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GUIDELINES FOR
SECTOR WORK IN THE POWER SECTOR

ABSTRACT

These guidelines suggest why studies of the power sector in developing countries should be carried out, point out that decisions affecting the sector's evolution reach across the whole economy, and caution that a mere inventory of facilities does little to illuminate the problems and prospects associated with the assurance of a long-term dependable supply of power appropriate to the needs of the country's development. A general approach is outlined, supplemented by reminders of specific information sought. The Annexes are offered as Aides Memoire in this connection.

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GUIDELINES
FOR
SECTOR WORK IN THE POWER SECTOR

TABLE OF CONTENTS

I. OBJECTIVES ........................................... 1 - 3

II. EXECUTION ............................................. 4

III. GENERAL APPROACH .................................... 5

- Coordination with National Planning ............... 5
- Demand Aspects ....................................... 5
- Access to Supply ...................................... 6
- Institutional Aspects ................................. 7
- Use and Development of Human Resources .......... 8

IV. SPECIFIC INFORMATION REQUIRED .................. 9

V. REPORT .................................................. 13

ANNEXES

1. Checklist for Power Sector Information

1.- Attachment 1 Production of Electric Power
- Attachment 2 Power: Production and Consumption Table
- Attachment 3 Summary of Electricity Consumption
- Attachment 3 Access to Electricity Supply

2. Checklist for Power Sector Problems

3. Outline of Power Sector Study Reports

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3. Generally, the Bank makes power sector reviews
   a. in countries where electric power lending activities by the Bank are planned, or at least contemplated;
   b. in countries where substantial lending in other sectors is planned;
   c. in countries where a special situation has arisen where power makes a large contribution, e.g. an electro-metallurgical enclave project.

In practice, most reviews have fallen into category (a). However, as the Bank broadens its action to cover countries where the main problems are related with extremely low access to service both in the urban fringes and in rural areas, one can foresee that sector reviews appropriate to these new situations will become important as well.

4. There are two dimensions to the sector -- supply and demand -- and the review should concern itself with both. On the supply side are encountered the institutions and agencies that design, finance, construct, own, operate and regulate the facilities that go to make the power supply; the facilities themselves; and their interrelationships with the primary energy resources they exploit. On the demand side we find the individuals and their homes; the industries and businesses; as well as the public institutions which combined form the market for electricity. In this area, the demands of low and high income, industrial and domestic, urban and rural consumers make competing claims on the limited funds allocated to the sector.

5. In most cases, full satisfaction of all claims is not a realistic short or even medium term goal; therefore development programs are often compromises after consideration of many factors: e.g., levels of funding; degree of emphasis on urban versus rural development; quality of service, including variations according to category of consumers; technical options, etc. These judgments are based on both qualitative and quantitative factors, but they can and should be made explicitly, and on the best available factual basis. In making these decisions, more and more emphasis is being given to "social" factors, by both governments and lending institutions. Social effects have to be considered when determining, for example, the urban versus rural emphasis, pricing policies, alternative tariff structures, the effects of programs on government revenues, the criteria of environmental quality, and so on. These are largely political choices and must therefore be made by government. However, they should be made in the full knowledge of the effects of the trade-offs involved.

1/ Regulation has recently acquired new dimensions such as environmental requirements, safety, energy policies, in addition to the traditional ones involving franchises, tariffs, etc.
6. The broad objective of carrying out sector studies is to provide a foundation for making these decisions by those responsible for sector development and management. In many cases, authorities are so preoccupied with day-to-day problems and emergencies that they have little or no opportunity to view the broad problems and policy issues facing the sector. This not only adversely affects decision-making at the sector level, but also means that the government's economic planners are not presented with information that enables them to make the best decisions in allocating scarce funds among competing projects. Thus a full sector survey, after analysis of the necessary sector information, will (a) identify the principal problems and constraints of the sector; (b) analyze existing goals or propose alternative goals toward which the national plan for the sector can be directed; (c) recommend the institution, or modification, of policies and practices required to achieve the goals, after consideration of whatever tactical alternatives may be available. It cannot, however, lead to establishment of inter-sector priorities.

7. From the narrower perspective of the Bank, the principal objective should be the development of sufficient knowledge of the sector's organization and legal basis to permit orderly pursuit of specific lending operations. In carrying out the sector review the staff should keep in mind this operationally-oriented objective, but in the context of the country's economic development program so that plans for the electric power sector -- both the supply and demand sides -- are consistent with overall national priorities.

8. In most cases, further studies will be needed before particular investment decisions can be made. These may range from preliminary engineering and feasibility studies to those concerned with the structure and management of project entities, financial policies, legal questions, economic investigations, or training. Such studies are needed both to support sound decisions, and because most agencies financing power projects are interested not only in the works to be financed but also in the ability of the borrower to deal with all of the continuing problems of the sector. The Sector Report should identify and describe the studies needed.
II. EXECUTION

9. Given the wide range of climates, population density, size, indigenous energy resources, economic conditions, etc. of the developing countries, it is obvious that the scope and depth of a sector study in any given one should be determined ad hoc. While the objectives outlined above can best be achieved with a full survey, a more limited study may best fit a given set of circumstances. In such cases, planning the study becomes even more important. A reconnaissance visit to the country can help in making these decisions.

10. Special emphasis on the demand side may be warranted in those countries where a majority of the population has not been supplied with power. Here the review should examine in the light of costs of supply and appropriate pricing and institutional policies, the economic and social benefits of extending supply to low income groups living in the fringes of urban centers, small towns, villages and in rural areas.1/

11. It is apparent that a sector study can be carried out as an exercise separate from other Bank activities although it may be related to them. This would usually be the approach in large sectors which are complex, as for example, Brazil. Indeed, such a study was carried out under the auspices of the UNDP, required considerable manpower (a consortium of consultants was employed) and extended over several years. On the other hand, the Bank deals with power sectors which are institutionally simple, as for example, Ireland. Here a thorough sector review may be carried out at little additional cost in connection with appraisal of the power supply agency which constitutes the whole sector. It is clearly in the interests of economy of staff to schedule such activities together where the nature of the sector is conducive to doing so.

1/ See, e.g., Public Utility Note No. 6, "The Appraisal of Village Electrification."
III. GENERAL APPROACH

12. What follows is meant to be illustrative rather than all-encompassing, and by nature "guidelines", as the title suggests, rather than a checklist. No general "guidelines" will be perfectly suited to all circumstances encountered, and they should not either be followed slavishly, or relied upon as a substitute for common sense. Attached to these guidelines are three annexes covering the following items:

Annex 1: Checklist for Power Sector Information
Annex 2: Checklist for Sector Problems
Annex 3: Outline of Power Sector Studies Reports

These annexes are intended to be used as tools in systematically reviewing possible gaps in sector knowledge information, problems and issues which might need investigation and analysis before or during a sector study.

Coordination with National Planning

13. A good starting point would be the country economic development plan if one exists, and any related studies available on the energy economy. Normally, development plans for the whole economy exist, however crude in form, but policies for the energy sector seldom exist. The power sector review will thus usually have to proceed without it. Information on the development plan should in the first instance be sought within the Bank: it would be preferable to require the host government to supply its development plan to headquarters rather than to rely upon reviewing it in the field when time will be scarce. The plan should have been examined by the appropriate country economist as well as whoever is responsible for the survey of the power sector. It should have been found to be reasonable, or anomalies noted and brought to the attention of the host government planning authorities. In any event, the plan -- or a plan with suggested amendments -- should be acceptable to the Bank, and present a balanced, realistic program giving due attention to economic and social objectives, inter-sectoral priorities, and resource availabilities. The plan should have a summary for the power sector. This summary should present the magnitudes and timing of the resources required to carry out the sector program. The power sector review effort should not be mounted unless a reasonable amount of relevant information has been collected by the host government.

Demand Aspects

14. A prediction of electricity consumption over a number of years should be available. In countries with complex sectors the national "forecast" requirements may be no more than the summation of forecasts of individual systems, and as such may ignore the real or potential effects of interconnection, integrated operation, and diversity between systems.
For the purpose of the sector survey these imperfections may be acceptable. The overall national electric energy requirements should be reviewed against the programmed level of economic activities implied in the strategy of the country economic development program. The forecast and the program should exhibit internal consistency. In a complex sector, the individual system forecasts should be examined vis-a-vis past sales, the nature of the service area and market, tariffs and any other relevant information including planned economic activities. Judgments should be made, not only as to whether the forecast growth consumption is likely to turn out to be accurate, but whether that rate of consumption, broken down as necessary by different consumer groups, is justified. In turn this requires that the role of price as a means of signaling investment decisions be seriously examined, subject to income distribution or other social constraints.1/

Access to Supply

15. In examining demand projections, caution should be exercised to properly take into account "hidden demand" which may exist. The most obvious element may be "suppressed demand" which exists solely due to the supply system's inability to provide all the service customers are seeking. It may be manifest by known restrictions in new connections or limitations on consumption by present customers; or it may be attributed to deliberate covert or overt rationing, as by on-peak voltage reduction.2/ The other dimension is less apparent and much more difficult to quantify; the demand which could be attributed to segments of the population who need to be explored have no access to service. In many societies the extent to which it is planned to cater to this demand is a question of penetrating social significance. Demographic data should be sought with special reference to availability of service and income level, where the information exists. This will generally require searching several sources: the appropriate government agency with access to census material; and the power supply agencies' customers' records. The performance of any rural or village electrification projects should be reviewed to determine if this type of market has been a responsive one. The purpose is to develop the basis for making evaluations and judgments concerning availability of service to all segments of the population, and plans to increase access to supply. These data may also prove useful in the examination of the potential role of the sector for such national goals as redistribution of income, decentralized regional development, industrialization, urban planning (including improvements in transportation and environmental quality), employment, etc.

1/ See Public Utility Note No. 5, "Pricing in Power and Water Supply."

2/ Evidently, captive generating capacity installed by industry at large because of inadequate public supply may or may not constitute hidden demand in the event measures are instituted to render the public supply adequate. The comparative costs to industry would have to be examined. See paragraph 25.
16. Electric power pricing policies in the less developed world have traditionally been related to the financial requirements of the power supply agency with only passing concern for social objectives, and almost none for the allocation of resources on sound economic bases. To best serve all objectives, tariffs should be calculated to achieve optimum resource allocation through the mechanism of providing correct signals about costs to consumers, modified by consideration of equity to all social classes, with due attention to achieving the financial targets of the enterprise. As with all compromises, no one objective will be served perfectly. The sector survey ideally should examine tariff policies and structures, and determine to what extent they fail to contribute to the achievement of these objectives. In practice, this would require the collection and review of (economically stated) enterprise marginal costs and making judgments as to whether tariff structures adequately reflect them; whether the tariff and metering system used provides consumers with the right incentives; and of whether any implicit cross-subsidies are in line with social aims. In practice, it may not be possible to do more than indicate the need for a more thorough review of tariffs, as suggested in paragraph 31.

Institutional Aspects

17. The institutional nature of the sector should be reviewed and reported upon. This would include in addition to power supply systems concerned, government agencies at both the national and lower levels. There may be ministries, specialized development instrumentalities, financing bodies, and regulatory agencies. Underlying their existence may be legislation, executive orders such as decrees, and charters. Sufficient knowledge must be gained of (1) the nature and interrelationship of the legal bases for all key agencies; (2) their powers and obligations; and (3) their access to resources to permit the development of a comprehensive understanding of "how and why" the sector works the way it does. True copies of all important laws, codes, decrees, charters, etc. should be obtained. Some or all will be germane not only to the path of sector development on the macro level, but also to eventual project financing.

18. It is particularly important to investigate the existence and application of legislation/decrees (or whatever) which govern use of water resources. Most societies hold agricultural claims against water in higher priority than those of power. It is most important not only to rational development of the country, but also to the efficacy of the Bank's role in this process, that these issues be sorted out before serious investment planning proceeds. In the event international waterways are involved, or where development of rivers is planned which may affect downstream riparian countries, especial care must be exercised. Any treaties and/or protocols must be reviewed, and copies obtained.

1/ See Public Utility Note No. 5, "Pricing in Power and Water Supply."

2/ See O.M. 2.22, "Projects on International Waters."
10. It should be realized that there is no single organizational structure best suited to the sector which would be most appropriate in all countries. Public and private utilities may coexist. Generation, transmission and distribution may or may not be managed by single entities and can be of a national, regional, municipal or cooperative nature. The sector organizational structure should be reviewed with an open mind and respect for national idiosyncrasies. In Bank experience organizational effectiveness seems to be more closely related to sound management than to organizational structure, although the most skillful management cannot operate effectively within a badly conceived organization structure. Nevertheless certain general characteristics for an effective organization can be established such as:

i. A policy making body (national or local) to set objectives and broad policies, and to monitor the performance of operating institutions;

ii. A reasonable degree of operational autonomy including financial independence, as well as powers to set charges within appropriate guidelines and controls, to collect revenues, to control cash, and to plan the financing of the entity's development through an appropriate combination of internally generated revenue, borrowings, and government contributions;

iii. Effective minimum information systems which can provide the financial and operating data which are the raw material for day-to-day management and control, and technical and financial planning. The most important single element of such a system is a well designed "commercial" accounting system;

iv. Authority to set salaries and wages at competitive levels in order to attract and retain competent staff, and the power to hire, dismiss or discipline staff members; and

v. A continuing program of staff training at all levels within the organization.

Assessment of the capacity and limitations of the institutional arrangements of the sector is an important part of the sector survey. Any programs planned or proposed need to be examined from this point of view, and the mission's judgment about the arrangements should be clearly stated in the report.

Use and Development of Human Resources

20. A sector study should give particular attention to management and manpower needs. The importance of power systems as well as the magnitude of present and planned capital investment should command a fair proportion
of available management talent. The waste of resources arising from inefficient management of entities in this capital-intensive sector far outweighs the cost of adequate management, which is very small in relation to the size of the investments. This usually can and should be conclusively demonstrated to decision makers. The lack of well thought out training programs for top management, as well as for all the other levels of operational responsibility, is often one of the major constraints to efficient and rapid development of the sector. A thorough sector survey should include a brief survey of educational institutions with theoretical and practical programs in the various disciplines important to the sector. The need for expansion of these programs and for short and long term training programs operated by sector entities should be specifically considered during the study. Other inhibiting factors include the difficulty of getting highly qualified staff to accept assignment in outlying areas where there is a dearth of educational, health, and other facilities. This problem is particularly difficult in dealing with village and rural electrification.

IV. SPECIFIC INFORMATION REQUIRED

21. At the same time as the information discussed in Section III is compiled, the present and projected position of the agencies carrying out the direct power supply function must be reviewed. As suggested, there may be few, or many institutions. The history of their past operation and a description of their present facilities need be of concern only insofar as they offer a guide to the future.\textsuperscript{17} For example, it would be important to have a concise five-year record of production and sales by principal customer category, but not necessary to have a detailed description of facilities that amounted to an inventory of transmission and distribution plant down to the total length of secondary circuits. Some judgment must obviously be exercised in collecting information, and the objectives of the review kept in mind.

22. Forecasts of demand and energy requirements will have been collected. It is desirable that the energy projections be available for each class of customer. The bases on which the projections were carried out should be known not only because a judgment about their validity is needed, but also because they should be tested against projections of economic activity at the national level, as suggested earlier. Sufficient information should be available in the historic sales data to reveal any seasonal variation which is characteristic of the market. When readily available, load-duration curves should be collected.

\textsuperscript{17} Except for the considerations discussed in paragraph 23.
23. In connection with the data described in paragraph 15, a special effort should be made to obtain historic information concerning the consumption of residential or domestic customers. To the extent that power supply agency records permit, these data should be sought on a basis as disaggregated as possible, and preferably so consumption can be correlated with income. Some societies have created special agencies to promote, in cooperation with the principal power supply institutions, programs of village and countryside electrification. Thus it may be necessary to correlate information from several sources. These data are of interest not only in examining sector policies, but are useful in connection with other Bank work where cross-section analysis is of interest.

24. Information on primary power resources and prices of fuels should be assembled and reviewed. Basically, this would include any inventories of potential hydroelectric developments together with any studies of specific proposals. Data should cover approximate energy available, projected capability, reservoir capacity, and an outline of probable operation. Estimated costs should be sought, and their basis determined. Fossil fuel resources should be investigated and present and projected prices obtained. A general appreciation of transportation and handling facilities should be gained, adequate to identify problems and potential bottlenecks. Where imported fuel (probably petroleum) figures importantly, a knowledge of seaport and pipeline capacities is necessary, and the role of domestic refineries should be understood. The prospects for development of indigenous fossil fuel should also be looked into. Finally, in the exceptional instances of those few developing countries with fairly sophisticated domestic manufacturing industries, a broad grasp of its probable role in power system development would be useful.

25. The existing power system(s) should be described. Here again, there is no need for an exhaustive inventory of every nut and bolt. The review should reveal whether or not the various elements of the supply system(s) appear in reasonable balance. Some indication should be obtained of the reliability of supply as available to the principal classes of customers, and if there is evidence that reliability is unsatisfactory, an assessment of the underlying causes should be made. (Thus the problem may be inadequate generating capability; improper maintenance; overloaded distribution plant, etc., or several factors in combination.) The existence of captive plant in the hands of industries which generally otherwise would rely on public supply may be taken as prima facie evidence that public

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1/ See Public Utility Note No. 3, "Generating Plant Reserve Margins" and Public Utility Note No. 4, "Standards of Urban Electricity Distribution" respectively.
supply is inadequate or unreliable. Some information should be obtained on the amount of such captive plant as well as its cost.

26. An appreciation is required of the soundness of planning for the forecast market development. The planning horizon should be reasonable vis-a-vis the probable time to conceive, engineer, and construct new facilities. Due attention should have been paid to alternative sources of generation; to possible bulk power transmission schemes; and to various different patterns of distribution system evolution. Preinvestment and feasibility studies particularly for generation and high voltage facilities should be carried out with significant lead time to allow for a meaningful comparison of development alternatives. In addition, market studies in new areas to be covered by the power system should be scheduled sufficiently in advance. Of particular importance is a national overview to assure that development plans for one system or region do not pre-empt the options available in another: thus for example the selection of the level for a new extra-high-voltage transmission system should be made only after considering the requirements of all geographic regions.

27. Satisfactory evidence should exist that the plan(s) constitute the "least-cost solution(s)" in the economic sense where costs have been measured in correct economic terms. With increasing frequency, the exercises leading to this conclusion are carried out by one or another type of power system model using computer techniques. Key inputs should be checked for "reasonability," and the basis for any constraints or anomalies understood.2/ For example, it may be national policy to burn indigenous fuel even though imports may be less costly. In this respect an appropriate long-term view of the prices and availability of indigenous and imported fuels should be considered. The range of primary resources has been considerably expanded with the development of nuclear and geothermal technology and the availability of fossil fuels with different characteristics (such as high and low content of sulphur which have important effects on prices). In the same manner new types of medium-sized generating plants such as large diesels, dual steam-gas cycles, gas turbines, etc. should be kept in mind. Finally, the "least-cost solution(s)" must be shown to be technically feasible by engineering analysis which has taken account of such considerations as steady-state and transient stability.

1/ But some industries (such as sugar where bagasse can be burned as a fuel, or chemical processes where steam is required) have economic advantages in producing their own electric power.

2/ But not necessarily accepted. The tests of "reasonability" may include whether appropriate use has been made of shadow pricing.
28. The plan should be translated into capital requirements, preferably by major category of plant. The incidence of expenditure should be as realistic as possible and correspond to the best estimate of the actual flow of funds needed to finance the construction contracts. A capital budget should be prepared corresponding to the period of the planning studies underlying it. Expenditures should be separated into domestic and foreign components.

29. Once the aggregate sector construction financing requirements are quantified, an outline plan of meeting them should be prepared. In the case of single-agency sectors this can probably most readily be done with the power supply agency itself. Where a number of systems are involved, the national planning office (or other appropriate agency of the national government) should have available projected funds statements for all the agencies constituting the sector. Generally speaking this information may be the most difficult of all to obtain on a reliable basis. Certainly, the government should have been alerted to its need well in advance of the field work in connection with the sector review. It may be more productive to contact the power companies directly. In the end, the Bank mission may have to prepare the largest part itself. This would entail visiting the key companies in the sector, with a view towards obtaining coverage as nearly complete as is consistent with a reasonable expenditure of time and effort. In many societies as few as three or four companies represent 75% or more of the sector, and a very good appreciation of overall sector financial requirements can be obtained by extrapolation. Care must be exercised to assure that where it is intended to aggregate data, they are comparable. The goal should be to identify broadly the extent to which recourse can be had to (i) revenues, (ii) borrowings, and (iii) government contributions in satisfying sector needs.

30. Broad judgments should be drawn about the adequacy of revenues (and hence tariffs) both from the apparent soundness of the overall financial picture, and the extent to which new construction can be financed from internal sources. If indicated, the proposed sources of borrowings should be contacted to determine the degree of realism underlying the projections. Finally, the overall plan should be reviewed in some detail with the planning office. Some feel for the Bank's role should be developed. At this stage any gross structural or institutional flaws should have become apparent, and the opportunity seized to bring them to the government's attention. For example, in the face of rapidly increasing electricity requirements, legislative limitations on earnings may tend to either create power shortages, force systems to borrow under imprudent terms, or result in overwhelming demands on budgetary sources. The principal conclusions from the review should be drawn before the mission departs from the country, and they should be discussed with the appropriate government agencies.

31. Assembling the information discussed in the two preceding paragraphs will allow a judgment to be formed about the adequacy of the general level of tariffs. In addition, however, tariff structures should be examined. For
example, peak and off-peak differentials, the justification of increasing or declining block rates, and the role of demand, energy, and customer-related charges all warrant critical scrutiny. All this may not be possible where many agencies are involved (except of course in the unusual circumstances where tariff structures and levels are uniform throughout the sector), the major systems and appropriate government bodies should be acquainted with the desirability of investigating the real effect of the structures in force. Inadvertent cross-subsidies of iniquitous nature may prevail, quite contrary to intention. On the other hand, pursuit of a policy of low tariffs believed to benefit lower income classes may introduce distortions in the shape of the daily load curve, which in turn result in unjustified investments in the power supply system. In villages (and in distribution networks in residential areas of towns) low returns on the investment may be a reflection on the tariffs, rather than a measure of the merits of the investment. One of the conclusions to be drawn from the sector review is whether or not a more detailed examination of tariffs appears desirable.

V. REPORT

32. The sector review should be made available to Bank staff in general by a report. The report should of course reflect the objectives of the review. To this end it should more nearly be a dynamic analysis of an evolving sector than a compendium of bare (and perhaps unstructured) data. Detail is fine in its place (i.e., annexes) but in preparing the report it should be borne constantly in mind that the reader should be given an appreciation of:

i. How the sector fits into the economy;

ii. To what extent it is consciously or otherwise used as an instrument of national social policies;

iii. Whether its development is founded on an adequate basis of market, preinvestment, and engineering feasibility studies; and if not, the shortcomings should be identified;

iv. How it will be financed and what demands it is likely to make on the national budget; and

v. The role appropriate to the Bank's participation in its development.

33. If the suggestions above have been followed the salient features of the sector will have been uncovered, and any outstanding anomalies or aberrations brought to the attention of the host government. The report prepared after the field work should of course include a discussion of any such aspects together with the mission's recommendations, and an evaluation of the government's position on them.

November 20, 1973
CHECKLIST FOR POWER SECTOR INFORMATION

1. Legal and Institutional

1.1 Government policy/legislation governing aspects of power development and the power supply industry. Laws, codes, decrees and other legislation affecting the organization of the power sector. Responsible authority at national, regional, and local levels; legal status and composition of planning, regulatory and coordinating agencies; organization of the various utilities owning and operating the power plants and systems.

1.2 Means by which decisions pertinent to power sector are implemented, controlled and evaluated, e.g.,

- tariff policy
- capital and operating budgets
- appointments to board memberships
- operating regulations
- licenses
- utility commissions

1.3 Details of any pooled operation with neighboring countries/regions.

2. General Information on Power Sector

2.1 Total and per capita electricity consumption; growth trend in electricity consumption;

2.2 Access to electricity supply:

- Population served by categories: large, medium, small cities, rural areas. (For a suggested format for presenting this information, see Attachment 3.)

- Distribution of electricity consumption by class of consumers: industry, commercial, residential, etc. (For an example of how this may be presented, see Attachment 2.)

2.3 Investment program for power sector for period covered by national development plan (if any). Criteria for determining priorities; financing plan for new investments.

2.4 Relationship between electricity consumption and economic activity. Electricity consumption and GDP per capita. Electricity consumption (production) and activity in other sectors. Methodology for forecasting electricity demand.
2.5 Design criteria for power systems: formulation and regulation of industry standards; procurement procedures, customs policy, import duties.

3. **Production**

3.1 Types of power plants (hydro, steam, diesel, nuclear, geothermal, etc.), their installed capacities, energy potentials and individual contribution of total production. Trend in installed capacity of various types of power plants. (See Attachment 1 for a suggested format for presenting this information.)

3.2 Geographic distribution of power plants. Reasons leading to choice of location and type of power plants in the various regions.

3.3 Trends in cost of production (broken down into interest on capital, depreciation, fuel costs, operation and maintenance costs) of electrical energy from different types of power plants in different regions.

3.4 Statistical summary of electricity production by type of generating plant and breakdown of consumption by sectors. (Attachment 2, Table 1 shows an outline suggested by the UN for presenting this data.) If electricity is imported, quantity, source, cost of such imports, and problems associated with imports. In the case of exports, details of export trade.

3.5 Characteristics of main producing companies. Scope of activity (whether generation, distribution, or transmission). Organizational and legal structure of the entity. Percent and type of customer served. Installed capacity and growth rate. Operating characteristics (load factor, peak demand, efficiency, etc.) Quality of service (reserve capacity, frequency of interruption, etc.)


3.7 Trends in capital investment (and foreign exchange components) involved in construction of different types of power plants.
4. Rural Electrification

4.1 Government policy regarding rural electrification.
Organization of agency responsible for planning, programming, promotion and control of rural electrification. General technical and economic problems of rural electrification. Means to cope with these problems.

4.2 Number and percentage of rural households receiving electricity; aggregate investment. Consumer response to electrification in villages.

4.3 Benefits of village electrification (development of agro-industries, irrigation). Effect on urban rural migration patterns. Tariff structures in villages and reasons for these. Sources of finance for village electrification programs.

5. Tariffs and Finances


5.2 Value of assets and basis of valuation. Depreciation policies.

6. Management and Staff

6.1 Organization chart of the lines of authority in the sector and in the main utilities. Manpower resources. Recruitment problems, if any. Training facilities and policy. Adequacy of managerial and technical staff in the sector. Use of foreign personnel in advisory and operational roles. Use of consultants.

7. Future Development

7.1 Overall national policy on energy sector development in general and power in particular. Proposed legislative actions, pricing policies, taxation measures. Plans to upgrade quality of supply and service. Improvement in efficiency. Power sector expansion program. Sources of finance for expansion program.

November 20, 1973
CHECKLIST FOR POWER SECTOR PROBLEMS

1. Technical
   a. Does the national planning agency know what is required of the energy/power sector to meet development objectives?
   b. Is there knowledge of energy and power resources and their probable roles in the future?
   c. Is the method of investigation of resources effective?
   d. Are design standards satisfactory?
   e. Are the maintenance and operation of existing systems satisfactory?
   f. Are the problems associated with electricity transmission and distribution known to national authorities?
   g. Are there plans to overcome the technical and other problems associated with rural electrification?

2. Managerial - Planning
   a. Is investment planning of a high standard?
   b. Are investment alternatives adequately examined?
   c. Are the criteria for the selection and location for power projects adequate?
   d. Do we know what equipment and materials can be supplied locally?
   e. Are procurement, contracting, and bidding procedures satisfactory?
   f. Can local consultants or government engineers be relied upon to carry out preliminary engineering and feasibility studies?
   g. Are local contractors efficient?

3. Financial - Economic
   a. Are accounting systems satisfactory?
   b. Do we know how electricity supply is charged for?
   c. Do charges reflect economic costs of providing the services?
d. Are utility companies financially viable?

e. Are metering, billing and collection systems reasonable?

f. Do we know terms and interest rates of local funds?

g. Are methods of subsidizing the sector, if any, likely to result in misuse of resources?

h. Is foreign aid to the sector likely to be maintained?

i. Are terms of interest rates likely to be changed?

j. Are there any extreme budgetary constraints?

k. What is the record of approving and implementing tariff increases needed in the past?

4. **Manpower**

  a. Are local personnel technically competent and sufficient in number to carry out the development plan?

  b. Are manpower training schemes effective?

  c. Could adequate skilled and semi-skilled manpower be supplied if the development plan were expanded?

  d. Do we know the manpower and training needs? Detail as to professional, sub-professional, and skilled labor - by area: (i) investigation and design, (ii) construction, and (iii) operation and maintenance.

  e. Can expatriates be employed if needed?

5. **Organizational - Administration - Legal**

  a. Are the laws, codes and decrees regulating power systems, and the allocation and consideration of power resources satisfactory?

  b. Is the division of responsibility for policy, construction and operation adequate?

  c. Are the roles of national, regional, and local public authorities clearly defined and satisfactory?
d. Is there need to change the legal status of any of the parts of the system (commercial corporations, utility commissions, administrative bodies, etc.)?

e. Are organizational structures of individual electric utilities conducive to efficient operation?

f. Are local officials aware of the requirements of international lending agencies for project preparation?

g. Are any laws or regulations in conflict with the Bank's procurement guidelines?

h. Is there sufficient coordination with other agencies with interest in energy development with responsibility for industrial or infrastructural development, urban planning, and so on?

i. Should there be any new government action to govern the future development of the industry?
PRODUCTION OF ELECTRIC POWER—

(Power generation capacity as total minimum monthly capability* and gross annual production)

<table>
<thead>
<tr>
<th></th>
<th>Utilities</th>
<th></th>
<th>Auto Producers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capacity</td>
<td>Production</td>
<td>Capacity</td>
</tr>
<tr>
<td></td>
<td>MW</td>
<td>GWh</td>
<td>MW</td>
</tr>
<tr>
<td>Hydro</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas turbine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average Tariff in USc/kWh

* Recognizing this will frequently not be readily available, and surrogates accepted such as "nameplate ratings."

November 20, 1973
<table>
<thead>
<tr>
<th>Years</th>
<th>(Trillion kWh)</th>
</tr>
</thead>
</table>

**Production**

<table>
<thead>
<tr>
<th>of which:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro-power plants</td>
</tr>
<tr>
<td>Steam power plants using:</td>
</tr>
<tr>
<td>Coal</td>
</tr>
<tr>
<td>Lignite</td>
</tr>
<tr>
<td>Natural gas</td>
</tr>
<tr>
<td>Coke-oven gas</td>
</tr>
<tr>
<td>Blast furnace gas</td>
</tr>
<tr>
<td>Refinery gas</td>
</tr>
<tr>
<td>Petroleum products</td>
</tr>
<tr>
<td>Other fuels</td>
</tr>
<tr>
<td>Diesel-electric plants</td>
</tr>
<tr>
<td>Nuclear power plants</td>
</tr>
<tr>
<td>Geothermal power plants</td>
</tr>
<tr>
<td>Gas turbine power plants</td>
</tr>
</tbody>
</table>

**Consumption**

<table>
<thead>
<tr>
<th>Consumption by energy sector of which:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal mines</td>
</tr>
<tr>
<td>Lignite mines</td>
</tr>
<tr>
<td>Coke ovens</td>
</tr>
<tr>
<td>Gas works</td>
</tr>
<tr>
<td>Patent fuel plants</td>
</tr>
<tr>
<td>Lignite briquetting plants</td>
</tr>
<tr>
<td>Crude petroleum extraction</td>
</tr>
<tr>
<td>Petroleum refineries</td>
</tr>
<tr>
<td>Natural gas extraction</td>
</tr>
<tr>
<td>Electric power plants</td>
</tr>
<tr>
<td>Pumped storage plants</td>
</tr>
<tr>
<td>Distribution losses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption by transportation sector of which:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air transport</td>
</tr>
<tr>
<td>Road transport</td>
</tr>
<tr>
<td>Railways</td>
</tr>
<tr>
<td>Internal and coastal navigation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption by industries sector of which:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining and quarrying</td>
</tr>
<tr>
<td>Textiles</td>
</tr>
<tr>
<td>Chemicals except fertilizers</td>
</tr>
<tr>
<td>Fertilizers</td>
</tr>
<tr>
<td>Cement</td>
</tr>
<tr>
<td>Non-metallic mineral products</td>
</tr>
<tr>
<td>Iron and steel basic</td>
</tr>
<tr>
<td>Non ferrous basic</td>
</tr>
<tr>
<td>Other industries</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption by agricultural sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption by domestic sector</td>
</tr>
<tr>
<td>Consumption by commercial sector</td>
</tr>
<tr>
<td>Consumption by government sector</td>
</tr>
<tr>
<td>Consumption by other sectors</td>
</tr>
</tbody>
</table>

November 20, 1973
### POWER SECTOR: SUMMARY OF ELECTRICITY CONSUMPTION

**ELECTRICITY CONSUMPTION BY CLASS OF CONSUMERS, REGIONWISE OR STATEWISE, 1971 (sample data sheet)**

<table>
<thead>
<tr>
<th>States</th>
<th>Region</th>
<th>Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Rural</th>
<th>Others*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Northern</td>
<td>North</td>
<td>156.2</td>
<td>91.9</td>
<td>69.0</td>
<td>0.0</td>
<td>73.4</td>
<td>390.5</td>
</tr>
<tr>
<td>All Northeastern</td>
<td>Northeast</td>
<td>878.8</td>
<td>473.5</td>
<td>1,500.2</td>
<td>29.5</td>
<td>553.5</td>
<td>3,435.5</td>
</tr>
<tr>
<td>Sao Paulo</td>
<td>Southeast</td>
<td>3,800.8</td>
<td>2,347.2</td>
<td>10,006.2</td>
<td>212.6</td>
<td>2,131.7</td>
<td>18,498.5</td>
</tr>
<tr>
<td>Minas Gerais</td>
<td>Southeast</td>
<td>738.4</td>
<td>326.4</td>
<td>3,541.8</td>
<td>39.5</td>
<td>404.0</td>
<td>5,050.1</td>
</tr>
<tr>
<td>Guanabara</td>
<td>Southeast</td>
<td>1,413.8</td>
<td>1,277.4</td>
<td>958.4</td>
<td>0.0</td>
<td>640.5</td>
<td>4,290.1</td>
</tr>
<tr>
<td>Rio de Janeiro</td>
<td>Southeast</td>
<td>723.7</td>
<td>280.5</td>
<td>1,091.0</td>
<td>3.4</td>
<td>290.9</td>
<td>2,389.5</td>
</tr>
<tr>
<td>Espirito Santo</td>
<td>Southeast</td>
<td>79.4</td>
<td>42.7</td>
<td>241.4</td>
<td>2.1</td>
<td>45.0</td>
<td>410.6</td>
</tr>
<tr>
<td>Sub-Total Southeast</td>
<td>Southeast</td>
<td>6,756.1</td>
<td>4,274.1</td>
<td>15,838.9</td>
<td>257.6</td>
<td>3,512.1</td>
<td>30,638.8</td>
</tr>
<tr>
<td>All West Central</td>
<td>West Central</td>
<td>250.3</td>
<td>157.4</td>
<td>75.5</td>
<td>2.0</td>
<td>228.9</td>
<td>714.1</td>
</tr>
<tr>
<td>All Southern</td>
<td>South</td>
<td>996.1</td>
<td>635.3</td>
<td>1,345.9</td>
<td>47.3</td>
<td>520.5</td>
<td>3,545.1</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>Main Utilities</td>
<td>9,037.5</td>
<td>5,632.3</td>
<td>18,829.5</td>
<td>336.5</td>
<td>4,888.2</td>
<td>38,724.0</td>
</tr>
<tr>
<td>Other Utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>580.0</td>
</tr>
<tr>
<td>Self Producers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3,624.6</td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>42,928.6</td>
</tr>
</tbody>
</table>

1/ 66 main distributing utilities surveyed by ELETROBRAS. With a few exceptions, these are roughly the same as the 63 OPE utilities and represent a market about 0.3 percent larger.

* This may be subdivided into agricultural, government and all others.

Source: ELETROBRAS

Reproduced from: The Economic and Social Development of Brazil

November 20, 1973
ACCESS TO ELECTRICITY SUPPLY

<table>
<thead>
<tr>
<th></th>
<th>Population</th>
<th>% Supplied Today</th>
<th>% Projected Supply for Yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cont. 1/ Discont. 2/ Total</td>
<td>Cont. 1/ Discont. 2/ Total</td>
</tr>
<tr>
<td>Rural Areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small towns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium sized towns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital city</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other large cities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ Continuously
2/ Discontinuously

November 20, 1973
OUTLINE OF POWER SECTOR STUDY REPORTS

I. SUMMARY AND CONCLUSIONS

II. INTRODUCTION
   A. Background and Reasons for the Study
   B. The Role of the Sector in the Economy
   C. Development of the Sector
   D. Bank Involvement

III. SECTOR DESCRIPTION
   A. Organization
   B. Policies
   C. Present Market Situation (supply, demand, access to supply, etc.)
   D. Tariffs

IV. SECTOR ANALYSIS
   A. Goals
   B. Organization
   C. Planning and Project Preparation Studies Needed
   D. Staffing
   E. Finances

V. RECOMMENDATIONS
   A. Recommendations to National Agencies
   B. Recommendations to International Organizations
   C. Recommendations to Bank Group

November 20, 1973