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UNDP - WORLD BANK

"ENERGY PLANNING: THE PROSPECTS AND CHALLENGES THAT LIE AHEAD"

PROSPECTUS

FOR

THE ENERGY PLANNING PROJECT

FOR

EUROPE AND ARAB STATES COUNTRIES

APRIL 17, 1987

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The World Bank

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ENERGY PLANNING PROJECT FOR EUROPE AND ARAB STATES COUNTRIES

PROSPECTUS

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PROSPECTUS

ENERGY PLANNING PROJECT FOR EUROPE AND ARAB STATES COUNTRIES

Background: Challenges and Opportunities

1. Sound investment decisions have always been needed in the energy sector, since the sector typically accounts for around 10% of all national investment and failures in supply have the potential for widespread disruption throughout the economy. Recently, with the volatility of international energy prices, the environment in which energy planning takes place has changed and requires an even greater emphasis on efficiency and the successful integration of policies across a broad front. Firstly, the decline in oil prices in early 1986 not only calls for a re-appraisal of energy strategy, but also reminds us of how uncertain many of the variables that influence sector strategy are. Because of this uncertainty, energy planning needs to be a continuous process so that energy strategies have flexibility to adjust to external changes. Secondly, many countries are facing balance of payments deficits and problems of debt service. The "debt crisis" has led to slowdowns in economic growth rates, and consequently slower rates of growth in energy consumption. It has also meant that financial resources are now much more scarce. Indeed energy investment programs often need to be re-examined in light of overall financial resources, and alternatives to building new capacity investigated.

2. The new planning environment is characterized by a need for closer attention to the links between the energy sector and the rest of the economy, as well as between energy subsectors; constrained resources for new investment requiring more policy alternatives to be considered; and greater uncertainty requiring more flexibility in energy strategy. As the planning environment changes so will the role of the energy planner - a role that will require increased emphasis on policy formulation and the investigation of policy alternatives, flexibility and adaptability in the interpretation of energy plans, and an ability to assess the impact of risk and uncertainty on decision making in the sector.

3. Furthermore, recent advancements in technology including the increased capabilities of relatively low cost micro-computers, as well as the associated development of sophisticated software suitable for energy planning, presents a timely opportunity for many energy planners to acquire new skills. It also eliminates the difficulties of energy planners obtaining access to costly mainframe computers.

4. In summary, energy planning is at a most interesting juncture, the challenges facing the energy planner have never been greater, and the opportunity to enhance skills in light of recent micro-computer developments never more timely.

Energy Planning in the Region - An Impressive Effort

5. The Europe and Arab States regions (defined for the purpose of the Project as the Region) consist of 31 diverse countries (see Section III) that

are potential recipients of UNDP funds or World Bank borrowers. All of the countries, whether well endowed with energy resources or major energy importers, share common concerns regarding the importance of the energy sector to their country's economic development and well-being. Most countries of the Region have recognized the importance of energy planning and, as a consequence, have established or strengthened their respective energy planning institutions. The collective regional experience is both impressive and wide ranging. One country has been at the forefront of modelling hydropower systems and their integration into least cost electricity supply models. Another country is implementing an innovative scheme to attract both foreign and local finance to the energy sector. Other countries have successfully managed intensive energy conservation schemes, renewable energy programs, and environmental programs. However planning is a dynamic and adaptive process requiring continuous attention to the updating of knowledge, skills and techniques. Furthermore, the range of experience and exposure within the Region is uneven.

An Introduction to the Project

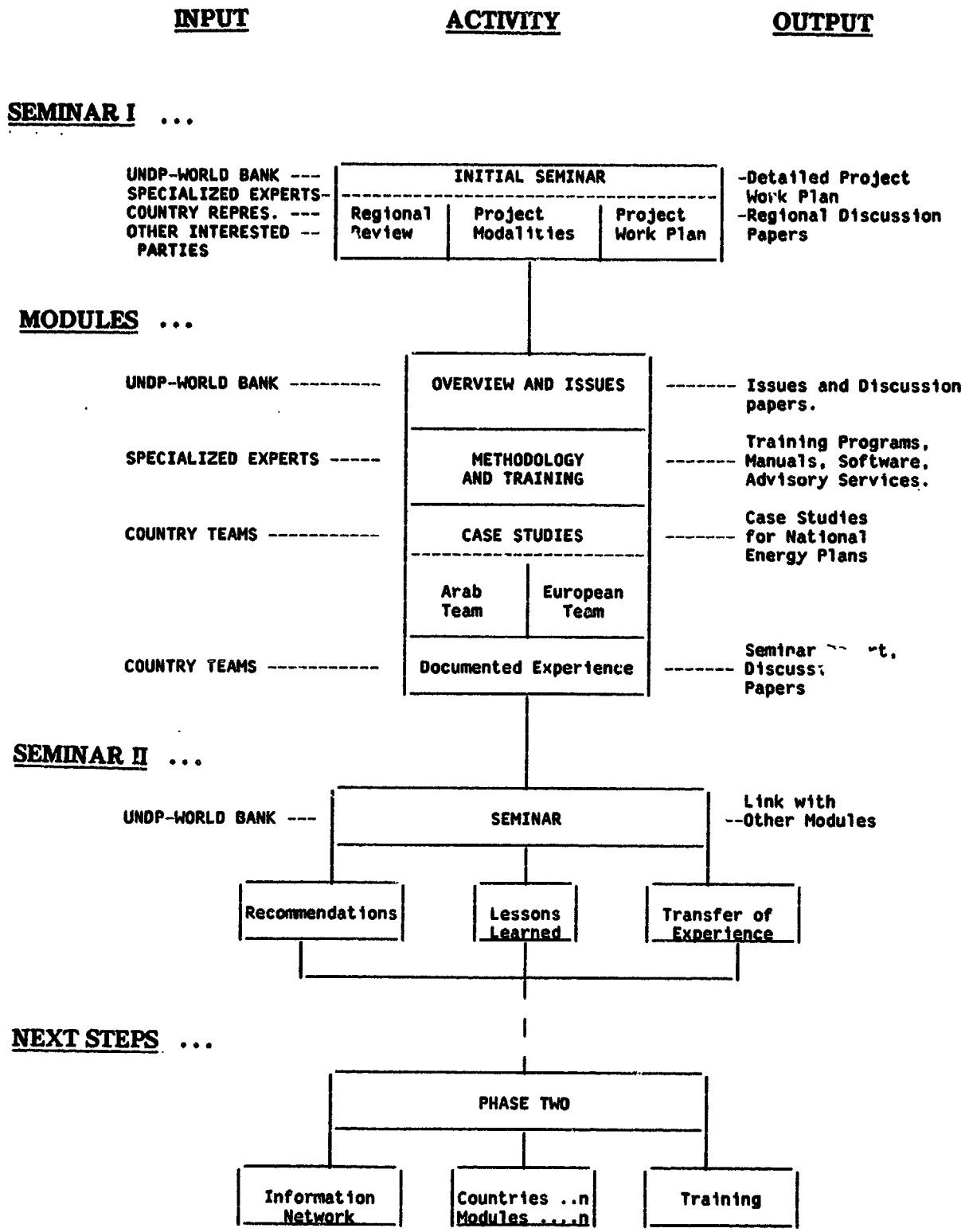
6. The United Nations Development Programme (UNDP) has initiated a technical assistance program in energy planning, of which this Project is the first phase. It is designed to stimulate the exchange and flow of knowledge and experience among countries of the Region. The World Bank has been designated as executing agency.

7. The Project is structured around a series of thematic modules covering a broad range of topics of interest to the contemporary energy planner. Each module, in turn, typically consists of an overview or "state of the art" paper; country level case studies carried out, under an agreed methodological framework, by national teams; and the preparation of seminar and training materials reflecting the findings of the studies and experience of the teams. In addition periodic training workshops and informational and working seminars will be organized. Specific outputs include:

- specialized training;
- exposure to current thinking on selected issues;
- collegial exchange of views and information; and
- enhanced planning skills.

8. The Project is participatory in nature and its success will be determined by the attention devoted to the preparation of the country level case studies. The case studies prepared by national teams should form an integral part of that country's energy planning work program as well as be of substantive interest to the Project. Since the purpose of the Project is training and experiential in nature rather than an exchange of data, participating countries would, at their own discretion, be able to decide upon the release of specific data for the seminars. An outline of the Project is shown on page 3.

PROJECT OUTLINE



Proposed Activities

9. The first phase of the Project will extend over a two year period. The development and preparation of case study materials will proceed from July 1987 onwards with external support as and when required. The overview papers will be prepared and circulated periodically over the two year period. A Final Report on Phase One will be prepared in December 1988. Seminar and training activities are scheduled as follows:

Seminar and Training Schedule - Phase One

Activity	Date	Location	Objectives	Participants
Initial Seminar	June, 1987 (22-26)	Austria	o Regional Energy Perspective o Project Modalities o Project Work Plan	o Country Representatives o World Bank, UNDP and interested bilateral, multilateral agencies
Training Programs (2)	October, 1987 March, 1988	USA USA	o Specialized training	o Country Representatives
Final Seminar	October, 1988	To be determined	o Information exchange o Skills Training o Case Study Demonstration	o Country Representatives o World Bank, UNDP and interested bilateral, multilateral agencies o Other interested parties

Who Should Participate?

10. We seek the participation of energy planners either at the national Government level or planners with specific subsectoral experience (e.g. electric power, coal, refineries, etc.). Leaders of country teams should have managed teams of energy specialists and should preferably have experience in the preparation of planning documents, Government policy papers or related working papers. Participants should be interested in current energy issues, be stimulated by professional debate, and be willing to participate fully in the seminars. Academic background is less important than experience although it is likely that participants would have exposure to either economics, engineering or finance.

11. We also welcome interest from other relevant multilateral and bilateral agencies as well as interested academic institutions and non-government organizations, as contributors, participants, observers or sponsors.

Further Information

12. More detailed information on the Project is contained in the following sections of this report. Persons or organizations requiring further information on how to participate in the Project should contact:

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I. MODALITIES AND EXECUTION OF THE PROJECT

Energy Planning - Objectives and Scope

1. Energy planning is not just the evaluation of investments, but also the analysis of energy policies at the sectoral, subsectoral and enterprise levels. There is a hierarchy of planning activities: 1/

(a) the formulation of sector strategy where the links between the energy sector and the rest of the economy are emphasized, overall sector objectives are set and the policies to implement them established and subsector programs are coordinated;

(b) preparation of subsector programs (e.g. for electric power, gas, refining, coal etc.) which involve considerations of investment, demand management, financing, manpower and the interfaces with other subsectors; and

(c) project appraisal which involves greater detail and is aimed primarily at investment decisions, although financing, manpower and other issues may also require evaluation.

2. To some extent this hierarchy of energy planning activities is artificial, since some may overlap, depending on the size of the country and the complexity of the sector. For example the decision to invest in a large project may determine most of sector strategy in a small country. In other cases sector strategy may be set by the programs of one of two dominant subsectors.

3. Energy planning essentially is the coordinated use of policy instruments such as investment, pricing, financial targets, direct controls, taxation, licensing of resource exploitation etc. to achieve the objectives of efficiency, equity and national security embodied in national economic strategy. It involves achieving consistency between the development of the energy sector as a whole and the rest of the economy. Today, energy planning also involves considerations of uncertainty so that the risks inherent in energy strategy are minimized or reduced to an acceptable level.

Project Objectives

4. The aim of the Project is to strengthen national energy planning capabilities within the countries of the Region through technical cooperation,

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1/ For an example of the hierarchy of planning activities see: World Bank Reprint No. 374: M. Munasinghe, "Practical Application of Integrated National Energy Planning (INEP) using micro-computers", National Resources Forum, Volume 10, February 1986, pp 17-38.

information exchange, training and advisory services. The purpose is to promote technical assistance within each country including the development of energy planning procedures, techniques, skills and organization.

5. The Project will:

(a) transfer a set of widely used planning techniques and methodologies to the participating countries;

(b) develop and/or improve approaches to energy planning as formulated on the basis of several discrete modules covering specialized aspects of energy planning;

(c) provide, within the framework of the modular approach, the development of country level case studies prepared by national teams;

(d) provide a forum for inter-regional training and information dissemination; and

(e) exchange views on a wide range of contemporary issues of concern to the energy planner.

The Work Program: I - Preparation of Modules

6. The list of modules is given in Part II. Modules consist of broad topics, e.g. energy demand, energy pricing etc., within which case studies applying one or more methodologies, or examining different topics, would be developed. Each case study will be carried out by teams of national specialists under general guidance, where appropriate, of internationally acknowledged experts. This approach has been adopted to avoid "one-off" studies by outsiders that soon become outdated; and to stimulate the transfer of knowledge and experience. Furthermore, during the First Phase of the Project it is unnecessary to promote at one time and in all countries the whole set of methodologies required for all aspects of energy policy formulation and planning. If sufficient interest is expressed, consideration will be given in Phase Two to a broader dissemination of techniques in more countries and the implementation of additional modules.

7. Each module will be policy oriented and designed to be operational. Each case study will be aimed to assist decision making, and will therefore deal with the examination of alternative options, sensitivity analysis, and general issues of risk and uncertainty. Several case studies will address planning issues in the electric power subsector, since this subsector is the largest consumer of primary energy, the largest source of secondary energy and also absorbs substantial financial and foreign exchange resources.

The Work Program: II - Seminars and Training

8. Each participating country would typically handle one case study. However, in order that each country be fully informed of the approaches, methodologies and experiences applied within the overall project framework, the country level case studies will be complemented by two seminars:

Seminar 1

9. The first seminar (June 22-26, 1987) will bring together energy planners from the Region and acknowledged experts in various specialized fields. The first seminar would:

(a) provide a comparative overview of the energy sector, and outline issues and strategies in the Region. This would be presented by the World Bank in light of a recently completed report on energy strategy in the Region. 1/

(b) provide the approaches and methodologies to be used for the analysis of each module including the case study. These will be presented by internationally acknowledged experts in each field; and

(c) enable participating national energy planners to have an overview of the modules and finalize country involvement and work programs.

Seminar 2

10. The second seminar will present the experience and results of each case study. This seminar would also include a number of papers on contemporary issues in energy planning including the implications for national energy policy analysis and decision-making, and the development of microcomputer and integrated national energy planning models.

11. At the end of the Project each participating country will have at its disposal the procedures and methodologies developed within the framework of all the modules of the entire project.

Training Programs

12. Two specialized training courses will be organized, each for a group of about twenty energy planners from the Region. The courses will focus on using planning procedures and techniques to address sector issues, prepare energy strategies, and evaluate investment options. These would largely be related to energy demand forecasting and energy supply planning.

The Work Program: III - Additional Activities

13. Additional assistance will be offered:

(a) On several major issues the World Bank will prepare background papers on current energy issues that will be presented during the two seminars and included in the final report on the project.

1/ "Energy Strategy in the Europe, Middle East and North Africa Region"; World Bank Report No. 6364; March, 1987.

(b) for each methodology requiring the use of a computer model, preference will be given to models that can be run on a microcomputer. If appropriate models are available only to mainframes, efforts will be made to convert them for microcomputer use.

(c) models would be released free of charge to participating countries wherever possible; and

(d) opportunities to establish a consolidated network of information and expertise available within the Region will be identified.

14. The Project will support the cost of external experts, seminars, training programs, and other advisory services. The preparation of country case studies by national teams will represent the Government contribution in kind to the Project. Furthermore, cofinancing will be sought in cases where larger than average training efforts are required or highly specialized training needs are identified.

Schedule (Phase One)

o June 22-26, 1987:	o Seminar including: a) experts on specialized topics. b) Country representatives. c) World Bank, UNDP, IAEA and other interested multilateral and bilateral agencies.
o June 1987-Oct. 1988:	o implementation and development of case studies in each participating country. o Specialized training courses.
o Oct. 1988:	o concluding seminar with report on all modules, case studies and exchange of expertise and experience.
o End 1988:	o publication of report including module description, suggested techniques and results of all studies.

II. THE MODULES

What is a Module?

15. The module is the building block of the Project. A module typically consists of:

(a) a thematic working paper setting out the broad issues, and providing a conceptual framework for the module in the context of the overall

energy sector as well as providing an up-to-date review of current thinking on the topic;

(b) a methodological working paper outlining in detail the methodology, analytical techniques and software to be used;

(c) one country level case study (or more if appropriate) based upon the methodological working paper but providing an operational dimension; and

(d) a summary report, prepared by the country team, outlining findings, experience and lessons learned.

The Issues to be Addressed

16. Several emerging issues of importance to the energy planner will be addressed. These include:

(a) energy demand forecasting in light of uncertainty;

(b) the role of energy in economic development;

(c) the impact of energy pricing policies;

(d) financing energy investment;

(e) energy and the environment;

(f) the complexity of planning hydro-thermal electric power systems.

17. The above tasks represent the core modules for the Project. If there is sufficient country interest additional topics would be investigated including (g) the role of renewable energy in national energy plans; (h) pricing of depletable resources, especially natural gas and coal; (i) coal planning and pricing; (j) planning oil refining investments in restructuring and new capacity; (k) joint investment planning and pricing for power and desalinated water supply or combined heat and power; (l) the potential for, and economic benefits of inter-regional trade (e.g. electricity, coal, petroleum products, natural gas); (m) regional energy price projections; (n) comparative institutions for energy planning and investment; (o) the planning of nuclear power programs; and (p) the planning and implementation of sustainable energy conservation programs.

18. The core modules are described in Sections (A) to (F) below. Additional modules, as well as special papers for presentation at the second seminar, are given in Sections (G) to (P).

Overview Papers - Setting the Stage

19. Several overview papers will be prepared during the implementation of the Project and presented at the seminars. These papers will focus on current issues of more general interest to the energy planner, while providing

contextual background material for all the modules. Topics, inter alia, to be addressed include:

(a) Risk and Uncertainty, which will review current thinking on the treatment of risk and uncertainty in decision-making; analyze the extent to which risk can be explicitly addressed in the preparation of energy plans; and offer guidance, to energy planners, on applied approaches to the subject;

(b) Integrated Energy Planning will focus on the increasing importance and benefits of integration and coordination of energy subsectors as well as across intra-subsectoral issues such as pricing and financing.

(c) The Role of the Energy Planner in the 1990s, will provide a retrospective and prospective analysis of the role of the energy planner since 1970, and offer, for debate, suggestions of future directions, priorities and opportunities;

(d) Multilateral Agencies and the Energy Sector will provide a retrospective and prospective analysis of the role of agencies such as UNDP, World Bank, IAEA and others in technical assistance, policy advice and lending activities; and

(e) Other Topics will be prepared as country interests are identified and other important issues emerge.

The Core Modules

A. Energy Demand Forecasting

Background and Issues

20. Energy demand forecasting is the cornerstone of energy planning. However, despite its importance many countries rely upon unimodal approaches to forecasting. Subsectoral forecasts and the preparation of energy balances are a prerequisite for effective planning.

21. The most common methodological approach consists of either straightforward trend extrapolation or a simple correlation between energy demand and global aggregates such as the gross national product (GNP). These forecasts tend to ignore structural changes in both the consumption of each sector and the economy as a whole. Moreover, the impact of sectoral policies on demand can not be determined, particularly pricing and the demand management measures.

22. Energy demand forecasting should be viewed in the overall context of development planning and ideally should take into account: industrialization strategy, transport policy, housing growth, balance between rural and urban areas, income distribution, consumption patterns etc.

Approach and Methodology

23. The International Atomic Energy Agency (IAEA) has developed a comprehensive disaggregated simulation model (MAED) 1/, that has been tested and adopted in several countries. However, as this model does not take price effects directly into account it is desirable to complement it with a disaggregated econometric model.

24. In addition, other well tested techniques will be applied such as the demand module of the ENPEP model developed by Argonne Laboratory, which is appropriate for countries facing lack of data. Other approaches are based on input-output models which enable a greater degree of sectoral disaggregation and are suitable for countries where good data exist. Such models can also be used for analyzing energy price [illegible]s (see Module B). Recent work has combined econometric analysis to [illegible]mine energy price elasticities with input-output models to analyse both [illegible] direct and indirect effects of changes in energy prices.

25. The module would include an overview paper setting out current thinking on demand forecasting under uncertainty; and a set of case studies using MAED, ENPEP and econometric analysis.

B. Energy Sector and Macroeconomic Linkages

Background and Issues

26. While energy demand forecasting takes account of much of the influence of the macroeconomy on the energy sector, there are many cases where the energy sector influences the performance of the economy. Examples of this are the impacts of energy resource depletion policy and domestic energy demand on the exports of an energy exporting country; the effect of a large energy investment program on overall investment and growth; and the consequences of an energy option involving significant imports on the balance of payments and creditworthiness of a country. Furthermore, there are sometimes complex feedbacks between the energy sector and the economy. For example, policies to restrain domestic energy demand in an energy exporter would lead to a higher exportable surplus of energy; increased exports would lead to higher economic growth and consequently higher energy consumption. Thus energy demand management (e.g. increases in energy prices) might paradoxically lead to higher energy consumption through the indirect influence on exports and economic growth. The issue is to evaluate these feedbacks in order to design energy sector policies (especially demand management and depletion policies), arrive at realistic energy demand forecasts and effective investment decisions, and to strengthen the formulation of economic policy.

1/ Model of Analysis of Energy Demand.

Approach and Methodologies

27. Computable general equilibrium (CGE) models have been used extensively for analyzing the feedbacks between economic sectors and the rest of the economy 1/. Recent studies published by the World Bank have analysed petroleum resource depletion issues in Egypt and Tunisia using CGE models. Another recent CGE model has been developed in France to analyse the impact of the French nuclear program on the overall economy (e.g. impact of investment and import options for the energy sector on the economy, analysis of alternative energy strategies on the balance of payments, effect of alternative industrial strategies on energy consumption and investment). 2/

28. CGE models usually have to be highly aggregated (i.e. a small number of sectors) to be manageable and this is a disadvantage for energy planning. In addition, models such as MELODIE use a sub-model of production that can analyse substitutions among the capital, labor, energy and materials factors of production (e.g. by using trans-log production functions) that may require data that are difficult or provide a poor representation of production decisions in the economies of the Region which are subject to a large amount of government direction. This module would aim at reconciling a reasonable representation of the economy with an operationally valid model of the energy sector. It presents an interesting challenge to the energy planner.

C. The Impact of Energy Prices

Background and Issues

29. Energy prices that reflect real economic costs can result in an efficient pattern of consumption and investment as well as mobilize resources to finance energy investment. Prices should, ideally, both communicate the costs of changes to consumers in order to give them incentives for adopting a pattern of consumption that they are prepared to pay for as well as mobilize financial resources to support new investments. In addition, energy pricing policies should consider the energy needs of the poor and possible distortions arising from other prices.

30. Although numerous theoretical papers are available on energy pricing, few practical approaches have been proposed. Furthermore, several issues should be investigated: how to implement marginal cost pricing; the relation between prices and taxes; the trade-offs between equity and efficiency; the pricing of depletable resources (coal, gas, oil); the appropriate relation between domestic prices and volatile international prices; and reconciling economic pricing and cost recovery.

1/ For a description of CGE models and their application see Kemal Dervis et al "General Equilibrium Models for Development Policy"; World Bank Research Publication, Cambridge University Press.

2/ For a description of the MELODIE model see the paper presented by Berthelemy, Devezeaux and Ladoux at the 13th Congress of the World Energy Conference, Cannes, October 1986.

31. Within the framework of this project only two major pricing issues are presently foreseen in the core program. However, this does not preclude other issues being investigated in additional case studies:

(a) the establishment of an electricity pricing procedure based on estimations of the long-range marginal cost (LRMC) of supply; and

(b) the impact of relative energy prices (particularly ex-refinery petroleum products) and tax changes on the general price level and on income distribution.

Long-Run Marginal Cost Pricing of Electricity (LRMC)

Approach and Methodology

32. Although problems arise in implementing tariff structures based on LRMC there is a general consensus that marginal cost pricing makes consumers aware of the real cost of their consumption and usually provides adequate revenues to the electricity producer to support future investment requirements. A recent experimental development in marginal cost pricing is spot pricing of electricity - making electricity prices responsive to short-term changes in costs - which has similarities to load management and tariffs for interruptible supply.

33. An approach has recently been developed using the WASP 1/ investment model to estimate the LRMC of electricity generation for tariff design. However, correctly identifying marginal costs and translating them into tariffs applicable to consumers presents practical difficulties, particularly when power systems are in disequilibrium (excess or shortages of capacity or where investments are lumpy). Also, before an actual price structure is determined, the LRMC of transmission and distribution must be estimated, and adjustments must be made to account for economic second best considerations, social-subsidy objectives, sector financial needs, and other constraints.

34. The proposed approach is a hybrid of the traditional static, balanced system approach to electricity pricing and the modern literature on spot pricing of electricity. WASP is used first to obtain the least cost generation investment program corresponding to a given level of demand; second a re-optimization with a sustained increase in demand added to the original demand projections; and third fuel savings arising from changes to the investment program are calculated. Estimation of incremental costs of capital, operations, fuel and unserved energy enable the calculation of the LRMC of generating capacity. 2/

35. Marginal fuel costs are estimated using the ICARUS model - a probabilistic simulation model of system operation over monthly periods and

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1/ Wien Automatic System Planning Model.
2/ "Application of WASP by World Bank in Preparing Electricity Pricing and Investment Strategy", by A. McKechnie, IAEA-TECDOC-364-Vienna, 1986.

typical days. This methodology involves simulating system operation with and without an increment of demand. As well as estimating marginal fuel costs the methodology estimates the probability of outages in each period which can be used to assign capacity costs to tariff periods.

The Impact of Energy Prices

Approach and Methodology

36. As well as the need for the levels of energy prices to better reflect costs, there is a need for a more economically efficient structure of prices in the energy sector and for rational direct taxes on fuels, particularly for petroleum products, that take account of government fiscal needs and the recovery of road user charges.

37. Recently an energy pricing impact model 1/ has been developed that combines an input-output matrix with separate pricing rules. This model could be utilized to assess the impact of changing energy prices and taxes of various fuels (mainly petroleum products) on producer and consumer prices and also the impact on wage rates, factor incomes, the balance of payments, and on inflation rates.

38. One practical issue will be to establish a procedure for linking volatile international petroleum product prices with ex-refinery prices and retail prices for petroleum products to ensure the promotion of efficiency in supply and consumption, and the generation of government revenues with the minimum of distortions.

D. Planning and Finance

Background and Issues

39. Because of the burden of external debt, insufficient cash generation by sector entities and rigidities in local financial markets, many countries have had to cut back on their energy investment programs. In other cases, low capital cost plant (e.g. combustion turbines) has been commissioned, even though it might not have been the least cost solution in the absence of a financial constraint. It is not unusual for investment planning to be carried out on the assumption that a "least cost" program could be financed, only to have the "optimum" program cut back or modified arbitrarily when it became apparent that insufficient funds would be available.

40. In addition, commercial banks and export credit agencies have traditionally financed the greater part of energy investment. In presenting an energy investment program for financing, it is useful to prepare financial

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1/ "A New Method for Estimating the Effects of Fuel Taxes", by G.A. Hughes, The World Bank Economic Review, Vol. I, September 1986.

data in a form convenient to financiers and have an appreciation of their requirements for creditworthiness. This module would seek to strengthen financial planning, at least so far as the interface between planning and financial analysis is concerned. The module would focus primarily on the important power sector.

Approach and Methodology

41. Because of the interrelationships among investments and operations in the power subsector financial analysis is usually carried out for the entity rather than the project. While project specific financial analysis may be carried out in other sectors, enterprise level financial analysis is also needed to establish the creditworthiness of the borrower. This module will therefore address financial analysis at the level of the enterprise.

42. There are two basic approaches to building financial models to complement energy planning. Firstly, financial analysis may be carried out separately from the planning exercise, but using data transferred from the planning analysis. Today, financial models are usually constructed using spreadsheets on a personal computer with software such as Lotus 1-2-3, Framework, Multiplan, Visicalc, etc. The spreadsheet approach offers considerable flexibility as to size, focus and complexity of the model. Spreadsheet models can also accommodate the wide differences found across the countries in accounting practices, taxation, legal obligations and debt management. However, spreadsheet models may become difficult to understand as their size grows and data becomes mixed with analysis. They also require the user to have a good knowledge of management accounting principles.

43. Templates, or spreadsheet model structures without data, can simplify the building of spreadsheet financial models. Templates make model construction easier for novices, but retain the flexibility of spreadsheets, since the details of the model can be changed to accommodate local features. A spreadsheet based financial model available to the project is FINPLAN, developed jointly between the IAEA and Banque Credit Lyonnais (France). FINPLAN is specifically designed to analyse the financial consequences of electric power investment programs. It uses data from investment optimization models (e.g. WASP) as input, and computes cash flows and financial ratios.

44. The second basic approach to linking financial analysis with investment planning is to incorporate a financial model directly into the investment planning computer program. This is done widely in the United States where large numbers of utilities exist using similar financial formats and facing similar tax regimes. However, this approach is less appropriate in many countries where economic analysis is carried out using shadow prices, which differ from the financial prices used in financial analysis, and financial formats, taxation, financing practices differ so much that a single model would be inappropriate.

45. In this module it is proposed to use a combination of FINPLAN and tailor-made spreadsheet models to carry out financial analysis related to investment scenarios. A case study would be carried out in one country and

financial analysis would be included in the case studies on power generation investment.

E. Environment, Human Health and Safety Effects in Energy Planning

Background and Issues

46. In most countries the organization responsible for the environment does not conduct energy investment studies. However when environmental effects are considered external to the planning process, then energy supply choices may result in serious environmental burdens.

47. For example, many countries are facing severe pollution problems due to coal or oil combustion which may affect the health of the general population, damage buildings and contribute to the production of acid rain. Construction of hydro-dams or the opening of coal mines may also have a social impact and result in a high economic cost due to the necessity to resettle large segments of the population.

48. Often the issues associated with environmental impacts are not only of national interest, and transboundary problems can occur. Examples of transborder impacts are numerous: air pollution, acid rain, hot water ejected by power plants, etc.

Approach and Methodology

49. The objective is to integrate environmental effects into the energy planning process and assess their importance in making energy investment decisions. Case studies will be prepared using an integrated energy and environmental planning model developed recently by Argonne National Laboratory 1/. The ENPEP model allows the user to identify and quantify the environmental impacts of energy supply decisions. The proposed case study will demonstrate the importance of uncertainty and environmental risk in the energy planning process.

50. This global approach will be complemented by a review of the requirements for a more in-depth analysis in order to prepare fully a high quality environmental impact statement:

(a) System Definition.

- o appropriate regionalization of the country into subunits for subsequent localized analysis (characterization of subregions in terms of existing air quality, water resource/quality, social/economic patterns, transport-infrastructure, land use patterns, etc.).

1/ "Energy and Power Evaluation Program (ENPEP)".

- o Identification of Energy Network (energy resources, including physical/chemical characteristics, environmental setting; energy production, locations, etc.).

(b) Administrative Framework:

- o Examination of existing regulatory mechanisms and practices in place to address environmental and related issues at the national and local level.

(c) Evaluation of Likely Impacts.

- o Within each subregion and its associated profile of energy resource development/transportation/power production, an assessment of environmental impact to be made including: air quality, water quality and resource, land use/competition, ecosystems (terrestrial/aquatic), socio-economic (job creation/loss, population resettlement, infrastructure requirements), cultural heritage, etc.

51. A systematic review of major technologies used to control various emissions will be undertaken. The review would include investment and management costs as well as technical efficiency. An interesting feature will be the extent to which it is possible to evaluate the cost of not having these emission control techniques.

F. The Planning of Hydro-thermal Systems

Background and Issues

52. Most computer models for power system planning have an over-simplified representation of hydroelectric plant. It is difficult to capture the stochastic nature of water inflows, interrelated operation of cascade plants and pumped storage satisfactorily, while at the same time having an accurate representation of thermal plant and the optimization of investment and operation of a mixed hydro-thermal system model. Even in the elaborate WASP model that is already extensively used within the region, the hydro-system is disaggregated in simplified blocks such as "peak", "base" etc. This disaggregation is somewhat arbitrary depending on which hydrological conditions and periods in the year being considered. The preparation of hydro data for WASP has to be done outside the model and it is a difficult and time consuming task which often does not result in an accurate or flexible representation of hydro subsystems.

Approach and Methodology

53. Electricidade de Portugal has recently developed a model (Valoragua) which allows a more systematic loading order for the hydro-electric plants proposed as candidate plants for the WASP optimization model. This model calculates the marginal value of water and has also been used for preparing

tariffs and designing hydro plants. This model is run iteratively with WASP - output from Valoragua is used to modify the hydro data input to WASP - so that the combined hydro-thermal system investment and operation are optimized jointly. Of course, this model needs good information on the hydrology of each basin, physical constraints, etc., information that is not always systematically available in many countries and that needs to be collected in a coherent manner by specialists in hydrology. Therefore, this case study will have to be supported by specialists not only in the Valoragua and WASP models but also by a hydrologist.

Additional Modules

54. Although of high interest these modules will be investigated only if a sufficient number of countries are concerned by these issues and if adequate funding can be allocated.

G. Renewable Energy and Planning

Background and Issues

55. Despite extensive debate about the role of renewable energy systematic attempts have been done to analyze their true economic cost and benefits. Furthermore, the issues relating to substitution and penetration of renewables in the general energy market of developing countries have rarely been investigated in a systematic manner. In particular, the relation of renewable energy to the policy environment (e.g. industrial policy, taxation, technical assistance, energy prices) has seldom been examined.

Approach - Methodology

56. Since the recent fall in international energy prices has lowered the economic viability of renewable energy, this module will not belong to the core program of the project. The module would be limited to:

(a) preparation of a state of the art paper based on the past experience of a participating country (or more) with recent experience in analyzing costs and benefits of renewable energy options. This document would cover both the technical aspects and the economic feasibly of renewables; and

(b) preparation of guidelines for analyzing the problems of substitution and penetration of renewables into the overall energy market.

H. Pricing and Development of Depletable Resources

Background and Issues

57. Consuming a depletable resource such as natural gas today means that it is unavailable for consumption in the future when it may be more valuable. If reserves are small such that all potential consumption can not be

satisfied, the pricing rule is to set the price of the depletable resource equal to the price of the substitute fuel. If reserves are very large and could meet all potential consumption for at least 50 years, then the resource should be priced at its marginal cost of production. An interesting case is when reserves are larger than necessary to sustain present consumption, but not large enough to meet consumption for all the foreseeable future (say less than 50 years). Under these circumstances the pricing rule is to set the price equal to long run marginal cost plus a depletion allowance based on the present discounted value of the future cost of the replacement fuel.

58. In practice, the calculation of the depletion allowance is complicated by uncertainty as to what fuel would be the substitute at the margin in the future, what its price would be, future energy demand, the extent of reserves of the depletable resource and the degree to which costs of producing the resource would change in real terms over time. Furthermore, there may be significant feedbacks between the resource depletion policy, economic growth and the domestic demand for energy. In addition, the substitution of domestic natural gas (which is not usually easily exported) for oil in domestic markets may allow greater oil exports and faster economic growth. Moreover, it is not uncommon to find that oil and gas depletion policy is set, de facto, by engineering considerations or to meet the financial objectives of the developer, who might have a discount rate much higher than the government or perceive that political risks require a high rate of depletion.

Approach and Methodology

59. Some analysis of natural gas depletion and pricing has been undertaken by the Bank in Egypt using a CGE model and gas development was analysed from the macroeconomic perspective in a similar study in Tunisia (see Module B). This topic could be analysed as part of the sector - macroeconomy analysis in Module B above, or a simplified stand-alone study that would concentrate on the estimation of depletion allowances under uncertainty could be carried out.

I. Coal Planning and Pricing

Background and Issues

60. In principle coal reserves should be developed with the lowest cost mines being developed first. However, two practical issues arise. Firstly, there is a need to clarify the methodology for calculating coal costs, since coal investment is characterized by lumpy initial investment, a stream of generally rising operating costs and periodic investments to maintain production. Because of the lumpiness of the cash flows, there is a need for a pricing policy that signals the correct cost to consumers and provides adequate income to coal producers without allowing them excessive profits that may induce inefficiency. Secondly, the high cost of transporting coal may influence the choice of investment (a high cost mine near a demand centre may be preferred to a lower cost mine in an isolated location) and the utilization of coal and its substitution for other fuels. For example, it may be more economic to transform the coal into electricity and transmit power, rather

than burn it at a demand centre a long distance from the mine. Environmental constraints may favor consumption by large consumers with pollution control equipment, rather than small consumers who cannot afford such controls. Furthermore, the economics of substituting coal for, say, fuel oil are influenced by the costs of coal transportation.

Approach and Methodology

61. Linear programming models are typically used to model coal investment, production and transportation. Such models are usually run interactively with an electricity generation model (e.g. WASP). However, very little work using such models has been done in developing countries. A further use of such models would be in determining coal prices. Even if the price of hard coal turned out to be closely linked to the cost of imports (usually the substitute fuel at the margin), an integrated production and transportation model would shed light on the appropriate prices for low grade coals (brown coal and lignite) which are often not economic to transport, as well as the price for coal at mines where the cost of production is much lower than the cost of coal at the margin before transport costs are considered.

62. A linear programming model of coal production and transportation would be constructed in a country with multiple options for mine development. Such a model would be constructed by a country team with limited consultant assistance, since a major part of the work would be the collection of data on a consistent basis. The model would be used to establish least cost scenarios for future coal mine development and the formulation of a coal pricing strategy.

J. Investment Planning in the Oil Refining Subsector

Background and Issues

63. The oil refining industry in both the European and Arab States faces problems of excess capacity, high losses, and a mismatch between production capacity and demand. Many refineries are technically obsolete with high losses of crude in the production process. Effectively, refineries are competing with new refineries in the Middle East and Western Europe which can achieve economies of scale, or with a European industry that has experienced drastic restructuring since the oil price increases of 1973. Governments in the Region need to examine the economics of new refining investments critically and arrive at strategies for improving the efficiency and restructuring their existing refineries.

Approach and Methodology

64. Within the World Bank two approaches to examining refinery economics have been developed. The first consists of a spreadsheet approach that simulates operations and can be used to obtain product balances iteratively through trial and error. The second approach is the more traditional linear programming model. Both types of model can be run on personal computers.

K. Investment Analysis and Pricing of Joint Products

Background and Issues

65. Little work has been done to arrive at a consistent framework for analyzing investments and setting the prices of energy and other products produced jointly with it. One example of such joint products is heat produced in conjunction with electricity and used for industrial process energy or to supply district heating systems. Combined heat and power production (also referred to as cogeneration) is common in the Eastern European countries and Turkey. Another example is the joint production of desalinated water and electricity in the Gulf countries, which is a specialized application of cogeneration.

66. In both cases there are complex system effects. Base load heat or desalinated water demand is met with back pressure turbines, mid range load with condensing extraction turbines and peak demand with low pressure boilers. Furthermore, the operation of desalination or CHP plant may constrain the operation of the power system and raise the costs of electricity above the level that would exist in the absence of joint production. In the case of desalinated water, further issues arise concerning the conjunctive use of desalinated water and groundwater, which in some areas is a depletable resource.

Approach and Methodology

67. Although a well proven methodology for investment analysis and pricing of products from CHP or desalination plants does not exist, some general principles can be established. If CHP or desalination turbines are not operating at the margin in the power system, the calculation of the marginal cost of electricity generation may be carried out in a conventional manner. In principle, the marginal cost of producing heat or desalinated water could be calculated from a heat balance model of a CHP unit, i.e. by determining how fuel costs change if an extra unit of heat is produced with electricity production being held constant. For marginal capacity costs, separable costs can be allocated to heat and power respectively. However, truly joint costs have to be allocated somewhat arbitrarily, e.g. on the basis of opportunity costs of heat and power production if production were not carried out jointly.

68. The module would contain more development of methodologies than most of the other modules in the project, since the state of the art is less advanced. It would consist of one or more case studies that would firm up the methodology for analyzing investments and pricing heat or desalinated water. Use would be made of widely available power system planning models such as WASP. Other models would be run interactively with the power system planning model and would be obtained from other sources, or adapted to model the heat or water supply system. The output from the module would be an operational methodology that had been demonstrated in at least one case study.

L. Regional Energy Trade

Background and Issues

69. International trade in energy within the region offers possibilities for using existing energy supply capacities more efficiently, lowering the costs of energy supply, generating foreign exchange and reducing the risks of forecast demand not materializing, or unexpected changes in costs and performance. Indeed, increasing trade enables some of the risks inherent in the new environment for planning to be offset. In some respects the Region already has some well developed energy trade because of its proximity to major markets in Western Europe and energy exporters of the Middle East and Eastern Europe. However, there is potential for expanded trade in some forms of energy, notably electricity (particularly in the Middle East and North Africa), refined petroleum products and natural gas.

Approach and Methodology

70. Work on this aspect would proceed in two stages. First, a paper for presentation to the second seminar would be prepared that would review previous studies on regional energy trade, identify opportunities for enhanced trade between countries and estimate their approximate costs and benefits. Second, one or two case studies would be prepared to examine specific projects in greater detail (e.g. electric power interconnection).

M. Regional Energy Price Projections

Background and Issues

71. Sound energy planning requires forecasts of future energy prices. It is not sufficient just to project their levels, since their likely variation is critical to an assessment of risks of energy options. Moreover, relative energy price projections are needed to evaluate energy projects, e.g. the prices of coal and natural gas, given a particular oil price scenario. For fuels such as coal and natural gas, transport costs may have a major influence on the price of the fuel delivered to the consumer.

Approach and Methodology

72. The purpose of this module would be to prepare a paper giving consistent scenarios for the prices of energy delivered in the EMENA region. These forecasts would be useful for countries planning to export or import energy, and for the analysis of energy strategy, programs and projects. The paper would concentrate on the prices of crude oil, fuel oil, gas-oil, natural gas and steam coal. Several consultants have produced models of the energy market in the Region and one of these would be engaged to produce a paper for the second seminar. The World Bank could also prepare a paper on energy price projections, but this would be limited mainly to crude oil and steam coal.

N. Institutions for Energy Planning and Investment

Background and Issues

73. It is well known that the performance of many energy sector agencies have faced difficulties. The quality of energy supply has deteriorated, agencies have needed subsidies from the government budget, chronic staffing problems exist and some inappropriate investment decisions have been made. The interface between government and enterprise is often ill-defined. Enterprises fail to reduce costs, and governments do not deliver resources or allow price increases and meddle in operational matters. With public utilities such as electricity and gas supply, natural monopolies exist and there are fundamental issues of ensuring accountability and efficiency. In other cases it may be inappropriate to have competing enterprises for reasons of country size or economies of scale.

Approach and Methodology

74. The output of this module would be a discussion paper for the second seminar. Experts in institutional issues in the energy sector would be engaged to prepare material on the organization, monitoring and control of the traditional energy sector public enterprises, as well as to present material on contemporary thinking on institutional issues, e.g. decentralized energy supply, privatization, and the relation of the energy sector to national institutional and economic reforms.

O. Planning of Nuclear Power Programs

Background and Issues

75. The experience of the International Atomic Energy Agency (IAEA) in investigating the situation of several countries during the preparation and implementation of nuclear power programs shows that delays are often due to underestimating the importance of basic infrastructural requirements.

76. Five infrastructural areas should be investigated before embarking on a nuclear program:

- the organizational structure and capability for planning and decision-making;
- the structure and size of the electricity grid;
- the qualification and skills of manpower;
- the existing or potential industrial support;
- the financial creditworthiness of both the utility and the country.

77. A key task during the planning stage is to assess where weaknesses lie within the five areas outlined above and develop an implementation plan to overcome them. The decision to mount a nuclear program must therefore be based on sound technical, economic, financial and national development policy arguments.

Approach and Methodology

78. The IAEA has considerable experience in identifying the various problems faced in the implementation of a nuclear power program. The module will aim at disseminating information by:

(a) providing interested participants with full sets of IAEA guidebooks e.g. "Energy and Nuclear Power Planning in Developing Countries" (TRS-245), "Introduction of Nuclear Power" (TRS-217), "Interaction of Grid Characteristics with Design and Performance (TRS-224), "Expansion Planning for Electrical Generating Systems" (TRS-241), "Manpower Development for Nuclear Power" (TRS-200), "Technical Evaluation of Bids for Nuclear Power Plants" (TRS-204), "Nuclear Power Project Management" (TRS-259). Other guidebooks still under preparation will also be made available e.g.: "Energy and Electricity Demand Forecasting for Nuclear Power Planning", "Assessment and Development of Supporting Industrial Infrastructure for Nuclear Power", etc.; and

(b) organizing, in cooperation with IAEA, short seminars where specialists will discuss the resolution of selected key issues.

P. Energy Conservation: A Comparative Analysis

Background and Issues

79. Despite the clear evidence that investment in energy conservation results in very high economic returns few countries have mounted sustainable and coordinated energy conservation programs. In part this stems from a lag in adjusting energy prices (often a pre-requisite for energy conservation) and the intricate and often difficult relationship between the energy sector and the industrial sector (where most savings will occur) but also from a lack of knowledge in establishing the institutional framework and operational modalities required to implement such a program.

Approach and Methodology

80. The output of this module would be a discussion paper for the second seminar. The discussion paper would first review comparative energy efficiencies in specific subsectors and/or industries drawing upon available data both within, and external to, the Region. In addition energy conserva tion experts would be engaged to document examples of successful and innovative energy conservation schemes and outline the key elements in their success.

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III. POTENTIAL PARTICIPATING COUNTRIES AND ORGANIZATIONS

UNDP - IPF Countries

UNDP-IPF Countries		UNDP - Non IPF Countries	Organizations
Europe	Arab States		
Albania	Algeria	United Nations Economic Commission for European (ECE) Countries	United Nations Specialized Agencies
Bulgaria	Bahrain	USA	O.E.C.D.
Cyprus	Democratic Yemen	Canada	O.A.P.E.C.
Hungary	Djibouti	Other Interested Countries	O.P.E.C.
Malta	Egypt		Academic Institutions
Poland	Iraq		Interested Non-Governmental Agencies
Portugal	Jordan		
Romania	Lebanon		
Turkey	Libyan Arab Jamahiriya		
Yugoslavia	Morocco		
	Oman		
	Qatar		
	Saudi Arabia		
	Somalia		
	Sudan		
	Syrian Arab Republic		
	Tunisia		
	U.A. Emirates		
	Yemen		

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