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PRELIMINARY SURVEY OF THE POSSIBILITIES AND PROSPECTS
OF CO-OPERATION IN THE FIELD OF ENERGY IN WEST AFRICA

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1. Present possibilities for multinational co-operation in the field of energy in West Africa

If anyone were to take stock of the energy resources of the fourteen States in the West African sub-region, on a middle- or long-term basis, he would discover from what we now know of their possibilities, that in certain countries there is a great discrepancy between their future needs and the national resources to meet those needs, and also between several neighbouring countries which are often adjacent. Some countries have an electrical potential which is greatly in excess of their present and short-term needs. This is the case in Guinea, Mali, Ghana and Nigeria. Others are likely to suffer from a substantial deficiency in energy which may hinder their industrial development. This is the case in Mauritania, Senegal, Gambia, Sierra Leone, Ivory Coast, Upper Volta, Niger, Togo and Dahomey. As yet, the countries in the first category have been taking a timid look at the possibility of the accelerated development of their potential resources with a view to export, on the one hand, because of the very high investments necessary, which are likely to remain unproductive for a fairly long period, and on the other hand because of the fact that any such immobilization is likely to compromise the general economic development, because of the scarcity of capital and the frequently limited amount of national income. The countries in the second category are compelled to cater to their needs by adopting expensive methods, and their development is retarded through the excessive cost of electrical energy, whereas co-operation with their neighbours would enable them to achieve a substantial economy in investments and have energy in abundance and cheaper. But both of these categories are exercising caution, because of political instability and the fact that the present market for electricity is limited.

And yet, there are great and interesting possibilities for multinational co-operation either for the production and exchange of energy obtained hydraulically, or through the supply of solid, liquid, or gaseous fluids, for the production of electricity thermically.

Some countries have already embarked on the study of these possibilities for co-operation, with a view to securing the integrated development of their joint resources, but these experiments might well be increased.

A. Projects under way

There are at present in West Africa, two multinational co-operative experiments centered under the development of the Senegal river and the Mono river basins.

(a) Development of the Senegal river basin

In July 1962 an Inter-State Conference attended by representatives of the Republics of Guinea, Mali, Mauritania and Senegal was held at Conakry, to examine the problems relating to the co-ordinated development of the Senegal river basin. After taking cognisance of and recognizing the unitary character of the basin, the Conference which also insisted on the need for co-ordinating and embarking jointly upon investigations and working arrangements for developing the basin in the interest of the peoples of the four States bordering on it, recommended the setting up of an inter-State Committee to co-ordinate the activities of the national organizations and facilitate a concerted plan of international action. It further suggested that, in the context of aid from the United Nations, a mission of international experts should be entrusted with the task of preparing a docket, as a working basis for the Committee. This docket would include, among other things:

- an inventory of knowledge gained in the various technical fields about the Senegal river basin and its tributaries;
- the study of the main projects, and the technical methods of giving effect to them;
- investigations and suggestions regarding the possibilities of obtaining international finance for the necessary work in connexion with the development of the basin.

At a second Meeting held at Bamako in July 1963, the four States signed a convention regarding the general development of the Senegal river basin, laying the foundations of the future legal status of the river and the bodies entrusted with its rational development. An inter-State Committee was set up with responsibility for promoting and conducting

the investigations and work in connexion with the development of the Senegal river basin, and its mode of operation was defined. The Republic of Mali was entrusted with the provisional secretariat of the Committee.

Then followed the first Meeting of the experts of the inter-State Committee at Nouakchott, in December 1963, to define the general lines of policy for the development of the Senegal river basin. The main objectives were:

- the agricultural development of the middle valley of the river;
- energy production and industrial development in the upper basin;
- the improvement of conditions governing navigability between Kayes and Saint-Louis.

The following study programme was suggested:

1. Survey of the Gouina dam
 - (a) a first draft,
 - (b) hydro-electrical possibilities,
 - (c) effects on hydro-agricultural developments,
 - (d) effects on navigation,
 - (e) conditions governing its exploitation;
2. Technical and economic surveys of the mining and industrial possibilities;
3. Surveys in respect of the agricultural reconversion of the middle valley, by keeping records of experiments;
4. Surveys of additional reservoirs in the upper basin.

At the same Meeting experts from the States bordering on the Senegal river adopted a draft convention establishing the status of the river, the draft Rules of Procedure for the inter-State Committee and its permanent general secretariat, as well as a recommendation advocating temporary measures to ensure increased economic co-operation among the respective States, and the avoidance of any interference with the national programmes already under way.

At its first Meeting at Dakar in February 1964, the inter-State Committee for the development of the Senegal river basin adopted a request to the United Nations Special Fund, regarding the development of the Gouina-Galongo reservoir dam and the two pick-up dams at Saldé and Saint-Louis. It also drew up the terms of a letter, in the nature of a prior request to the Special Fund, with the slant on investigations to be conducted in the upper basin for energy production, particularly, through the building of a dam at Tougué. In addition, the provisional general secretariat of the Committee was entrusted with the task of preparing:

1. A draft request regarding hydro-agricultural improvements;
2. A draft request regarding the navigability of the river and the improvement of the ports of Saint-Louis and Kayes;
3. A draft request regarding mining and industrial possibilities.

During the Tokyo Conference in 1964, the representatives of the four States exchanged views on the economic integration project and the creation of an economic and industrial pool with the possibility of a free-trade and industrial development area. The meeting requested the Committee's secretariat to do all it could to make the creation of this economic and industrial complex a reality, and set in train the necessary surveys, with the help of the IBRD. This problem was brought up at the Extraordinary Meeting of the Committee's general secretariat at Conakry, in November 1965. This resolution which was described as a "resolution on regional grouping"^{1/} stipulated, among other things:

Considering the need not only to envisage the development of the river basin, but also to promote the integrated economic development of the whole of the basin and the national territories;

Noting that the preoccupations underlying the setting up of the inter-State Committee, greatly transcend the limits of the Senegal river basin, and are of interest to a geographical area covering all the countries

^{1/} The title of the resolution as well as its terms are approximate, the actual text of the original document not being readily available.

intersected by the water courses that have their source in the Fouta Djallon mountains, the water reservoir of the whole region;

Decide to propose that the African States concerned should set up a regional West African grouping and, to this end, empower the President of the Islamic Republic of Mauritania to make the necessary moves;

Decide, here and now, to set up within this particular grouping a regional sub-group made up of the States bordering the Senegal river;

Invite the secretary-general to prepare, for the next meeting of the Heads of State a draft convention in respect of the structures and operation of the regional sub-group, covering the four member States, with a view to working out a joint programme of economic integration;

Further, invite the President of the inter-State Committee to call a conference, as soon as possible, of the Ministers of the various economic sectors to study national development plans with a view to harmonizing them, and strengthening the bonds of co-operation between the States.

Resolution No. 66/2/CIE which was passed at the fourth Meeting of the inter-State Committee for the development of the Senegal river basin, held at Bamako in February 1966, decided that a conference of the Committee should be called at Dakar in August 1966 to include also the Ministers responsible for the various economic sectors of the respective States, with a view to working out for the assembly of Heads of State, basic documents relating to the harmonization of the national development plans and the status of the regional sub-group. To this end, the resolution empowered the secretary-general of the inter-State Committee to work out for presentation to the wider meeting including Ministers, detailed reports analyzing every aspect in all the four States of problems dealing particularly with:

- trading exchange,
- mineral research and exploitation,
- agricultural production and development,

- production as well as energy and industrial programmes,
- transport, ways and means of communication,
- education and training, and
- demography.

The development of the Senegal river basin which started as an idea of inter-State co-operation has ended up by being in its present phase a scheme for sub-regional economic integration. Its evolutionary process has been characterized by the following features:

- the setting up of an inter-State Committee for the development of the Senegal river basin, attested by the signature of a convention defining the objectives and organization of the Committee;
- the creation of the regional sub-group of the States bordering on the Senegal river, as a first step towards an African regional grouping, with a view to progressive economic integration.

The inter-State Committee is made up of four Ministers, one for each State bordering the Senegal river, the Ministers being free to avail themselves of the assistance of any experts they may care to choose. Each State will in turn preside over meetings for a period of two years. The Committee will meet once a year in ordinary session, and will be convened by its President, while extraordinary sessions will be held at the request of a member State. These meetings may be held successively in each of the four States bordering the Senegal river. The Committee will have a permanent general secretariat with headquarters at Saint-Louis in Senegal, and this will be the machinery for investigation and liaison. It will be under the direction of a secretary-general, assisted in each State by an assistant general secretary. It will have various technical commissions. The role of the general secretariat will be to implement all the decisions of the Committee, and to give an account regularly of the implementation of its decisions, as well as any steps it may be called upon to take.

The inter-State Committee can already claim credit for working out the status of the Senegal river, organizing the general secretariat, working out rules of procedure, and investigating and preparing several requests for finance which have been made to the United Nations Special Fund.

The decisions of the inter-State Committee are submitted for approval to the annual conference of Heads of State.

The institutions to be established in the context of the regional sub-group of States bordering on the Senegal river, set up by the assembly of Heads of State which met at Nouakchott on 12 and 13 September 1965, are at present being studied.

(b) Development of the Mono basin

On 8 June 1960 and 28 March 1962, the Governments of Togo and Dahomey respectively signed agreements for the integrated study of the Mono basin. This study was undertaken by the United Nations Organization, acting as an agent entrusted with the implementation of the project on behalf of the United Nations Special Fund.

The object of the project is to supply the two Governments with an estimate of the hydraulic resources present in the Mono river and its tributaries. In this connexion, a report is to be submitted on the possibilities of improving the hydro-electric resources in the most favourable conditions for both countries, and on the best means of controlling floods and developing irrigation in the areas by which the lower course of the river is bounded, and also in respect of the collection of water for domestic and industrial purposes. The project includes all the necessary reconnaissance work and also entails an investigation into the market for electricity.

Another project concerns the development of electrical energy in Dahomey and Togo. Its aim is to plan the development of production, transport and possibly the distribution of electrical energy in both countries, provide for a better use of hydraulic resources; provide for

and facilitate the setting up on a permanent legal basis of a joint organization which will co-ordinate, direct and administer electricity supplies in both countries, and ensure vocational training for staff responsible for the operation and maintenance of power stations and electrical networks.

According to a note on the development of electrical energy in Dahomey and Togo, the project entails the following investigations:

1. The nature and functions of a joint organization responsible for directing production, transport and possibly the distribution of electricity in both countries, including the legal and financial basis of that organization, as well as the regulations for normalizing the electrical equipment, and making it uniform.
2. The organization of vocational training and the provision of refresher courses for the staff required to operate and maintain the electrical installations.
3. Reconnaissance and investigations in respect of the hydro-electrical sites chosen in the two countries, other than those investigated under the Mono project.
4. A complete plan for the development of electrical energy in Togo and Dahomey, up to 1975 approximately.

The first project led to the choice of four interesting sites for hydro-electrical and hydro-agricultural developments on the Mono river, three of them being situated in Togolese territory, and the fourth at the frontier of both countries. These four sites will make it possible to install power of the order of 115,000 kW and develop 50,000 hectares for agriculture.

Under item 1 in the second project, the ad hoc commission after carrying out preliminary investigations, arrived at the conclusion that it would be necessary, in order to emphasize the dual role of the joint organization, legally and industrially, to proceed as follows:

- (a) entrust an inter-State Committee with the co-ordination and regulation of activities affecting electricity in both countries;
- (b) entrust a higher authority constituted as a public establishment of an industrial and commercial character, with the setting up and management of the plant.

With a few exceptions, the higher authority would have the monopoly of production and transport, in connexion with plant to be installed. Nevertheless, the setting up of such a plant would not interfere with the status quo in so far as existing plant is concerned, if the Governments so desire. The selling price of energy by the higher authority to the Government would be fixed in such a way as to cover the entire cost of the joint organization. The intention is to inter-connect the networks of the two countries, but no decision has yet been taken. Experts nominated by the United Nations Organization to study item 1 of the project, would like to have as much information as possible on the items which can be defined only in accordance with the wishes of the States concerned. These items have been the subject of a questionnaire forwarded to the Governments of the countries concerned, and deal particularly with:

1. The missions with which they intend to entrust the "joint organization": the experts would like to know whether the Governments contemplate entrusting this organization with a mission having responsibility for the setting up and management of the electrical plant; a general function in the matter of co-ordination and regulation of electricity so far as the two countries are concerned; participation in the working out of certain programmes and projects;
2. The structure of the "joint organization"; if the Governments envisage the possibility of entrusting it at one and the same time with management and control of electricity, and associating it with certain aspects of the work of programming;

3. The method envisaged by the Governments of both countries for regulating certain special problems affecting relations between the State and the "joint organization" or its agents, whatever the form of that "organization" (a dual organization or a community).

The problem has been clearly put before both countries, and on their reply will depend the direction in which co-operation moves. It would appear, however, that the promoters of the project would like to see it develop as a progressive but completely integrated venture in the field of electrical energy. Would it be possible to extend it to other fields and other countries? No answer can yet be given to this, as everything will depend upon the result of the Togo-Dahomey experiment which would be the only experiment of its kind if the spirit of its promoters is respected.

Will it be possible to carry it through? Already, it would seem that the total expenditure would be in the neighbourhood of 30 billion francs CFA, 10 billion of which, at least, would be for hydro-electrical developments. The study of the reports of the viability of the project will determine the decisions to be taken, and the wishes of the two States will do the rest.

- (c) By way of reminder, reference may be made to another example of co-operation in West Africa, namely, the supply of coal which has gone on for several years now, from Nigeria to Ghana, the respective tonnage being as follows:

1958	90,000
1959	80,000
1960	30,000
1961	40,000
1962	35,000
1963	30,000
1964	30,000
1965	30,000

The commercial ties existing between the two countries for the supply of coal might be maintained and even strengthened, and may actually provide a basis for wider co-operation.

B. Other possibilities for short-term and middle-term co-operation

B.1. On the basis of the available hydro-electrical potential or the existing electrical equipment in Ghana

The technical survey of energy in Ghana has revealed the following facts:

1. The exploitable hydro-electrical potential of Ghana is evaluated at the minimum at 12 billion kWh per year;
2. Fourteen sites have been recognized in the basins of the Volta, Tano, Pra, Offin, and Ankobra rivers, and may be capable of equipment in excess of 1,200,000 kW for an annual productivity of the order of 10.5 billion kWh of regulated flow;
3. The hydro-electrical power station at Akosombo is now complete, and is at present in operation, with an installed power of 512,000 kW, which may in the final stages rise to 768,000 kW;
4. The maximum power required in Ghana according to present forecasts would be 369,000 kW in 1970, and
589,000 kW in 1975;
5. Within the next ten years, there would be extra power which could be exported particularly to Ghana's neighbours. The position as regards energy in the neighbouring countries of Ghana may be outlined as follows:

TOGO: Hydro-electrical possibilities on the Mono river, the development of which is now being studied, as part of a joint project with Dahomey; if it is agreed that it will take eight years from 1966 to carry out investigations, research into financing and general work to be done, the supply of electrical energy from the Mono installations cannot be contemplated before 1973/74. Meanwhile, the country will have to depend upon new diesel thermic installations, or the setting up of small hydro-electrical development plant, which cannot be justified on economic grounds, to meet its needs which may quite conceivably develop as follows:

	<u>In energy (in kWh)</u>	<u>In power (in kW)</u>
1970	51,000,000	14,600
1975	77,000,000	19,300

A maximum power of 15,000 kW in 1970 may be accepted for an annual usage of 3,500 peak hours and 20,000 in 1975 for an annual usage of about 4,000 peak hours.

Bearing in mind the normal wear and tear of the present generators, it may be assumed more or less, that it will be necessary to install an additional power of 6,000 kW in 1970 and 12,000 kW in 1975, which represents an investment of approximately 600 million francs CFA in 1970 and 1 billion francs CFA in 1975.

DAHOMY: Electricity supply from the installations at Mono, cannot be contemplated before 1973/74. Meanwhile the country will have to satisfy its foreseeable needs as follows:

	<u>In energy (in kWh)</u>	<u>In power (in kW)</u>
1970	48,500,000	14,000
1975	91,000,000	23,000

On a similar basis for Togo, a peak power of 15,000 kW in 1970 and 25,000 kW in 1975 may be assumed. The new power to be installed will probably be of the order of 6,000 kW in 1970 and 15,000 kW in 1975, representing respectively approximately 600,000,000 francs CFA and 1.5 billion francs CFA.

In the event of the Mono projects being carried through, the minimum investments for each country as regards provisional thermic equipment, in 1973/74 would be of the order of 900 million for Togo and 1,600 million for Dahomey. This would represent a total of nearly 2.5 billion francs CFA of new investments, without security, as far as both countries are concerned.

THE IVORY COAST: If we accept the fact that there will be no difficulty about financing all the hydro-electrical development projects, in the Ivory Coast, it will have the following possibilities in millions of kWh:

	1970	1975	1980
- Ayame I and II	250	250	250
- Kossou	550	550	550
- Attakro	-	450	450
- Malamalasso	-	-	850
Total	800	1,250	2,100

The minimum foreseeable needs of the Ivory Coast will be of the order of:

1970: 470 GWh
1975: 1,175 GWh

These needs will be met if the Kossou and Attakro projects are carried through before 1975. If there should be any delay, probably due to difficulties in financing, the Ivory Coast would have to face a deficit in energy which she would be bound to make good by setting up substantial installations for the thermic production of electricity. The total additional power might be 60,000 kWh in 1970, that is, a minimum investment of 3 billion francs CFA.

Since we are here dealing with a country that is relatively rich, it is not impossible that at least some of the projects visualized may be carried through before 1975, but one is not now in any position to specify the date.

THE UPPER VOLTA: This country is at present poor in energy resources. The hydro-electrical possibilities are limited, and it will be necessary to have recourse to thermic production or co-operation with neighbouring States in order to satisfy the needs in electricity with a view to the industrial development of the country.

The estimate of future needs is as follows:

	<u>In energy (in kWh)</u>	<u>In power (in kW)</u>
1970	33,000,000	10,000
1975	66,000,000	16,500

It will be necessary to install additional thermic power of approximately 6,000 kW in 1970 and 10,000 kW in 1975. The corresponding amount of investments would be 600 million and 1 billion francs CFA respectively.

(a) Possibilities of co-operation with Ghana and Togo

Pending the achievement and putting into operation of the works forming part of the integrated Mono development, Togo will be compelled to use additional thermic power to satisfy her needs in electrical energy for development. Ghana might, even now, supply her with energy obtained hydraulically, by establishing a link between the power station at Akosombo and Lomé, its chief pole of development. The distance separating these two points is of the order of 125 km as the crow flies.

Investments for the delivery station, the transmission line and the arrival station in Lomé, calculated on the basis of an average price of 6 million francs CFA per km for the 161 kV line (with a station having a girder of 161 kV at the delivery station and a station with two girders at the point of arrival equipped with two 161 kV/MT of 15,000 KVA), would be of the order of 950 million francs CFA, including interest at an assumed rate of 12 per cent with a period of ten years for amortization.

Two assumptions may be made in the calculation of the cost price of a kWh in Lomé. It may, in the first place, be assumed that Togo participates in the amortization of the generators for the Akosombo power station. In the second place, it may be considered that since that would be a marginal price for consumption intended to improve the load factor in distribution and, therefore, the output of the generators, Togo should not participate, in the amortization of the generators.

The first assumption: The selling price of energy from Akosombo would consist of two terms: a fixed amortization premium of £15 (pounds) per kW per year and a proportional price per kWh actually delivered by the power station. For a load factor of 80 per cent this price would be around 0.7 of a penny, that is about 2.10 francs CFA.

If the consumption is 50 GWh in 1970, assuming that losses on the line amount to 2 per cent, the power station would have to supply 51 million kWh and guarantee a maximum power of 15,000 kW. In these circumstances, the fixed premium would represent 157,500,000 francs CFA and

the proportional price 107,100,000 francs CFA. The cost of a kWh from Akosombo would be around 5.20 francs CFA.

The cost of transport from Akosombo to Lomé would be at the maximum 1.60 francs CFA, taking into consideration the economic circumstances already defined.

The cost of the supply of a kWh, at the M.T. terminals of the Lomé transformers would be substantially 7 francs CFA, taking into account maintenance on the line, since there is no guarantee of its being renewed.

Second assumption: The selling price of a kWh, at the power station terminal, may be fixed for a load factor corresponding to the actual use of the generators at the moment when the connexion is made. If it is put at approximately 70 per cent, the cost of a kWh on delivery would be in the neighbourhood of 2.40 francs CFA. The cost of transport being the same as in the previous case, the supply of a kWh at the M.T. Lomé transformer terminals, would be substantially 4.20 francs CFA, taking maintenance costs on the line into account.

Another solution might be found in negotiating other possibilities such as, for instance, a flat rate which would safeguard the interests of each of the two parties. In any case, the average selling price of a kWh at Lomé seems bound to vary from 4 to 6 francs CFA, the last figure being regarded as the marginal cost of a kWh produced by the thermic diesel power station at Lomé, if the fuel used is exempt from all rates and taxes on entry at Togo.

Both Togo and Ghana might derive mutual advantages from such co-operation. In the case of Togo, it would mean a substantial economy in investments between now and 1975; the possibility of immediately having cheap energy that will help to promote the industrial development of the country; finally, the possibility of an extra source of supply even after the putting into operation of the first hydraulic power station at Mono. An important point is that after the period of ten years' amortization of the line, the marginal cost of a kWh delivered at Lomé would be around 2 to 3 francs CFA per kWh.

In the case of Ghana, this inter-connexion would make it possible in the immediate future, to improve the output of the Akosombo generators, and facilitate their amortization; it would improve the general load factor in distribution, and meet one of the conditions laid down by the IBRD for financing the Akosombo works; finally, it would have the possibility of serving another country, namely, Dahomey from the link with Togo.

As far as the sub-region is concerned, it would be an embryonic inter-connexion making it possible at a later date to connect the networks of Nigeria with those of the Ivory Coast, and thus link all the countries along the Benin coast.

(b) Possibility of co-operation between Ghana and Dahomey

This possibility stems from the previous one. It would not be feasible or capable of being achieved from an economic standpoint, unless there is a connexion with Lomé from Akosombo.

To simplify the calculations and arrive at some orders of magnitude which are acceptable from the point of view of selling price per kWh at Lomé and Cotonou, the three following cases might be visualized:

First case: Dahomey would not sponsor any of the amortization costs, or maintenance of the Lomé-Cotonou section, all charges relating to the connexion with Lomé from Akosombo being borne by Togo.

Second case: Dahomey would have to bear a share of the charges affecting the Akosombo-Lomé section, and would be solely responsible for charges in connexion with the Lomé-Cotonou section.

Third case: The inter-connexion of the Togo and Dahomey networks which was provided for as part of the integrated development of the Mono basin, is taken for granted; the amortization of the line would take a longer time, but the renewal charges would be met at the same time as maintenance costs. It is possible to argue on the assumption that Dahomey would, provisionally, sponsor all the charges on the line, or on the possibility of their being apportioned between the two countries, on the basis of consumption.

These three cases have been studied in the two assumptions previously defined, as to whether or not there should be any participation in the amortization of the generator sets of the Akosombo power station.

The cost of supplying energy to the power station terminals is calculated for a supply of 102 kWh to both countries. This price is 4.40 francs CFA on the first assumption, and 3.00 francs CFA on the second assumption.

In the first case, defined above, the cost of transport would be substantially:

0.95 of a franc CFA for Lomé and
2.00 francs CFA for Cotonou

The selling price of a kWh at these two points, since energy is delivered at the MT terminals of the starting station transformers, would be of the order of (in francs CFA):

	<u>First assumption</u>	<u>Second assumption</u>
Lomé	5.35	3.95
Cotonou	6.40	5.00

In the second case, since participation in the amortization of the Akosombo-Lomé section is assumed to be equal to 0.50 of a franc CFA for Togo and 0.45 of a franc CFA for Dahomey, the selling price of a kWh at the two points would be substantially (in francs CFA):

Lomé	4.90	3.50
Cotonou	6.85	5.45

In the third case, bearing in mind amortization in 20 years, renewal and maintenance of the Lomé-Cotonou line, the charges being identical for the Akosombo-Lomé section, the cost of supply of a kWh at the two points would be approximately (in francs CFA):

Lomé	5.35	3.95
Cotonou	5.40	4.00

(in the event of the Akosombo-Lomé section being sponsored by Togo and the Lomé-Cotonou section by Dahomey).

If all charges are shared by both countries, the price of a kWh delivered at the two points, would be of the order of:

	<u>First assumption</u>	<u>Second assumption</u>
Lomé	5.40	4.00
Cotonou	5.40	4.00

It follows from all these assumptions that the price of a kWh delivered at Lomé and Cotonou from the hydraulic power station at Akosombo would vary within the following limits:

- For Lomé: from 3.95 to 5.40 francs CFA
- For Cotonou from 4.00 to 6.85 francs CFA

Nevertheless, it must be admitted that the price of the maximum supply to one or other of the delivery points will not exceed 6 francs CFA, which is considered as the marginal cost of a kWh produced at the terminals of the local diesel power stations, as an exemption from all charges and taxes on fuel intended for the production of electrical energy.

Observations

1. The object of all these calculations which are somewhat improvised and not very accurate, is simply to indicate orders of magnitude. It is clear that a more detailed and thorough study will be necessary later, if the countries concerned are sufficiently interested in the possibilities of the co-operation mentioned in this report. More specialized missions might then be sent on the spot to study all the aspects of the necessary co-operation.
2. In order to avoid any calculations based on present reality, it has been assumed in all cases studied that the year 1970 is the year when co-operation will begin, and all the results indicated would then apply.
3. The view taken of the length of the period of amortization of the Lomé-Cotonou line is the least optimistic. This means that the prices given above, in the third case, are maximum values.

(c) Possibilities of co-operation between Ghana and the Ivory Coast

In this survey, we are concerned with the possibilities which the Ivory Coast might exploit, in case there is a substantial delay in carrying through its programme of hydro-electrical equipment, and that country is forced to buttress its thermic electrical installations in order to meet expanding needs.

These possibilities which will be merely mentioned in this report, are as follows:

The connexion of the inter-connected Abidjan network on the 161 kV Akosombo transmission line, from Prestea, following the Prestea - Samreboi - Ayamé plotting (or any point in Ivory Coast). The supply of energy would be provisionally provided by the hydraulic power station at Akosombo. The distance separating Prestea from Ayamé is about 120 km as the crow flies. The investments necessary for such a link would be of the order of 800 million francs CFA, including the arrival station.

The cost of the supply of a kWh would be in relation to the annual amount of energy absorbed by Ivory Coast, and guarantees and limits of usage (in power and energy), might be imposed by Ghana.

If the hydrological, geological and topographical conditions allow, the construction of a reservoir dam on the Bia, in Ghana, to regulate the flow of that water course, with a view to increasing the productivity of the works already constructed at Ayamé I and Ayamé II, might be contemplated.

No order of magnitude can be given at the moment regarding the size and extent of investments necessary for such work.

Joint construction of hydro-electrical developments at Tanoso, Jomuro and Sedukrom, all of which are situated not far from the Ivory Coast-Ghana frontier, for power of the order of 102 MW and a minimum annual productivity of 600 million kWh. These three power stations would be inter-connected to meet any additional needs Ivory Coast may have in electrical energy.

Assuming that the delivery point of such energy is Ayamé, the necessary investments would be approximately as follows (in millions of francs CFA):

- Tanoso	31.2 MW	=	2,142
- Jomoro	21.8 MW	=	1,861
- Sedukrom	49.0 MW	=	4,310
- Inter-connexion of power stations		=	587
- Transmission line		=	800
Total			9,700

That is, less than 10 billion francs CFA.

The price or cost of the supply of a kWh cannot be calculated except as a function of the quantity of electricity annually delivered at Ivory Coast. This fact is unfortunately not yet known, and any estimate would be likely to be erroneous for the moment, because of efforts now being made to increase power.

(d) Possibility of co-operation between Ghana and the Upper Volta

As far as we now know, the Upper Volta is a very poor country, in energy resources, and very few possibilities of hydro-electrical development have been indicated there. The sites already studied are not of interest economically, either because of their low productivity, or because of the very high cost of setting up works. The possibilities which the Black Volta may hold out are not however known as yet, but it is proposed to carry out prospecting there. Not far from the Upper Volta frontier with Ghana, near Lawra on the Black Volta, an interesting site has been shown which will make it possible to equip a 36,000 kW power plant for an annual production of 180 million kWh. This site may be developed by the two countries in order to meet the needs of the north-west region of Ghana in addition to those of the Upper Volta.

The necessary investments would be substantially as follows, to be shared by both countries:

- Development costs - approximately	3.80 billion francs CFA
- Transmission line from Lawra - Bobo	
- Dioulasso	1.05 " "
- Transmission line from Lawra - Koudougou-	
Ouaga	1.60 " "
- The Lawra - Tumu - Navrongo- Bolgatanga Line	1.45 " "
- Distribution or arrival stations	0.50 " "
Total	8.40 billion francs CFA

The distances taken into consideration are the following, as the crow flies: Lawra - Bobo, 175 km; Lawra to Koudougou to Ouagadougou, 260 km; Lawra - Tumu - Navrongo - Bolgatanga, 240 km.

On the assumption that it is possible to secure a loan over 20 years at 5 per cent interest, the amount of annual amortization would be 441 million francs CFA approximately. Bearing in mind renewal, maintenance and operational costs of the works, the maximum amount of annual charges would be of the order of 410 million francs CFA.

If one admits that the annual consumption will be 60 million kWh in 1970 (33 million for the Upper Volta and 27 million for the north-western region of Ghana, the cost price of a kWh at the MT terminals of the arrival station transformers, would be at the most 8 francs CFA if the charges are equally divided between the two countries. This charge is of the order of half that of energy produced at the present diesel thermic power stations in the Upper Volta. A more detailed study of the problem would certainly enable a reduction to be made, particularly if equipment is acquired in several stages.

B.2 On the basis of hydro-carbon fuels from Nigeria

(a) Supply of crude oil to the oil refineries of the sub-region

In 1965, four oil refineries were being operated in the West African sub-region. It is proposed to set up three other units before 1970. Table eight (8) gives the details of these installations, their siting and refining capacity in 1965, 1970, 1975 and 1980.

This table brings out the total capacity of the refineries in operation at the end of 1965, and that was of the order of 5 million tons of charcoal equivalent, that is less than 30 per cent of Nigeria's crude oil production in 1965.

Bearing in mind the fact that three other refinery units are to come into operation before 1970, the total capacity of oil refinery in West Africa would be 8.4 million t.e.c. approximately, that is less than 50 per cent of Nigeria's crude oil production in 1965.

Nigeria's exports in 1965 represented 13.3 million metric tons of crude oil, that is approximately 17.3 million tons of charcoal equivalent. The chief countries to which this oil was exported were: Great Britain, Germany, France, Belgium, Argentina, Curaçao, the United States of America, Canada and Denmark.

The oil refineries of the sub-region import crude oil from Algeria, Venezuela, Gabon etc.

A fair degree of co-operation can be established in this field between the West African States.

(b) Supply of fuel for the thermic production of electricity and products for other needs

There already exists a certain amount of co-operation between the countries that produce refined oil and their immediate neighbours, but this production is still insufficient to meet all the needs of the countries concerned. The oil refinery at M'Bao in Senegal, provides petroleum products for the south of Mauritania and Mali, the one at

Vridi in the Ivory Coast supplies the countries of the "Entente", in part; and those at Tema in Ghana and Port Harcourt in Nigeria, are hardly sufficient, for the time being, to cover the internal needs of those two countries.

It seems possible right away to make a survey of the market for hydro-carbon fuels in West Africa, with a view to meeting the demand from sub-regional installations, which should be strengthened or set up. In this context, the countries in the interior should have a certain degree of priority.

The study of the use of natural gas from Nigeria might offer interesting possibilities for all the countries of the sub-region.

TABLE
Oil refineries in West Africa
(Capacities in thousands of tons)

1. Existing refineries	1965	1970	1975	1980
1. TEMA: Ghanaian- Italian Petroleum Co. (AGIP) - Began to operate in September 1963	1,000	1,200	1,400	1,650
2. M'BAO: "Société Africaine de raffinage (SAR)- Began to operate in January 1964	600	1,200	1,400	1,600
3. VRIDE: Société ivoirienne de raffinage (SIR)- Began to operate in August 1965	700	700	1,000	1,400
4. PORT HARCOURT (Alesa - Eleme) Nigerian Petroleum Refining Co. Ltd., began to operate in November 1965	1,500	1,500	2,000	4,500
2. Proposed refineries				
5. LIBERIA: (Monrovia or Lower Buchanan) - probable date of operation - 1967		750	750	1,000
6. SIERRA LEONE: (Freetown) Probable date of operation 1968		500	500	850
7. GUINEA (Conakry) Probable date of operation 1968/69		600	600	900
Annual total	3,800	6,450	7,650	11,900

2. Long-term prospects for co-operation in the field of energy in West Africa

It is very difficult, from what we know at present, to predict the future development of the various energy resources of the sub-region, and the possibilities for co-operation which might exist in the long run. The over-all energy potential of West Africa is still not very well known, but prospecting is going on practically everywhere, and the results are tending as the years go by to modify the estimates previously established.

In the field of electrical energy, however, the spectacular progress in consumption necessitates the accelerated building of new works both for production as well as for transport and distribution. The necessary investments are considerable, particularly in view of the fact that the countries concerned have to reckon with imports, transport and the mounting of equipment material. Often, the lack of credits considerably hinders the economic development of those countries.

A satisfactory solution may be found in the inter-connexion of networks, the development of water courses of common interest, which often offer great hydro-electrical possibilities for the local manufacture of production material, transport, distribution, use of electrical energy, and vocational training. It would seem that, even now, co-operation in all the countries of the sub-region is necessary to launch a joint investigation of all the problems, and secure the realization of the projects which may favour the acceleration of their industrialization, with a view to progressive economic integration. Indeed, the production of electrical equipment adapted to their needs is only possible after standardization and normalization of the equipment used in the various countries. Similarly, the inter-connexion of networks is only possible when a survey of the market for electricity reveals sufficient knowledge of the foreseeable needs, and promotes the economic comparison of the various possibilities that lie open to each country for the satisfaction of its needs in electrical energy.

This co-operation is all the more necessary, since in the present state of their economies, all the countries realize that large investments only yield an economic return through the play of differential compensations. Whether one is dealing with energy production or exploiting the sub-soil, or setting up processing industries, or developing communication routes, it is difficult to find a solution that is economically viable for each case taken singly. It is by setting up complexes that an economic justification can be found.

The establishment of such co-operation necessitates the prior study of possibilities and needs, and the synchronization of activities. To do this, it would seem to be urgently necessary to create favourable conditions for the development and definition of an energy policy which will be adequate, and at the same time compare ideas, experience and experiments.

The most salient feature of the African countries in general and West Africa in particular, is the fact that faced as they are with the difficult problems of building up the nation, they are often unaware of the possibilities and means at their neighbour's disposal. The myth of development in West Africa is something of an autarchy. Failure to compare ideas and plans often leads to regrettable errors, which might have been avoided by efficient co-ordination.

It would therefore seem that it is now a good solution to advocate the setting up of specialized committees, which would for a given period concern themselves with a thorough investigation of the main problems that cannot be solved except by effective co-operation.

An energy committee on which all the countries of the sub-region are represented might tackle problems concerning electricity and hydro-carbon fuels, as they apply to the individual development of each country, and to their development as a whole. A study of markets would make it possible to define the main objectives in relation to possibilities of needs as well as established priorities, and suggest joint solutions acceptable to the various Governments of the countries that make up a given sub-region.

The individuals, countries and institutions interested in the economic development of the African States should become convinced of the need to endow them with large quantities of cheap energy. They should also accept the fact that it is the rate of energy development in general, and electrification in particular, which as a rule determines the growth rate of all the other sectors of the economy.

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