction work can be carried out cheaply and rapidly.

As the price of aluminium is considerably cheaper than copper, the use of all-aluminium conductors instead of copper has also resulted in an economy of about 20 to 30 per cent per mile of distribution and medium voltage lines.

If local people were to participate in construction work by offering free labour and the supply of supports, construction costs would be lowered. Local manpower could help in the transport of materials to the site, the erection of posts, concreting, the installation of line materials and conductors.

It was pointed out that a problem common to the less-developed countries is the lack of an adequate number of trained and experienced technical personnel. In this connexion, it was noted that it will be necessary in the initial stages to seek foreign assistance; the nationals of the country should however associate themselves closely and continuously with the foreign consulting engineers, in order to become familiar with the methods of work and to obtain a clear understanding of various technical points. By such association, they will gain the self-confidence which is essential for assuming independent responsibilities in due course.

ANNEX I

**LIST OF REPORTS ALREADY PUBLISHED, AND OF REPORTS IN PREPARATION,
ON RURAL ELECTRIFICATION**

The following is a list of reports published after adoption by the Working Party for the Study of Rural Electrification, and of reports being prepared:

I. PRODUCTION

- Operation of wind-driven power plants in parallel with low-capacity hydro and thermal plants (Federal Republic of Germany), Vol. I, 1956.
- Principles governing the link-up of low and medium capacity hydro plants in local power networks, and the connexion of the latter to the main grids (France), Vol. III, 1958.
- Low and medium capacity thermal plants for the combined production of electric power and heat required for agricultural production and the needs of the rural population (USSR), Vol. III, 1958.
- Production of electric power by means of independent wind-driven power stations (Federal Republic of Germany), Vol. IV, 1959.
- Utilization of agricultural waste products for the production of electric power (USSR), Vol. IV, 1959.
- Principles and plans followed in introducing automation in the low-capacity thermal power stations supplying agriculture with electric power for ordinary or exceptional purposes, and their efficiency from the economic point of view (USSR), Vol. VI, 1963.
- Low-capacity emergency generators (Sweden).

II. TRANSMISSION AND DISTRIBUTION

- Protection of the rural population against any excess voltage occurring in overhead low-tension transmission lines during storms (USSR), Vol. I, 1956.
- Regulation of the tension in rural low-tension distribution networks (Federal Republic of Germany), Vol. I, 1956.
- Earthing calculations and earthing arrangements in rural electricity installations with a particular view to protecting livestock against electrical leakage on farms (Finland), Vol. I, 1956.
- Standardization of tensions used in agricultural plants (Sweden), Vol. I, 1956.
- Use of the ground as a conductor (Finland), Vol. II, 1957.
- Experience gained in mechanized methods of constructing and installing rural power stations, transformer sub-stations and transmission lines (USSR), Vol. III, 1958.
- Extension of the working life of wooden poles carrying transmission lines in country districts (Netherlands), Vol. IV, 1959.

II. TRANSMISSION AND DISTRIBUTION (continued)

- Comparison of the safety regulations in force in the various countries and the administrative regulations applying to network installations (Austria), Vol. IV, 1959.
- Design, manufacture and use of concrete poles for low and medium voltage networks serving rural areas (Czechoslovakia), Vol. IV, 1959.
- Experience in the use of various standards for the design of rural electric power networks with the object of selecting the design promising the greatest economic and technical efficiency (USSR), Vol. V, 1961.
- Experience in the use of combined three-phase and single-phase systems in rural electric power networks and their technical and economic advantages over the three-phase system (USSR), Vol. V, 1961.
- Technical measures of ensuring automatic voltage control in rural electric supply networks, their efficiency from the economic point of view and field of application (Czechoslovakia), Vol. VI, 1963.
- In preparation:
 - The most efficient methods used in different countries to increase the capacity of medium-voltage and low-voltage rural electric-power lines so as to cope with the increase in the loads. Technical and economic efficiency of such methods (Romania).
 - Mechanical and other apparatus and means of transport and communication used in different countries for repairing medium-voltage and low-voltage rural electric-power lines (Czechoslovakia).

III. UTILIZATION

- Utilization of electric light for the hot-house forcing of vegetables and early produce, and supplementary lighting of hen-houses to increase egg production (Switzerland), Vol. I, 1956.
- Formulation of methods for drying agricultural products by means of high-frequency current (Switzerland), Vol. I, 1956.
- Formulation of a method of heating hot-houses by electricity and waste steam from thermal plants for the purpose of growing vegetables and early produce throughout the year (Switzerland), Vol. I, 1956.
- Utilization of ultra-violet rays in agriculture (United Kingdom), Vol. I, 1956.
- Examination of the various national safety regulations for electrical installations on farms (Belgium), Vol. I, 1956.
- Formulation of a system and methods for supplying power to electric tractors from stationary or seasonal networks (United Kingdom), Vol. II, 1957.
- Examination of the rate of expansion of rural networks and agricultural plants (Federal Republic of Germany), Vol. II, 1957.
- Formulation of a system for electrified spraying plant on the artificial rain principle (Italy), Vol. II, 1957.

III. UTILIZATION (continued)

- Methods adopted in various countries to prevent excess voltages of atmospheric origin in low and medium voltage networks (Bulgaria), Vol. III, 1958.
- Application of electric power to transport and conveyance on farms in general and on stock-breeding farms in particular (USSR), Vol. III, 1958.
- Drying agricultural produce by means of infra-red rays (Poland), Vol. III, 1958.
- Formulation of a system of automatically-controlled mechanical equipment for electrifying grain threshing, sorting and drying operations (Romania), Vol. V, 1961.
- Grass conservation by means of low-temperature blowing (United Kingdom), Vol. V, 1961.
- Utilization of electric machines for preparing and conserving fodder by the most modern methods (Poland), Vol. V, 1961.
- The technical and economic effectiveness of the use of electrical transmission in complex agricultural machines (USSR), Vol. V, 1961.
- The use of electrical appliances for pest detection and destruction in agriculture (Yugoslavia), Vol. V, 1961.
- Automatic devices used in electrically operated installations on farms, and the efficiency of automation from the economic point of view (United Kingdom), Vol. VI, 1963.
- Plant converted to electrical operation, and means of automation used, in large poultry farms for the maintenance of egg-laying poultry and the raising of "broilers" (United States of America), Vol. VI, 1963.

In preparations:

- The use of heat pump in agriculture (Yugoslavia).
- Development of standard machines and electrical appliances for model farms according to area and production (Poland).

IV. ECONOMIC, ADMINISTRATIVE AND FINANCIAL PROBLEMS

- Methods of financing rural plants (Belgium), Vol. II, 1957.
- Propaganda (sales promotion) methods at present applied in the different countries (Belgium), Vol. II, 1957.
- Optimum utilization in the various applications, with particular reference to heating (Italy), Vol. III, 1958.
- Upward trends in the percentage of rural inhabitants served, and in rural consumption, according to types of use, in absolute figures and per inhabitant served (France), Vol. III, 1958.
- Comparison of the various methods of rate-fixing for electricity supplies sold to farmers (Austria), Vol. IV, 1959.

IV. ECONOMIC, ADMINISTRATIVE AND FINANCIAL PROBLEMS (continued)

- Technical training and education (United Kingdom), Vol. IV, 1959.
- Enquiry, from the economic viewpoint, into the optimum utilization of electrically-driven agricultural equipment in the aggregate on farms (Italy), Vol. VI, 1963.
- Investigation of methods of reducing peak loads in agricultural undertakings and of ensuring that electric power is used economically (Rapporteur: Mr. Friedrich), Vol. VI, 1963.

In preparation:

- Study on the technical and economic characteristics of the agricultural uses of electricity in family enterprises (France).

ANNEX II

LIST OF THE SUBJECTS PROPOSED FOR THE LONG-TERM PROGRAMME OF WORK OF THE WORKING PARTY FOR THE STUDY OF RURAL ELECTRIFICATION

Problems to be studied first: (listed in order of priority)

1. Study of the methods of subdivision and automation of rural electricity networks and sub-stations and of types of equipment and installation that might be used for this purpose, to ensure the maximum reliability and continuity of power supply to rural consumers.
2. Phytotrons and plant growth chambers, lamps and lighting.
3. Electricity in horticulture: an outline of the various applications of electricity to commercial horticulture, with brief technical descriptions including quantitative data.
4. Analysis of the economic viability of the use of electric power to increase production in rural areas, with special reference to the electrification of various branches of production, including horned cattle, pig-keeping etc., crop conservation, e.g. grain and grass drying, etc., and animal environment, e.g. raising of broilers, pigs, etc.
5. Research centres for the application of electricity in rural areas, the nature of the research undertaken and methods used to develop the results of research and experimental work.
6. Study of ways and means of storing electric energy for rural consumers to ensure for them the necessary reliability of power supply, together with a special study of the economic viability of different methods of storage.

Problems to be studied at a later date:

1. Study of the organization of control by dispatchers and of service connexions between the rural networks; study of control-, switch-, and relay gear.
2. The use of multiple-motor agricultural machines.
3. Analysis of the economic viability of the application of electricity on farms of more than 200 hectares of cultivable area.
4. Methods of financing and organizing rural electrification in developing countries.
5. Experience in the construction of co-operative electrical installations in rural areas, and methods of improving their economic efficiency.

ANNEX III

REPORT OF THE PANEL OF EXPERTS ON RURAL ELECTRIFICATION
IN THE ECAFE REGION

The problem of rural electrification in the ECAFE region was included in the agenda of almost all the sessions of the ECAFE Sub-Committee on Electric Power, and some of its technical, economic and financial aspects were discussed at the meetings.

As a further measure towards promoting rural electrification, the Sub-Committee at its seventh session (Tokyo, October 1959) recommended that the Executive Secretary should constitute a panel of experts on rural electrification; this panel would visit countries so requesting it and study the problem particularly bearing local conditions in mind. Following this recommendation, which was endorsed by both the Committee on Industry and Natural Resources and the Commission, the Panel was constituted for a period of one year starting from 1 May 1962, with the following broad terms of reference:

- (1) to make a general study of the status of electric power development and make an assessment of the scope and needs of rural electrification in the countries of the region;
- (2) to prepare practical programmes of rural electrification for the countries of the region, at their request, having regard to their overall electric power development programmes;
- (3) to examine the potentialities of rural industries and suggest general lines for their development - agricultural processing, cottage and small scale industries, etc. - which would provide economic justification for rural electrification on an extensive scale;
- (4) to tender advice on technical aspects of rural electrification projects including questions of design, methods of construction, operation and maintenance, etc.;
- (5) to examine the financial and administrative aspects of the problem and tender advice to the countries of the region on the methods of financing and administering rural electrification schemes;
- (6) to consider and report on matters connected with propaganda, publicity and the promotion of electricity sales in rural areas.

At the request of the respective governments, the Panel visited fourteen countries in the ECAFE region - Thailand, Sarawak, Brunei, North Borneo, Pakistan, Afghanistan, Iran, Indonesia, Singapore, the Federation of Malaya, the Philippines, the Republic of Korea, Cambodia and Ceylon in that order. Individual reports on the problems of these countries have already been submitted, but they are expected to be of interest only to the countries concerned.

The overall report of the Panel contains general observations, findings and broad recommendations on the problems of rural electrification in this region. The salient points of the Panel's report are brought out in the following paragraphs.

General considerations of rural electrification

The use of electricity is broadly divided into two classes - domestic purposes such as lighting, ventilation, heating, cooking, etc., and economically productive purposes such as motive power in industrial undertakings. In all the countries of the region, the rural population contributes very substantially to the production of national wealth, though at present the production per capita may not be as high as it should be. The use of electricity in various rural activities would help in augmenting the economic output per worker. The Panel is therefore of the opinion that high priority and emphasis should be placed on the application of electric power for productive purposes in the fields of both agriculture and industry. Among the productive uses of electricity in the rural areas of the countries of the region are: irrigation and dewatering, processing of agricultural produce such as corn grinding, rice hulling, oil pressing, sugar-cane crushing, etc., cold storage and preservation of food, fish, vegetable and fruits, and small scale and cottage industries such as coconut coir industry, small weaving looms, ceramics, pottery and toy making. This does not mean that the use of electricity for domestic purposes is to be disregarded, but that it need not be pursued as the primary objective.

Organizational and planning matters

To ensure the properly co-ordinated and sound development of electric power, the first essential appears to be a strong central authority to take care of all aspects - administrative, financial and technical - of power development. While power development may be undertaken directly by the government or by private enterprise, it

is necessary to ensure proper control and regulation of this important public utility. The Panel observed that some countries have taken the necessary measures to regulate and control the working of the electricity supply industry on efficient and sound lines. It has recommended that such arrangements be made by other countries also.

The Panel has stressed the importance of overall long-term planning for power development and co-ordination of power development with the growth of industries, agriculture and other economic activities, to ensure that the country's natural resources are exploited and utilized in the most economic manner. The Panel has recommended the formulation of master plans covering the next 10 or 20 years to which all the schemes undertaken should conform as far as possible.

Standardization

The Panel has emphasized the high importance it attaches to the adoption of proper technical standards for equipment, methods and practices and suggested that countries should try to adopt uniform practices in regard to design, construction and operation. It felt however that, while it was important to maintain high standards in the establishment of electrical supply facilities it might, in the case of rural electrification, be permissible to reduce the standards to some extent in order to effect savings in the capital outlay. This reduction in standards should not be made at the expense of general safety.

Sources of supply and methods of rural electrification

The conventional sources of electricity generation are water power sites, coal or fuel oil. So far as rural electrification is concerned the simplest method of development is to construct extensions of transmission and/or distribution lines, wherever possible from an existing grid network. In the absence of such a grid network within economic proximity, it is necessary to resort to the use of local power stations. The type and size of the local power station will be determined according to local conditions and the anticipated short-term load demand. Diesel stations lend themselves admirably to meeting the needs of most rural areas. Generally speaking these diesel stations serve local areas as pilot power plants stimulating and encouraging load growth; and, when adequate load has been built up, the local distribution line is connected to a grid network or to a central power station whenever possible.

Design and construction

A very substantial part of the capital outlay in rural electrification schemes is distribution. The Panel feels that, while for some time to come most countries of the region may have to import all their heavy electrical plant and equipment, local sources of materials such as wood poles, cross-arms, etc., for distribution lines, transformer substations and consumer services, may be developed to save the expenditure of foreign exchange.

The Panel emphasizes the need to ensure simplicity and utility in the design and construction of all power supply facilities including power stations. It is economical to mount distribution transformers on poles instead of their costly indoor installation in specially constructed buildings - which are expensive. Also buildings provided for small power stations, particularly diesel stations should be simple and inexpensive, as in most cases these are likely to be temporary installations.

Operation and training of personnel

The Panel has recommended that the collection and compilation of adequate statistical data relating to the operation and commercial aspects of power plants and power distribution systems be given a very high priority. Proper planning for the future is difficult in the absence of reliable data. Unless effective steps are taken to collect and analyse essential operating data, it will not be possible to take remedial action on defects and deficiencies that may arise in the system.

The Panel noted that, generally speaking, the ECAFE region still lacks technical personnel at all levels. The number of experienced senior engineers is inadequate for the large volume of urgent development work. Technical qualifications from universities cannot in themselves enable engineers to discharge their responsibilities. In order that they may gain practical experience under proper conditions, the Panel has recommended that countries arrange for a selected number of young engineers to undergo training abroad.

Finance

It appears to have been the general experience that although rural electrification schemes are not self-supporting in the initial stages, the position improves in time; after five to ten years the revenue is usually adequate to meet all the expenses.

In view of the importance of rural electrification for a country's agricultural economy, governments must provide adequate financial assistance for rural electrification schemes. This may take various forms; annual deficits may be covered by government subsidies for a specified number of years; the government can make an outright grant of a given percentage of the capital outlay required for the rural electrification schemes, or it may advance the necessary capital for rural electrification at little or no interest and repayable over a reasonably long period such as 35 to 40 years.