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Energy Conservation

By

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1. **PRESENT SITUATION:**
TOTAL PRIMARY ENERGY CONSUMPTION 1984–85 24 MTOE**
COMMERCIAL ENERGY = 17.5 MTOE i.e. 73% of total Energy Consumption.

GROWTH RATE DURING 5th PLAN – 8.5%

ELASTICITY OF CONSUMPTION vis a vis GDP= 1.35 – 1.40 against developed countries ratio of 0.5 and Asian Region developing countries of 1.0

2. **ENERGY IMBALANCE:**
Domestic supply of total primary energy has been limited to 20 MTOE (77%) and the remaining is being met by imports of petroleum and petroleum products to the extent of 6 – 6.5 MTOE or 23%. This implies a huge import bill of $ 1.7 billion per year, offsetting the remittances from overseas Pakistanis. The annual import of 3.5 million tons of coal for the Pakistan Steel is over and above.

3. **SUPPLY OF ENERGY – POWER, GAS AND PETROLEUM ETC.**
The composition of the energy supplies has been shown in the transparency No. For the petroleum products the domestic and imports share has also been shown in transparency No. . In case of coal, there has been a conspicuous decline in its share in the total energy supplies since 1950. Although we have valuable coal, gas, oil, hydro power potentials, the financial constraints and the long lead times have resulted in continued increase in oil imports.

Besides, the population growth at the rate of 3% per annum and continuing need for economic development has been creating a greater demand for energy.

4. IMPORTS BILL OF ENERGY:
If the present situation is allowed to continue i.e. greater fuel imports, and declining remittances, a state would soon be reached, that no resources would be available for the economic development. (Transparency No.

5. **PAKISTAN TRADE BALANCE/FOREIGN EXCHANGE RESOURCES:**
Such deficits in energy supply compared with growing imports adversely affect the foreign exchange balance, economic output, debt and resource mobilisation, thereby jeopardising the objectives of improving the quality of life, and attaining the self reliance, and progress.

6. **DEMAND OF ENERGY:**
Over the past 10 years, Pakistan's energy supply/demand imbalance has increased as demand has outpaced domestic production and imports. As a result, electricity and natural gas shortages, which first occured in the early eighties, are expected to continue into the foreseeable future.

7. **DEFICITS AT PEAK DEMAND – POWER AND GAS:**

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** MTOE: Million Tonnes of Oil Equivalent

8. **OPTIONS TO MEET THE DEMAND/DEFICITS:**
The shortest and simplest course to meet these deficits is to develop the indigenous energy supplies at a rapid pace. But no amount of financial resources can shorten the long gestation periods of energy projects generally. Even if we succeed in accelerating the exploration and exploitation of petroleum, which has no doubt recorded a high rate of success in the last two years, increasing the domestic production of oil from 11000 bpd in 1983 to 42000 bpd in July 1985, the development of refinery capacity and logistic infrastructure is time consuming. Extraordinary effort is therefore desirable and is being planned.

9. Same is the situation in case of power where the hydel generation projects take 7 to 10 years, and thermal generation 3–5 years. The financial constraints in our case further aggravate the situation, when it is not possible to meet all the deficits as short term affairs. Thermal generation would also have to depend on imported fuels, to conserve the natural gas. This points towards the revival of indigenous coal for thermal power generation and other usages. A policy has been therefore adopted that all future thermal generation would be based on coal.

10. **OPTIMISATION AND EFFICIENT USE OF EXISTING SUPPLIES:**
Capability development decisions involve heavy capital investments and long gestation periods, implicating increased load shedding, industry shut downs, agricultural sector losses, and brown outs, which are both economically and politically more painful, if continued for a long time. Therefore in the short term, our option should be for improving the energy situation by energy demand management and conservation activities.

11. **CONSERVATION – THE NEED FOR EFFICIENT USE OF ENERGY:**
These activities include increasing the efficiency of energy use by reducing energy waste in all sectors of the economy and, where feasible, switching from expensive and unreliable fuels to cheaper and more reliable energy sources such as domestic coal.

12. MEASURES FOR ENERGY CONSERVATION:

i) The Sixth Five year Plan, whose prime objective in the energy sector are to provide additional energy supplies to support economic growth, and to prevent current shortages in supply from re-emerging at a later date, has set targets for reducing the elasticity of energy demand from 1.4 (over the Fifth Five Year Plan Period) to 1.15 by 1988 and to less than 1.0 during the Seventh Five Year Plan period. The plan has allocated some Rs.116.5 billion for the overall energy programme. Of this amount, the Government of Pakistan (GOP) intends to allocate Rs. 350 million, or 0.3 percent of the budget, for energy conservation. The main focus of the conservation strategy outlined in the plan is on energy pricing that will bring Pakistan's energy prices in line with international prices within a socially acceptable time frame. The plan also contains proposals for spurring conservation by actions in several key areas.

- Providing incentives for the purchase of energy–efficient equipment;
- Conducting an energy conservation awareness compaign;
- Labelling equipment and appliance with energy efficiency information;
- Setting minimum standards for energy-efficient equipment and banning equipment that does not meet those standards. The plan also encourages certain basic changes in life style, such as using public transport instead of personal vehicles, decreasing

the use of household electrical appliances and improving architectural design standards to reduce building heating and cooling requirements. The Sixth Five Year Plan's conservation – related proposals are both valid and appropriate, however, most of them have not so far been implemented.

ii) Potentials of Energy Conservation – (Transparency No.).

iii) Investments.

iv) Savings.

v) Energy Savings.

It may be seen that the total energy savings by 1992–93 would approximate 500 to 600 MW per year and deduction of system losses in WAPDA/KESC would be about 300 MW. The total savings would thus amount to 900 MW.

In fact the savings by conservation means the avoidance of capital investment required to provide that much energy which after efficiently implementing the conservation programme can be avoided and used for other needs. The investment in conservation programme is relatively much small and is about 16 percent as compared to new energy supply investment.

13. **ASSESSMENT OF EXPERIENCE IN CONSERVATION PROGRAMME IN OTHER COUNTRIES:**

PHILIPPINES: The Bureau of Energy utilisation was established during 1977 and Omni Bus Energy Conservation Law was passed in June, 1980 which were instrumental in implementing energy conservation and efficient use of energy. By 1982 it was possible to reduce the energy/GNP Ratio by almost 20 percent. (Transparency No.).

In the Industry Sector alone the savings in various industries range between 2 percent for pulp and paper to 15 percent in case of iron and steel and mining (Transparency No.).

JAPAN: Similarly in Japan under Energy Conservation Law the conservation programme was launched in 1977 which resulted in reduction in import of petroleum from 210 M. Ton in 1978–79 to 180 M. Ton in 1982–83.

14. **ASSESSMENT OF PRESENT STATUS:**

Recognizing the obvious need for conservation, several ministries and some public sector consulting organisations and private companies have started to deal with energy conservation. Several donor organisation e.g. the United States Agency for International Development (USAID), the World Bank, and the United Nations Industrial Development Organisation Programmes and other are being planned. Major current activities are summarized below:–

a) **Ministry of Production:**

The *State Cement Corporation of Pakistan (SCCP)* recently completed a study on energy conservation at one of its facilities in Karachi (Projected Investment is US$ 1 million), and has other studies underway aimed at increasing the efficiency of energy and raw material use and exploring fuel substitution at six operating plants.

The *National Fertilizer Corporation (NFC)* constantly monitors its energy efficiency to maintain its energy consumption at or close to design standards. Opportunities for plant modernization were examined in a joint study by NFC and the World Bank in 1982. Some projects identified in that study have been implemented, resulting in energy savings. An energy conservation study of all NFC plants is planned for 1985.

Pakistan PVC plans to undertake a project that will save approximately 33 percent of the electrical energy used to convert brine to chlorine and cuastic soda.

Pakistan Steel Mills has invited several foreign suppliers to undertake a survey of their instrumentation and control systems and make recommendations for modernization to achieve greater energy efficiency.

The *Special Technical Cell* within the Ministry of Production has commissioned a survey to characterize the national boiler pollution and to report on the causes of their inefficient operation and fuel use. The Cell plans to set up a group to assist in improving design and testing of indigenous equipment.

b. **WAPDA/KESC**

WAPDA is currently implementing a programme with USAID assistance designed to improve the thermal efficiency of plants by major rehabilitation. Another project, which is part of a rural electrification programme and funded by multilateral and bilateral donors, focuses on reducing both technical losses (caused by equipment and circuit components) and non-technical losses (those resulting from billing errors and theft of electricity) associated with transmission and distribution. U.S.$ 26.7 million have been earmarked by USAID for this Energy Loss Reduction Programme. WAPDA also plans to introduce a customer service programme which would provide advice, free of charge, on the more efficient use of electricity.

KESC has initiated a number of programmes related to heat rate improvement, and thermal generating unit renovation and capacity restoration. They have also implemented a load management programme to reduce peak deficits by staggering customer working hours and eliminating the unnecessary use of electricity. KESC has also implemented programmes to control non-technical losses, and to manage energy use in their own transport vehicle fleet.

KESC in conjunction with Karachi Chamber of Commerce has also surveyed 30 industrial units, and carried out detailed investigation of electrical power use in two plants. Recommendation have been circulated to all the members of the Chamber of Commerce.

c. **Ministry of Petroleum and Natural Resources**

The Ministry of Petroleum and Natural Resources is responsible for the development of the energy conservation and renewable energy technologies component of Pakistan/ USAID's Energy Planning and Development Project.

Oil and gas companies are expected to play a major role in energy conservation by first improving energy efficiency in their own distribution networks and by offering advice on the efficient use of energy to their major consumers. Pakistan State Oil's (PSO) program, for instance, recommends conservation for the transport, domestic, agricultural, industrial, oil refining, and oil marketing sectors.

To support energy conservation and offset supply shortfalls, the ministry has also directed natural gas companies to reduce distribution losses to less than 2 percent.

The Ministry is coordinating a programme funded by UNIDO consisting of a number of energy audits in the textile, paper and board, and metal products industries. The Ministry's work on renewables has also relevance for conservation activities. Recently, it has emphasized two fuel substitution activities; the installation of family sized biogas systems in rural areas to provide gas for cooking, and the use of solar photovoltaic systems to provide electrical power in remote areas.

Finally the Ministry has investigated the feasibility of converting surplus molasses into ethanol to replace high octane blending compound, a gasoline additive which, in addition to being a pollutant, is a burden on the national foreign exchange resources.

d. **Ministry of Industries**

The Ministry contemplates requesting World Bank assistance to finance a survey of energy use in private industry.

The *Ghee Corporation of Pakistan* (GCP) has started to monitor the energy consumption per ton of production at its plants. Older boilers are being evaluated to determine the need for upgrading or replacement; the most inefficient boilers have already being replaced.

e. **Ministry of Planning and Development 1/**

The Ministry of Planning and Development sponsored the creation of *ENERPLAN* under the Pakistan/USAID Energy Planning and Development Project. As originally designed, the project is aimed at improving the GOP's ability to undertake long-term energy planning and programming, manpower development, conservation, and development of indigenous energy resources with an emphasis on coal and renewables. However, in light of the special importance of energy conservation, this component is now being given significantly more attention and resources than originally envisioned under the Project.

f. **Private Sector**

A substantial share of business and commercial activity in Pakistan is in the hands of the private sector. At this time there is very little information available on private sector energy conservation activities. It is known, however, that several private-sector fertilizer plants have – or plan to, establish energy management programs. At least three plants *(Dawood Hercules Chemicals Limited, Exxon Chemicals* and *Fauji Fertilizer Company)* are known to have established energy programs. Dawood Hercules has budgeted Rs. 50 million for a major rehabilitation programme that will incorporate energy efficiency measures. *Packages Limited,* another large privately owned company, has also initiated a number of energy conservation measures. More recently, a study was carried out jointly by KESC and the *Karachi Chamber of Commerce* into the more efficient use of electricity by a number of industrial facilities in the Karachi area. In addition, as previously described, the Ministry of Petroleum is coordinating a series of energy audits in private sector industrial plants being financed by UNIDO.

The need for an Integrated Approach

The successful implementation of energy conservation in Pakistan must overcome several technical, financial, social, regulatory, and institutional barriers. These barriers exist at the national and the end-user level.

At present, several national policies hinder energy conservation. For example, heavy import duties are levied on most types of equipment needed to improve energy efficiency; the prices of manufactured goods are set by the government on the basis of production cost providing little incentive for responding to higher energy prices by conserving energy; there is a lack of rationalisation in the prices of fuels. In addition, detailed and reliable statistics on energy use by sector and subsector are not available at the national level. At the end-user level, the information, people, equipment, and adequate financing needed to implement conservation measures are generally lacking.

TABLE 1

EXAMPLES OF ENERGY CONSERVATION MEASURES IMPLEMENTED IN PAKISTAN INDUSTRY

Industry	Measures Implemented	Investment (Thousand Rupees)	Annual Savings (Thousand Rupees)	Simple Payback (Months)
Oil Terminal	Improved Metering	Rs. 2,334	Rs. 14,700	2
Textiles	Improved Steam System	135	288	6
	Improved boiler & Steam System	252	1,200	3
	Improved Steam System	600	1,020	7
	Improved Steam & Condensate System	800	1,200	8
	Capacitors/Power factor improvements	1,220	665	22
Oil & Ghee	Improved Steam Distribution System	275	515	7
	Improved Steam System Control	435	600	9
	New Boiler, Steam System	1,200	570	25
Cement	Improved Kiln Control	1,095	1,204	11
	Improved Kiln Control	650	726	11
	Improved Kiln Control	3,000	2,370	15
Petroleum Refinery	Improved Combustion, Steam System	16,800	40,000	5
	Power Factor Improvements	9,600	640	15
	Waste heat Recovery Boiler	8,270	5,724	17
	TOTAL	Rs. 46,666	Rs.71,536	

Sources: ENAR Petrotech, Zelin and INTRAG

Although as described above a number of sound initiatives are being taken, there is little coordination among them and the overall process can be characterized as "piecemeal". This situation actually constitutes one of the major barrier to energy conservation in Pakistan.

To ensure maximum chances of success at the national level, Pakistan needs a centrally coordinated national energy conservation programmes such an effort will require the participation of both governemnt and the private sector in a well-defined programme and implementation strategy. This programme must be comprehensive and address all sectors of the economy: industry and power as well as transport, agriculture, and buildings where in major conservation potential exists. However, it must be recognized from the outset that this national programme must be dynamic and able to respond and adapt to continually changing situations.

The national energy conservation programme would be implemented by GOP ministries, provincial government institutions and private sector institutions and companies. Overall planning, coordination, and monitoring of the programme should be provided by the National Energy Conservation Centre (ENERCON), a new body to be set up under the programme for the duration of the national effort.

PROGRAMME OBJECTIVES AND RATIONALE

The primary objective of the national energy conservation programme is to increase the supply of energy to all sectors of Pakistan's economy by reducing energy waste and improving the efficiency of end-use. A secondary objective is to reduce foreign exchange expenditures for imported crude oil and refined petroleum products by "backing out" oil where possible.

The programme will focus initially on implementing energy conservation in the industry and power sectors, for three reasons:

- First, energy use in these two sectors which account for approximately 50 percent of the country's commercial energy consumption is highly concentrated in a relatively small number of facilities. Less than 100 facilities (industrial plants and electric power stations) are estimated to consume over 70 percent of the commercial energy used in these sectors. By focusing the bulk of the programme's resources on these two sectors, the quickest, most tangible and most substantial energy savings can be achieved.

- Second, energy conservation technology and expertise in these two sectors are highly developed in other countries, and can be readily transferred to Pakistan. The technology has been proven, and there is minimal risk involved in its transfer and implementation in Pakistan.

- Finally, many facilities in these two sectors are state-owned, allowing GOP to take the lead in demonstrating the benefits of energy conservation to the private sector.

At the same time, the programme will immediately initiate activities in the transport, buildings, and agriculture sectors. Substantial energy conservation benefits are also feasible in these sectors, but the diversity of end-users makes it more difficult to quickly achieve the full benefit of conservation. Because longer lead times are required to achieve tangible results it is crititcal to start laying the groundwork for future actions in these three sectors very early in the programme.

1. Industry and Power

At present, based on the results of audits and surveys of industrial energy users in Pakistan, up to 40 percent of every barrel of oil produced and imported, every cubic foot of gas produced, and every kilowatt hour of electricity generated is lost because of end-use waste or inefficiency.

Based on an analysis of the conservation potential in industry carried out by USAID's consultants Hagler, Bailly & Company, feasible energy savings range between 14 and 40 percent of 1983/84 energy consumption depending on the specific industry (with the exception of the particular case of the sugar refining industry which consumes mostly non-commercial energy). The average potential saving across all subsectors is nearly 21 percent. (See Table 2)

As shown on Table 3, the consultants' analysis indicates that in industry and WAPDA, Pakistan could realistically achieve total savings of some 1.6 million toe between now and the end of the Sixth Five-Year Plan (1987/88) and nearly 9 million toe by the end of the Seventh Five-Year Plan (1992/93). On an annual basis, more than 880,000 toe could be saved in 1987/88 and nearly twice that amount or 1.8 million toe in 1992/93. This level of savings is technically and economically feasible using only proven technology and conservation practices that have a payback, on the average, of less than 2 years at current energy prices.

Capturing this energy conservation potential would result in substantial foreign exchange and domestic financial savings. These savings could then be channeled into other investments, not only in the energy sector for power generation, oil and gas exploration, and development of indigenous resources but also into non-energy sectors such as industry, agriculture, education, health care, roads, and other infrastructure.

As shown on Table 3 & 4 which summarizes the overall costs and benefits of the ENERCON programme, the consultants have estimated that in industry and WAPDA alone, Pakistan could save nearly U.S. $ 2.6 billion in energy costs between now and the end of the Seventh Five-Year Plan of which U.S. $ 340 million would be net foreign exchange savings (the amount of foreign exchange that would have been spent on energy minus the foreign exchange cost of the investment.)

On a net present value basis, the cost of conserving a barrel of oil equivalent by 1993 would be about U.S.$ 8.40. These attractive figures result from the very short paybacks enjoyed by energy conservation investments in Pakistan, which typically range from a few months to 2 years as has been shown on Table 1.

2. Other Sectors

Similar data for other sectors such as transportation, buildings and agriculture are more difficult to develop because the basic information needed is currently not available in Pakistan.

Nevertheless, preliminary orders of magnitude can be established as summarized on Tables 3 and 4. In the case of transportation, USAID's consultants have estimated, based on a review of literature in Pakistan and experience in countries with similar transportation structures (e.g., Sri Lanka, India, Bangladesh and Indonesia), that another cumulative 1.4 million tow worth approximately U.S. $ 450 million could be saved between now and the end of the Seventh Five-Year Plan (1992/93).

Similarly in the other sectors (buildings, government and agriculture) about 1.9 million toe could be saved between now and 1992/93. These savings would be worth nearly another U.S. $ 560 million. (See Table 4)

SUMMARY OF ENERCON PROGRAMME COSTS AND BENEFITS

	INDUSTRY AND POWER 1/	TRANSPORT 2/	BUILDING GOVT.AND AGRICUL-TURE/2	TOTAL ALL SECTORS
1983/84 Commercial energy Consumption (million toe)	8.2	3.2	5.0	16.4
OVERALL PROGRAMME (TO 1992/93)				
o Cumulative Savings				
– Energy savings (million toe)	9.0	1.4	1.9	12.2
- Energy cost savings (US $ million)	2,570	451	558	3,579
– Net foreign exchange savings	338	361	228	927
– (US $ million) 3/				
o Cumulative Investment 4/				
– Total (US $ million)	377	112	147	636
– Foreign exchange only (US $ million)	181	90	51	322
o Energy Cost Savings/Investment Ratios				
– Overall	6.8	4.0	3.8	5.6
– In Foreign exchange	1.9	4.0	4.5	2.9
OVER BALANCE OF VI THPLAN PERIOD (TO 1987/88)				
o Cumulative Savings				
– Energy savings (million toe)	1.6	0.2	0.2	0.2
– Energy Cost savings (US $ Million)	415	78	40	533
– Net Foreign exchange savings (US $ million) 3/	(27)	45	6	24
o Cumulative Investment 4/				
– Total (US $ million)	222	41	40	303
– Foreign exchange only (US $ million)	110	33	14	157
OVER VIITH PLAN PERIOD (1988/89 TO 1992/93)				
o Cumulative Savings				
– Energy savings (Million toe)	7.3	1.1	1.7	10.1
– Energy cost savings (US $ million)	2,155	373	518	3,016
– Net Foreign exchange savings (US $ million) 3/	365	316	222	903
o Cumulative Investments 4/				
– Total (US $ million)	155	71	107	333
– Foreign exchange only (US $ million)	71	57	37	165

Numbers have been rounded and totals may not add to the decimal point.

1/ WAPDA only
2/ Preliminary estimates
3/ Net foreign exchange savings are the total foreign exchange savings minus the investment in foreign exchange. ( ) means net cost.
4/ ENERCON programme management and coordination costs have been included in industry and power sector investments.

Source: Hagler, Bailly & company, Inc. Refer to Volume II - Supporting Data and Analysis for details.

3. Other Energy Conservation Benefits

In addition to combined energy costs savings on the order of U.S. $ 3.6 billion by 1992/93, a rigorous energy conservation programme could also reduce electricity and natural gas load shedding. Under such a programme, electricity load shedding would be reduced by more than 20 percent in 1986/87 and 15 percent in 1987/88. Similarly, the conservation of natural gas in industry could reduce natural gas load shedding by more than 10 percent in 1986/87 and 18 percent in 1987/88.

Energy conservation will also ease the transition to higher energy prices. By starting to save energy now, large and small consumers will slow the increase in their energy bills and thus be better able to afford and less resistant to higher prices. Another important benefit of conservation will be the likelihood of reduced load shedding for both gas and electricity, as all energy saved will be made available for other uses. Finally, energy conservation, because it requires a very disciplined approach to understanding processes, will also result in a number of other productivity improvements in areas such as production planning and scheduling, operations' management and maintenance.

C. PROGRAMME DESCRIPTION AND IMPLEMENTATION PLAN

1. Programme Components

The National Energy Conservation Programme will involve six main components:

- Planning
- Data base development
- Technical support
- Training
- Information dissemination and outreach
- Implementation and monitoring

The implementation of these components will be phased, First, a short-term programme covering the next 3 years and starting with a "crash" first year effort, will be initiated. Then, once fully developed, a longer-term programme covering the Seventh Five-year planning period will be implemented. (See "Implementation Schedule" below).

a. Planning

The main objective of the planning activity is to develop a national blueprint of energy conservation activities in the industry, power, transport, buildings, and agriculture sectors. The blueprint, hereafter referred to as the National Energy Conservation Plan (NECP), will be developed after reviewing the current and projected national energy supply/demand balances, and assessing the optimal role for conservation. The NECP will outline in complete detail, the activities that need to be carried out in all consuming sectors so that for prespecified levels of investment, the largest impact would be made on the energy balance of the country in the shortest possible time. The planning activity will be a continuing process, and the NECP will be periodically updated to respond to

changing conditions.

b. **Data Base Development**

The objective of this component is to review, validate and integrate all existing data of relevance to the development of a conservation program. This activity will identify data gaps and take measures to fill them. The data base will be continuously updated and will not only help formulate the NECP but also support its implementation. Because of an overlap with the data base development activity under ENERPLAN. The data will be centrally stored in computers at the ENERCON's headquarters and be available for dissemination to bonafide parties.

c. **Technical Support**

The objective of this component is to provide necessary technical support (through foreign consultants and wherever feasible through local sources) to help plan and implement the national energy conservation program. Technical support will be provided at a variety of levels, including: to local organizations on collection and analysis of data; to GOP ministries on evaluation of energy conservation-related proposals; to the private sector on the operation, manufacture, and/or import of energy efficiency equipment; to R&D organizations on testing, development and certification of energy efficient appliances; and, to various national entities on planning and implementing demonstration projects.

d. **Training**

The basic objective of this component is to upgrade or update local capabilities in areas where they are currently deficient to ensure timely and efficient planning and implementation of the national energy conservation program. The training will include: overseas short study tours and degree courses; seminars and workshops given by foreign consultants and custom-tailored to meet specific Pakistani needs; and , vocational training (e.g. for boiler operators). The training component will affect a large variety of personnel including GOP officials, consulting engineers, plant managers, and technicians.

e. Information dissemination and outreach

The main objective of this component will be to create public awareness of the potential benefits of energy conservation in order to mobilize public participation in the national conservation programme. The outreach component will include activities such as television (TV) and newspaper campaigns, publication of pamphlets, booklets, and do-it-yourself leaflets.

f. **Implementation and Monitoring**

The main objectives of this component will be to implement demonstration and other energy conservation projects and to monitor the performance of a selected number of projects (especially the demonstrations) on both micro and macro levels so that country-wide projections can be made of the potential for energy conservation in various sectors. This component will continuously gauge the progress of all energy conservation activities. It will also recommend modifications, as needed, to ensure that the energy conservation projects are properly implemented and that real fuel savings are realized.

2. **ENERCON**

a. **Organization and Management** .

The National Energy Conservation Programme will be implemented by GOP ministries, provincial government institutions, and private-sector institutions and companies. Overall planning, coordination, and monitoring of the programme will be provided by the National Energy Conservation Centre (ENERCON), a new body to be set up under the programme in the Ministry of Petro-

leum and Natural Resources. ENERCON will serve as the Focal point for all energy conservation activities in the country.

ENERCON will receive policy guidance from a National Energy Conservation Council (NECC) comprised of representatives from the major energy-producing and energy-consuming GOP ministries and provincial governments as well as senior level representatives from the private sector. The individuals selected for the Council must be senior level personnel, to ensure effective coordination and implementation of the overall programme.

The following ministries, whose roles have a major bearing on the development of energy conservation activities in the country, will be represented on the council:

- Agriculture
- Communications
- Finance and Planning
- Housing and Works
- Industries
- Petroleum and Natural Resources
- Production
- Railways
- Water and Power

The private sector on the other hand will be represented by senior representatives from the Federation of Pakistan, Chambers of Commerce and Industry, Karachi and Lahore, Chambers of Commerce, and some major trade associations. It will be important to ensure that the private sector receives adequate representation on the Council. The actual size of the Council should be limited to perhaps no more than 15 members, to keep the meetings manageable.

With assistance from ENERCON, each of the organizations represented on the Council (except the Ministry of Finance and Planning) will create (if they have not already done so) an energy conservation cell to oversee their own sectoral programmes. The funds for staffing and operating the ministry cells will for staffing and operating the minsitry cells will come from ENERCON. (See "Staffing" and Chapter D on "ENERCON's budget" below). Figure 1 presents an overall organization chart for ENERCON.

As a coordinating body, ENERCON will stimulate, channel, strengthen, and integrate the capabilities that already exist in national ministries (such as the Ministries of Production, Petroleum, Water and Power, Industries, Science and Technology), in provincial public-sector institutions and private sector organizations such as trade associations, engineering and consultancy firms, financial institutions, and equipment suppliers, However, implementation of specific energy conservation measures and investments will rest with those national and provincial bodies and the private sector, and not with ENERCON. A guiding principle of ENERCON will be to lend support to activities already underway and to initiate new activities.

To be successful, ENERCON must have autonomy, authority, and national recognition to ensure that in about four years, Pakistan will have in place a nationally and internationally recognized programme that is making a major impact on the energy supply of the country. Because of the urgency of the energy situation, and the breathing time that the conservation programme will provide to help remedy it, the programme must proceed rapidly and on schedule: this can happen only if ENERCON is accorded adequate authority and autonomy.

Crucial to the success of the programme will be the selection of the Chairman of ENERCON, who will direct the activities of ENERCON on a day-to-day basis and ensure timely and efficient implementation of the national energy conservation programme.

Given the nature and level of his responsibilities, it is essential that the Chairman be a nationally known figure, someone who has been successful in promoting, coordinating, and managing projects in the public and/or private sector. He must command the respect of the governmental and private sector entities. It is also desirable that the person be experienced in dealing with various international public/private sector and donor agencies. The Chairman of ENERCON should have the power of the GOP similar to that of the head of the National Logistics Board or the Overseas Construction Company of Pakistan. To impart national visibility and proper importance to the conservation programme, it may be desirable for the Chairman to be appointed by the President of Pakistan.

b. **Roles and functions.**

The main purpose of ENERCON is to oversee the planning and implementation of the National Energy Conservation Program. In this regard it will undertake a number of activities including:

i. **Preparation and Implementation of a National Energy Conservation Plan (NECP)**

Within a year, ENERCON will prepare a comprehensive energy conservation plan covering the industry, power, transport, buildings (residential, commercial, institutional and industrial) and agriculture sectors. The plan will investigate technical, social, economic, financial and legislative issues (focusing especially on demound management, inter-fuel substitution, pricing, barriers to large scale propagation of energy conservation credits and incentives), prioritize various options 1/ and develop a detailed workable action programme, specifying the costs, benefits, institutional arrangements and the associated time requirements. The plan will be dynamic and periodically updated, especially in 1987, when it will form the basis for the energy conservation section of the Seventh Five-Year Plan. ENERCON will also coordinate the activities of the various national entities involved in implementing specific components of the National Energy Conservation Plan.

ii. **Data base Development**

ENERCON will develop a comprehensive data base by synthesizing the existing information available from various national sources and whenever necessary augment it by commissioning additional studies, through local entities in the public and private sectors as well as through foreign consultants. The data base will provide crucial input into the NECP and therefore must be periodically updated. (This activity will be closely coordinated with the work done at ENERPLAN. Volume II - Supporting Data and Analysis, presents a preliminary approach to establishing a national industrial data base in Pakistan).

iii. **Training**

ENERCON will provide energy conservation training opportunities at all levels to ensure that the Pakistani personnel become self-sufficient within about three years. Training will be offered to energy auditors for industry and buildings, engineers and technicians in various ministries, consulting engineers and others as needed, Training will include workshops, seminars, short overseas study tours and degree courses in U.S. universities. ENERCON will assist in initiating degree/non-

1/ The options available are numerous and an optimal choice would require extensive analyses. Examples of the variety of the technical and management options which might be available to Pakistan are presented in Volume II - Supporting Data and Analysis.

degree energy management programmes in Pakistan's universities and help propare corresponding curricula. Finally, vocational training (e.g. for boiler operators, truck and bus drivers) will be an important part of this activity.

iv. **Information dissemination and outreach activities.**

ENERCON will serve as the main clearing house of information on energy conservation in the country. It will develop a comprehensive library including the latest information on various conservation options available for use in different sectors and a listing of conservation equipment and sources of supply. NERCON will also develop pamphlets on energy conservation for use by engineers, technicians, policy makers, managers and the general public. The Centre will develop mechanisms to efficiently disseminate the information within the country and also systematically use the media to create general public awareness of the need for energy conservation.

v. **Research, Development and Demonstration (RD&D)**

A highly applied, goal-oriented and quick-yielding research and development (R&D) effort will be supervised by ENERCON to fill in important information gaps (e.g., determination of thermal properties of structural materials used in buildings, determination of energy efficiency of indigenous appliances) without which the conservation effort would be seriously hampered. Also, where deemed necessary to ensure diffusion on a large scale (e.g., energy conservation in residential, commercial and institutional buildings), ENERCON will undertake demonstration programs. (See Volume II - Supporting Data and Analysis, for a proposed research, development and demonstration agenda.)

vi. **Standardization and Certification**

ENERCON will oversee the standardization and certification of appliances and equipment (especially those locally built and for which no energy efficiency data are available) to assist consumers in the choice of energy efficient goods. The Centre may also consider establishing minimum energy efficiency standards for various appliances and buildings.

vii. **Institution Building**

ENERCON will emphasize institution building in the country at different levels so that conservation efforts can proceed unhampered and without external support after about the first four years of the project. For instance, Pakistani consulting companies involved with energy conservation will be helped to expand and quickly raise their standards to international levels through training and enhanced consultancy opportunities provided by ENERCON. A related goal of this ENERCON activity is to develop a consulting capability to not only respond to national needs but also to compete internationally in the conservation field. Similarly, the testing and standards laboratories will be provided with proper manpower training and equipment to undertake the appliance standardization and certification effort.

viii. **Legislation**

ENERCON will draft, starting in the first year and whenever necessary afterwards, appropriate legislation for the conservation of energy. The Centre may also propose amendments to existing laws hindering energy conservation.

ix. **Procurement of funds**

ENERCON will serve as the national agency for procuring funds to undertake conservation activities from national sources (mainly federal and provincial institutions) as well as international donors and lending institutions. The funds will then be quickly disbursed to relevant national

agencies (e.g., WAPDA, Ministry of Production's ENAR Petrotech) and other organizations to implement specific energy conservation activities and projects. The prospects of a national conservation entity (i.e., ENERCON) obtaining adequate funds from donor agencies, to develop a meaningful level of energy conservation activities and thereby make a tangible impact on the energy situation of the country, are much better than if individual national agencies were to approach the donors. This has already been demonstrated by major multi-million dollar commitments made by USAID and the World Bank to ENERCON, and indications of interest by other financial assistance institutions to also channel their funds through ENERCON.

It is important that ENERCON be accorded sufficient authority and autonomy to be able to rapidly pass on donor funds to the relevant implementing GOP agencies and private sector organizations without causing unnecessary delays so that planning and implementation of the National Energy Conservation Programme proceed on schedule and its objective are attained in a cost and time efficient manner.

LIST OF TRANSPARIENCIES

Serial No.	TITLE
1.	EXAMPLES OF ENERGY CONSERVATION MEASURES IMPLEMENTED IN PAKISTAN INDUSTRY.
2.	POTENTIAL FOR INDUSTRIAL ENERGY SAVINGS IN PAKISTAN.
3.	PROJECTED ELECTRIC CAPACITY DEFICIT AS PERCENT OF PEAK DEMAND.
4.	PROJECTED NATURAL GAS DEFICIT AS PERCENT OF PEAK DEMAND.
5.	IMPACT OF INDUSTRIAL ELECTRICITY CONSERVATION ON ELECTRIC LOAD SHEDDING.
6.	IMPACT OF INDUSTRIAL NATURAL GAS CONSERVATION ON NATURAL GAS LOAD SHEDDING.
7.	LEVEL OF SAVINGS ACHIEVED EACH YEAR IN THOUSANDS OF TONNES OF OIL EQUIVALENT.
8.	CUMULATIVE ENERGY COST SAVINGS IN BILLIONS OF DOLLARS.
9.	ANNUAL INVESTMENT REQUIREMENTS IN MILLIONS OF RUPEES
10.	CUMULATIVE ENERGY SAVINGS IN THOUSANDS OF TONNES OF OIL EQUIVALENT.
11.	CUMULATIVE INVESTMENT REQUIREMENTS IN MILLIONS OF RUPEES.
12.	NET CUMULATIVE FOREIGN EXCHANGE SAVINGS IN MILLIONS OF DOLLARS.
13.	ENERCON.

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15. ILLUSTRATIVE ACTIONS: POWER SECTOR.
16. ILLUSTRATIVE ACTIONS: INDUSTRY SECTOR.
17. ILLUSTRATIVE ACTIONS: TRANSPORT SECTOR.
18. ILLUSTRATIVE ACTIONS: AGRICULTURE SECTOR
19. ILLUSTRATIVE ACTIONS: BUILDINGS SECTOR.
20. ILLUSTRATIVE ACTIONS: EDUCATION.
21. LEGISLATION.
22. INCENTIVES/SUBSIDIES.
23. FIRST YEAR ACTION PROGRAMME.
24. REVOLVING FUND.
25. TABLE S-i.

TABLE 1.

EXAMPLES OF ENERGY CONSERVATION MEASURES IMPLEMENTED IN PAKISTAN INDUSTRY.

Industry	Measures Implemented	Investment	Annual Savings (Thousand Rupees)	Simple Payback (Months)
Oil Terminal	Improved Metering	Rs. 2,334	Rs. 14,700	2
Textiles	Improved Steam System	135	228	6
	Improved boiler & Steam System	252	1,200	3
	Improved Steam System	600	1,020	7
	Improved Steam & Condensate System	800	1,200	8
	Capacitors/power factor improvements	1,220	665	22
Oil & Ghee	Improved Steam Distribution System	275	515	7
	Improved Steam System Control	435	600	9
	New Boiler, Steam System	1,200	570	25
Cement	Improved Kiln Control	1,095	1,204	11
	Improved Kiln Control	650	726	11
	Improved Kiln Control	3,000	2,370	15
Petroleum Refinery	Improved Combustion, Steam System	16,800	40,000	5
	Power Factor Improvements	9,600	640	15
	Waste heat Recovery Boiler	8,270	5,724	17
	TOTAL	Rs. 46,666	Rs. 71,536	

Sources: ENAR Petrotech, Zelin and INTRAG

TABLE 2

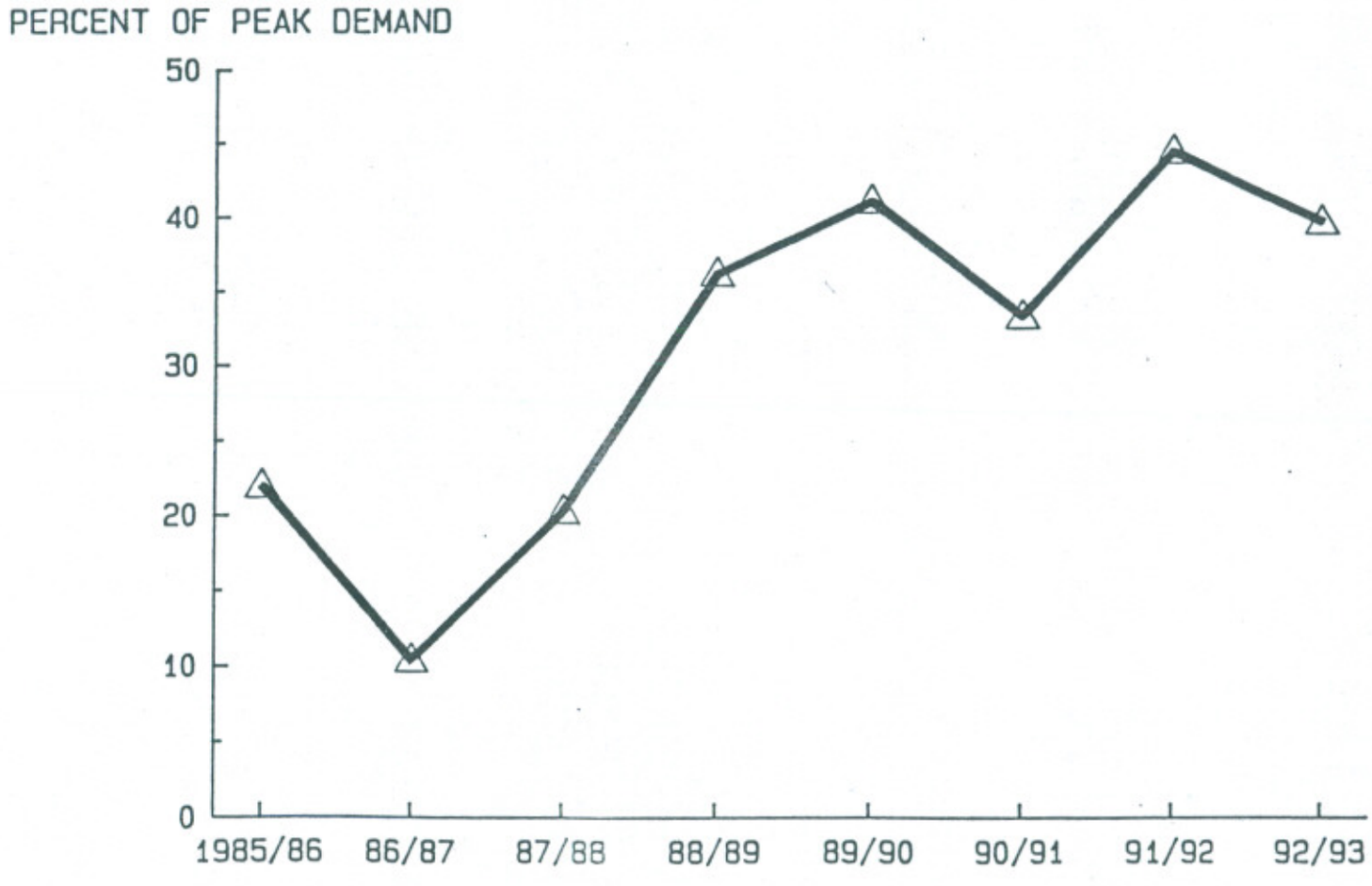
POTENTIAL FOR INDUSTRIAL ENERGY SAVINGS IN PAKISTAN

Industry Subsector	1983/84 Energy Consumption (1000 toe) Commercial	Non Commercial	Total	Feasible Savings as % of 1983/84 Consumption 1/	1992/93 Programme targets as % of 1983/84 Consumption
Iron and steel	574	0	574	22.6	16.4
Foundries	10	0	10	15.0	10.5
Cement	728	1	728	39.9	28.7
Brick	1,454	4	1,458	25.2	18.7
Glass, ceramics	43	0	43	14.9	10.4
Refining, petrochem	296	0	296	35.0	25.0
Organic chemicals	119	29	147	20.1	13.9
Inorganic chemicals	335	0	335	25.1	17.3
Fert. and pesticides	564	0	564	30.0	21.8
Textile	552	2	553	29.9	22.7
Pulp and paper	209	1	210	14.9	10.4
Sugar refining	117	1,859	1,977	2.0	1.6
Metal products	51	1	52	24.5	18.1
Equip. & machinery	115	4	119	19.5	14.4
Leather & footwear	17	1	18	14.2	10.0
Misc. industries	197	2	199	14.8	10.4
Food, bev. & tobacco	536	23	559	24.0	17.7
TOTAL	5,917	1,927	7,844	20.7	15.1

1/ Based on technically and economically feasible measures with simple paybacks of less than 3 years.

Source: Hagler, Bailly & Company Inc., based partially on information and data from DGER, IEDC, ENAR Petrotech and INTRAG. Refer to Volume II – Supporting Data and Analysis for details.

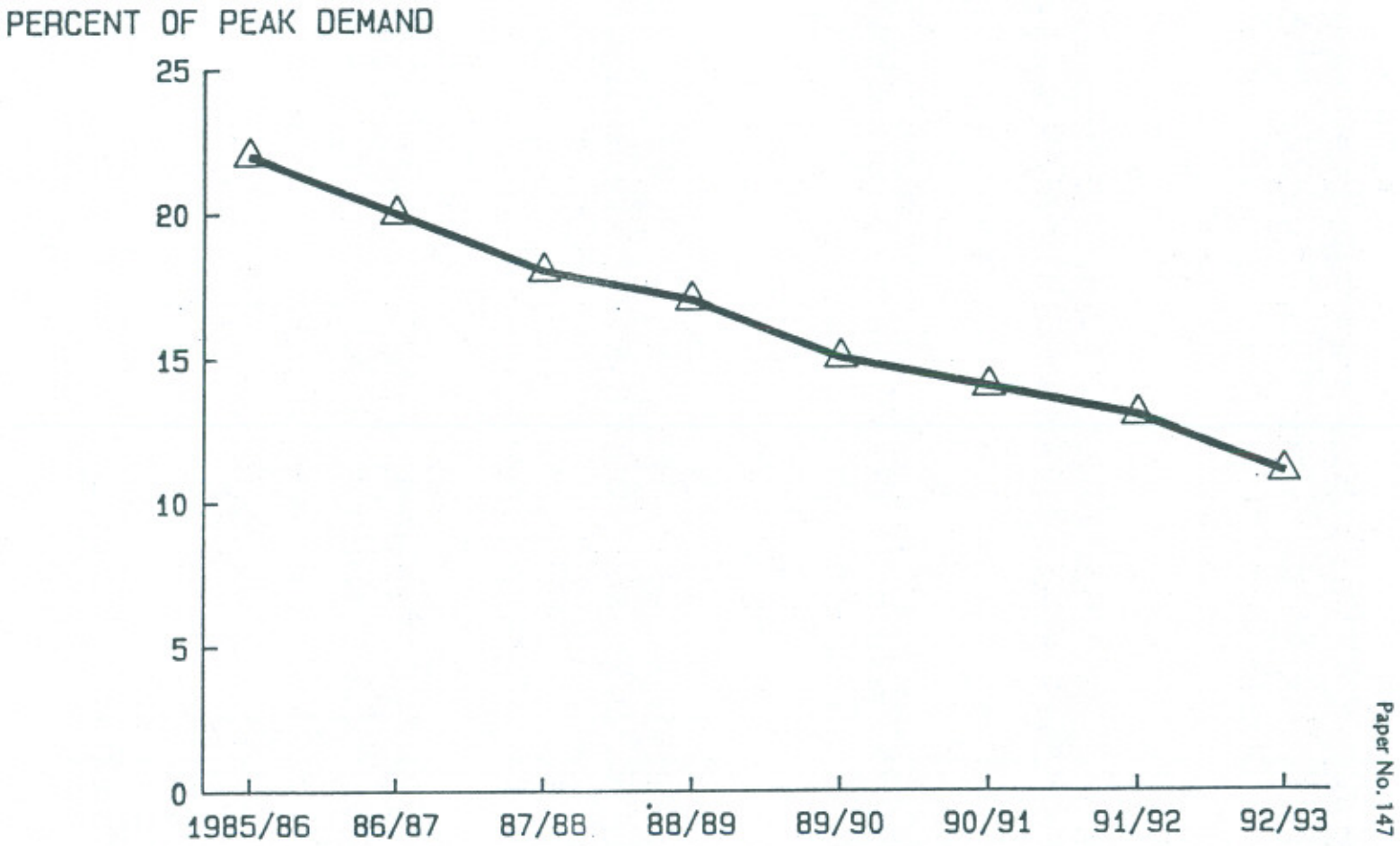
PROJECTED ELECTRIC CAPACITY DEFICIT AS PERCENT OF PEAK DEMAND



995 MW DEFICIT IN 1987/88

Paper No. 147

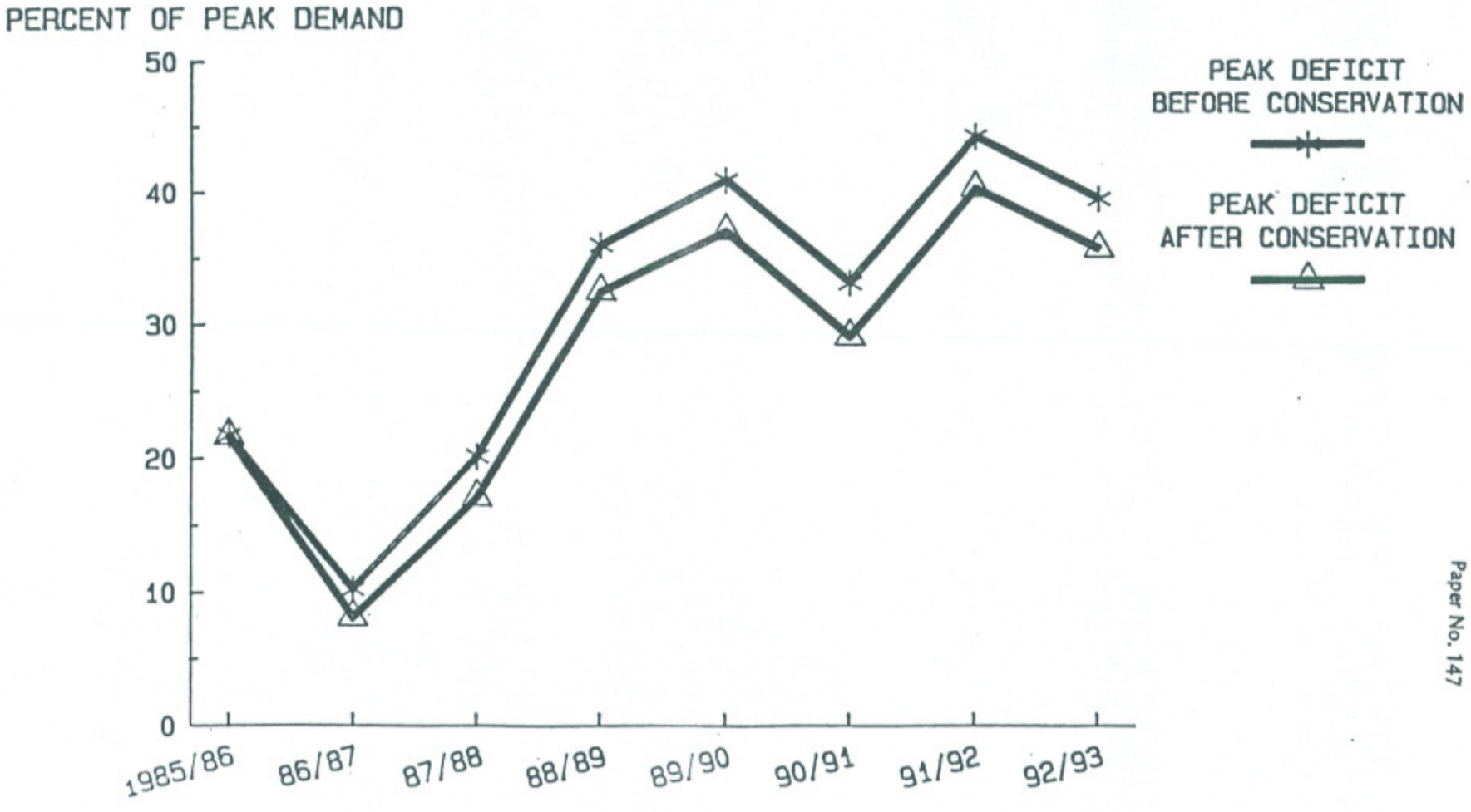
PROJECTED NATURAL GAS DEFICIT AS PERCENT OF PEAK DEMAND



Paper No. 147

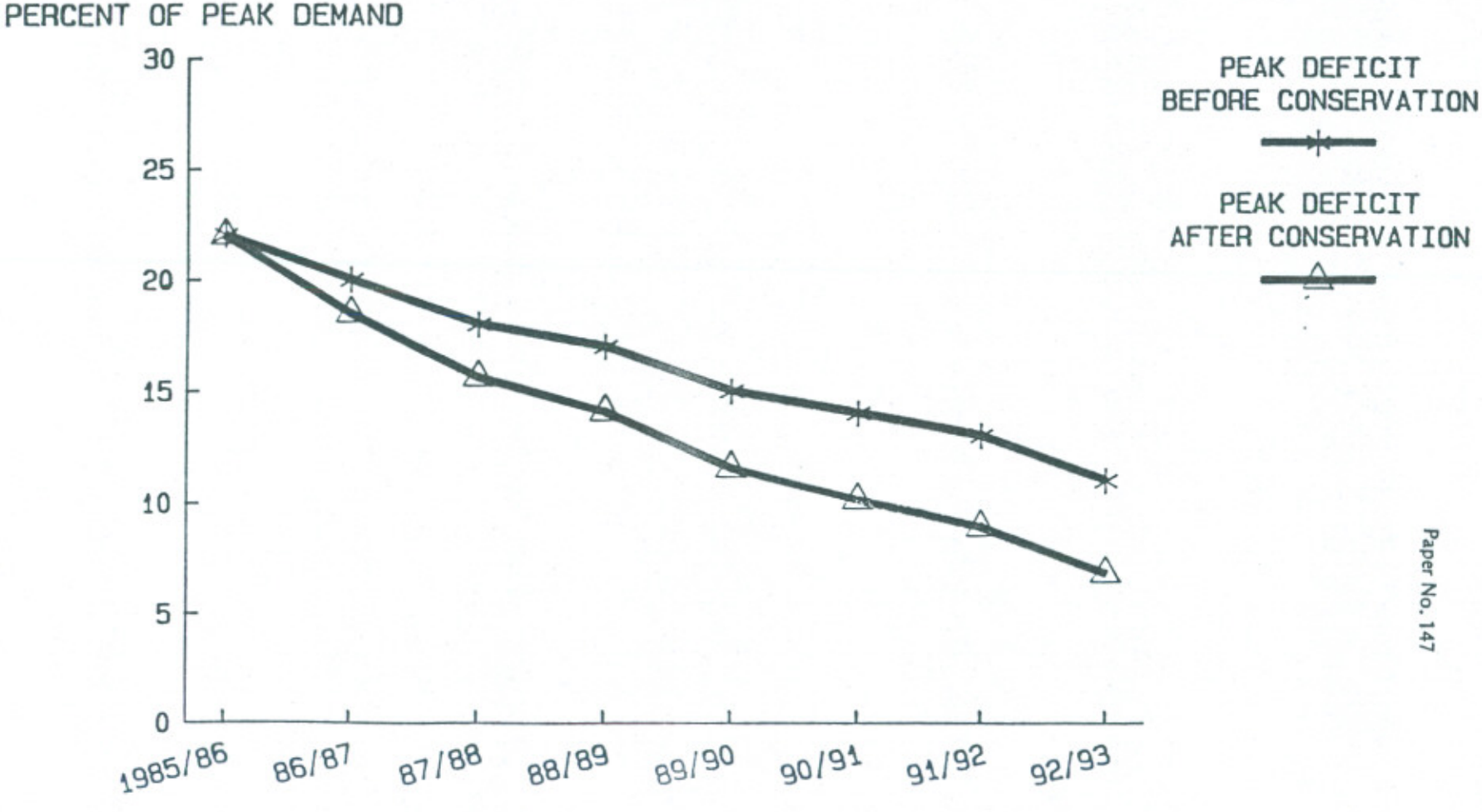
205 MMCFD PEAK DEFICIT IN 1987/88

IMPACT OF INDUSTRIAL ELECTRICITY CONSERVATION ON ELECTRIC LOAD SHEDDING



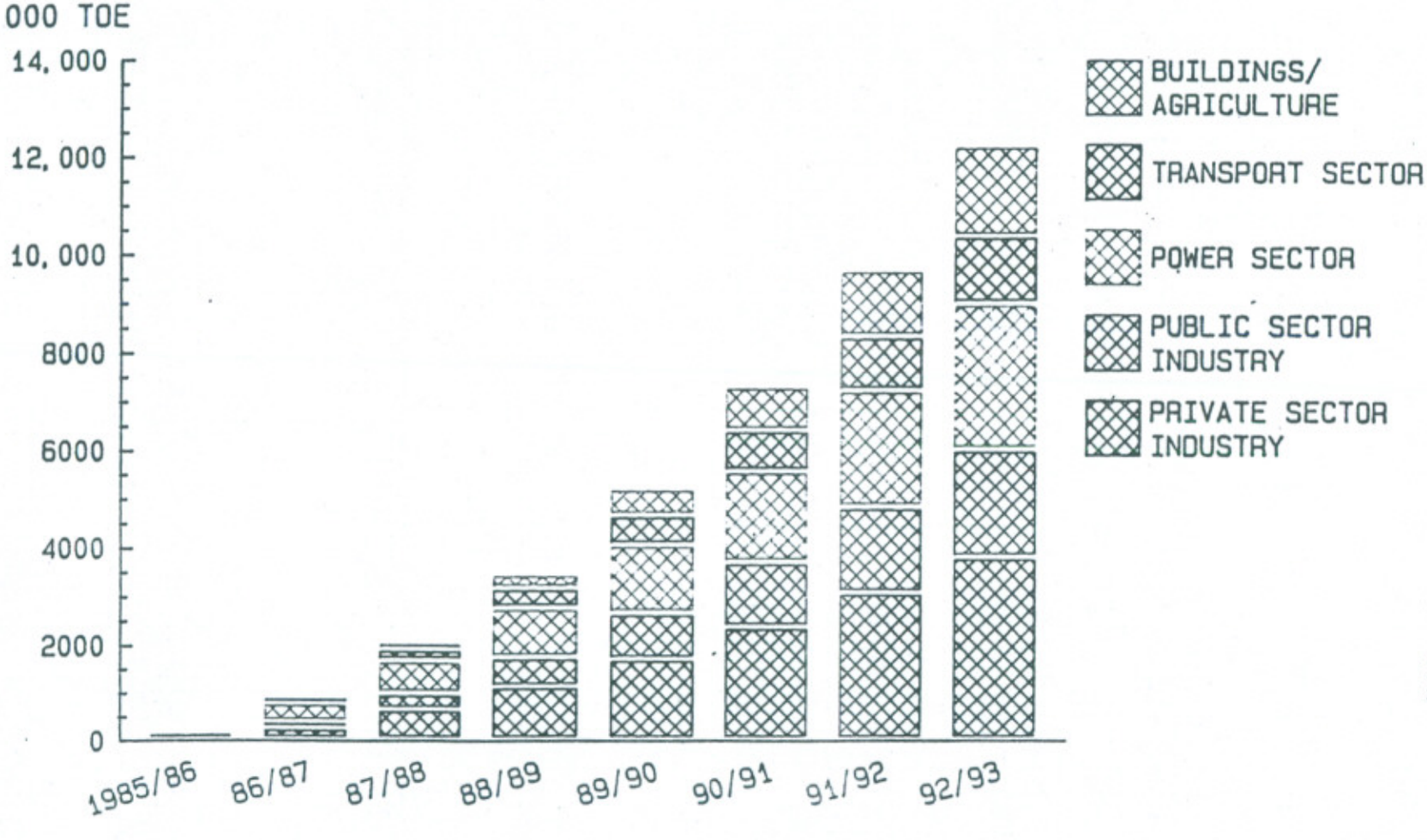
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IMPACT OF INDUSTRIAL NATURAL GAS CONSERVATION ON NATURAL GAS LOAD SHEDDING



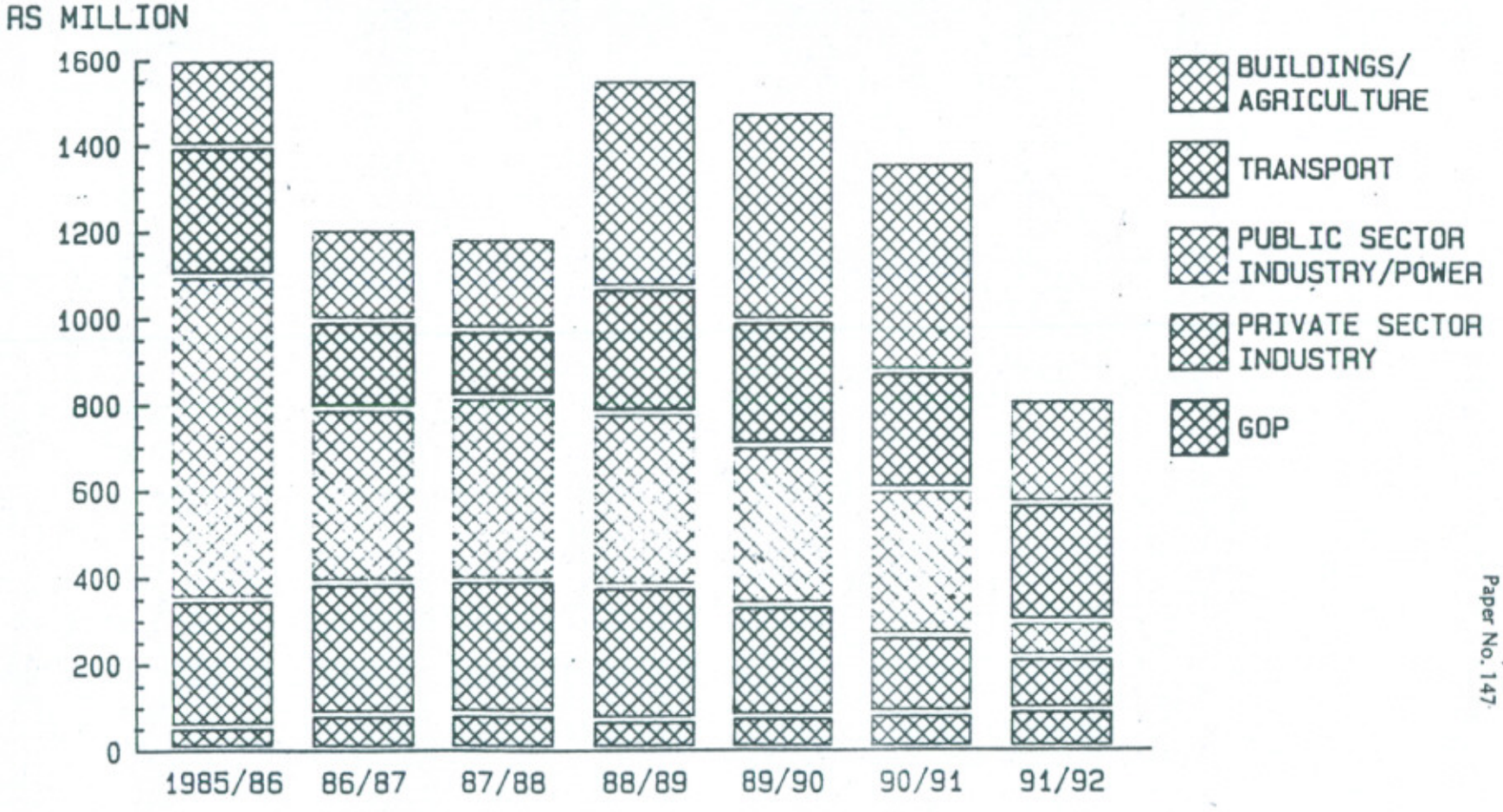
Paper No. 147

CUMULATIVE ENERGY SAVINGS
IN THOUSANDS OF TONNES OF OIL EQUIVALENT



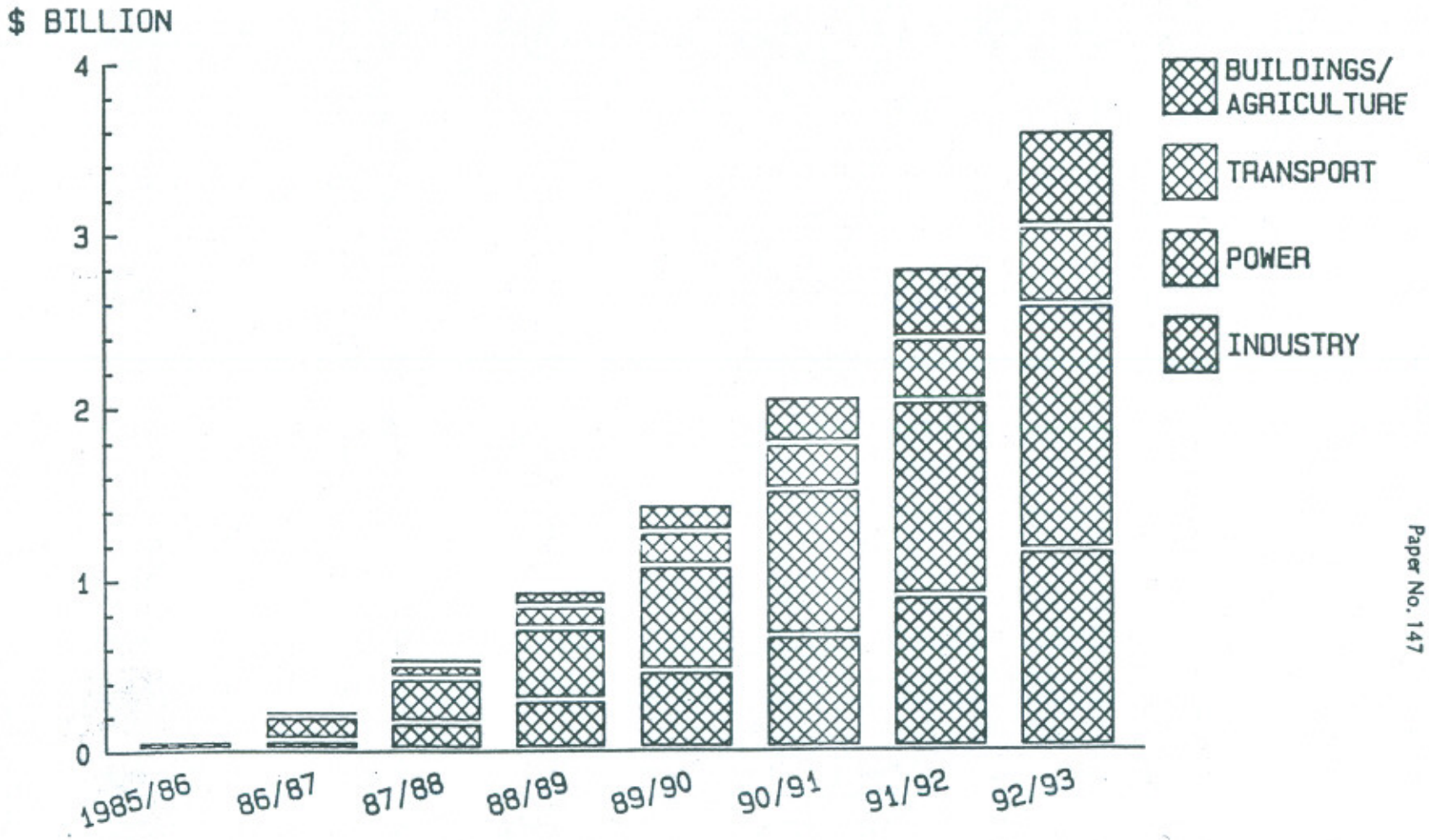
Paper No. 147

ANNUAL INVESTMENT REQUIREMENTS IN MILLIONS OF RUPEES



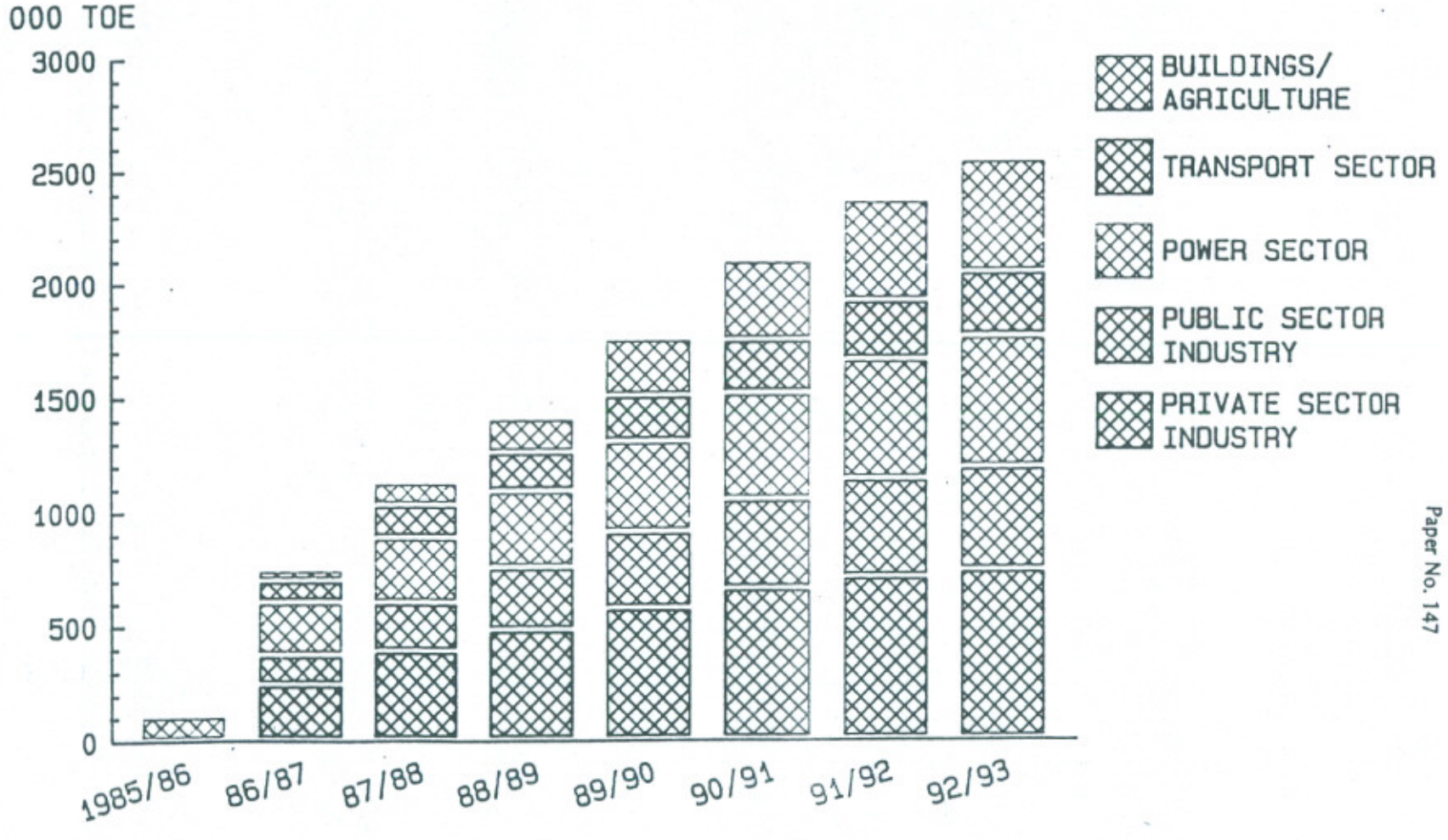
Paper No. 147

CUMULATIVE ENERGY COST SAVINGS IN BILLIONS OF DOLLARS



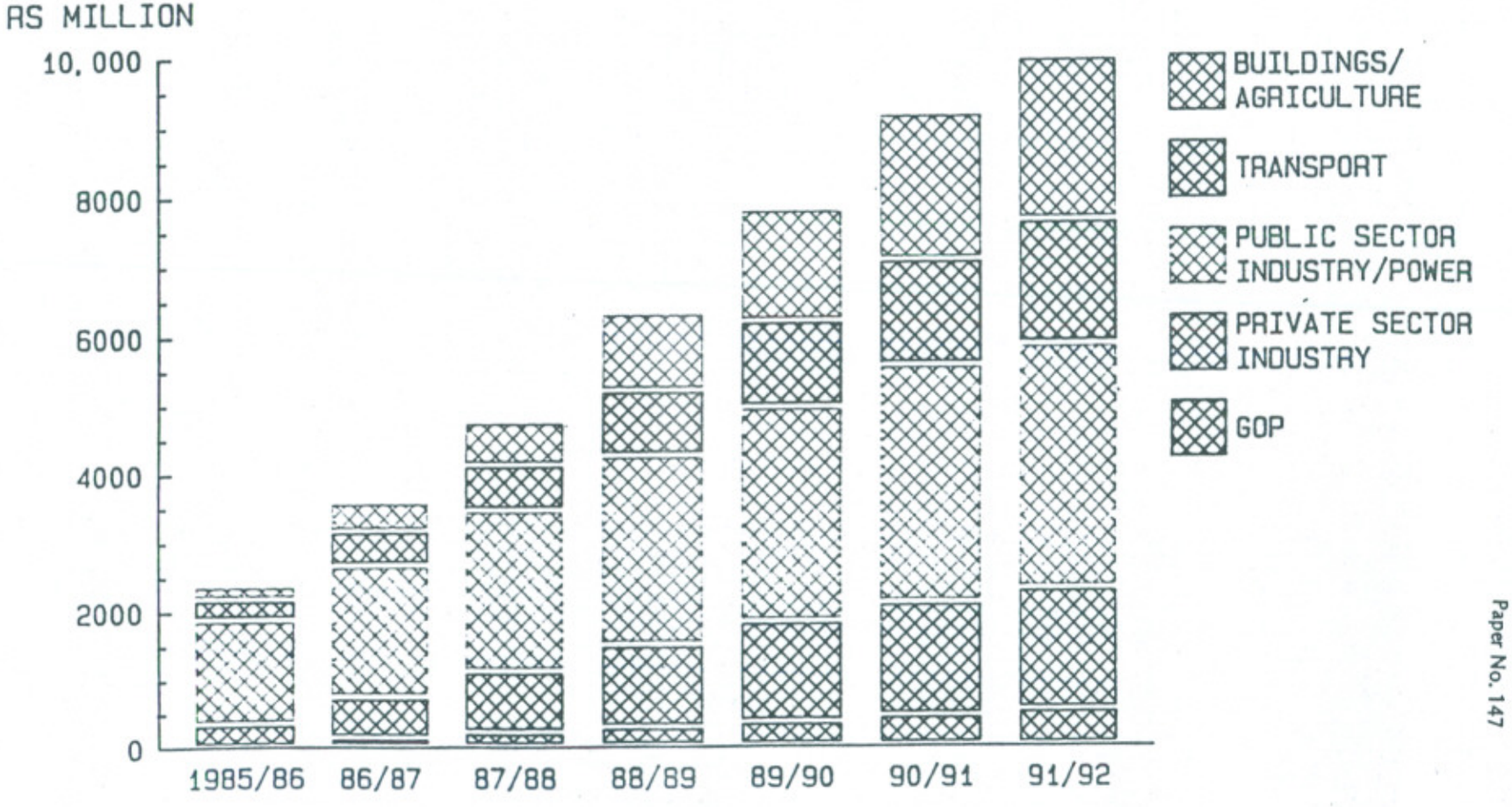
Paper No. 147

LEVEL OF SAVINGS ACHIEVED EACH YEAR IN THOUSANDS OF TONNES OF OIL EQUIVALENT

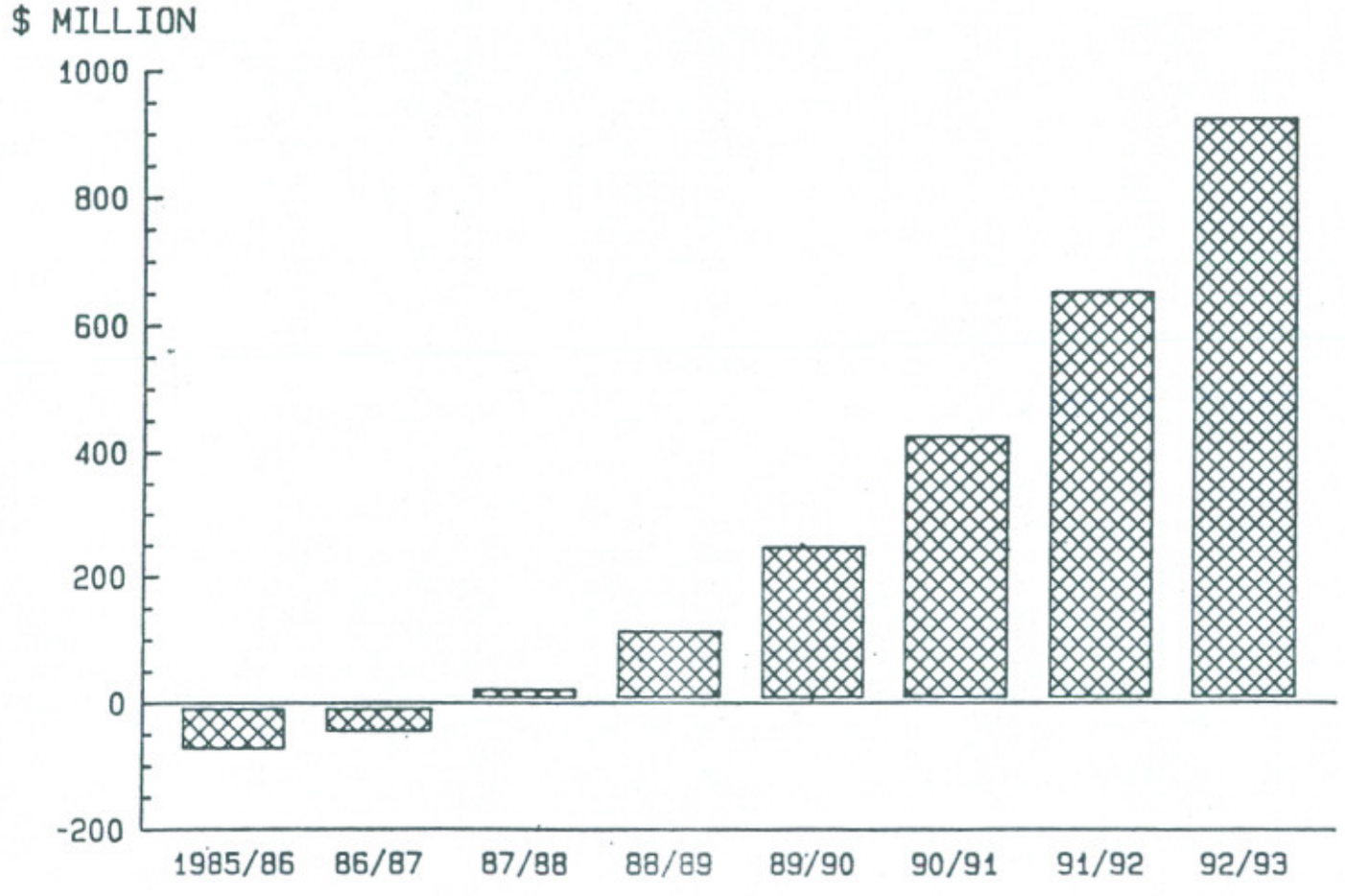


Paper No. 147

CUMULATIVE INVESTMENT REQUIREMENTS IN MILLIONS OF RUPEES



NET CUMULATIVE FOREIGN EXCHANGE SAVINGS IN MILLIONS OF DOLLARS

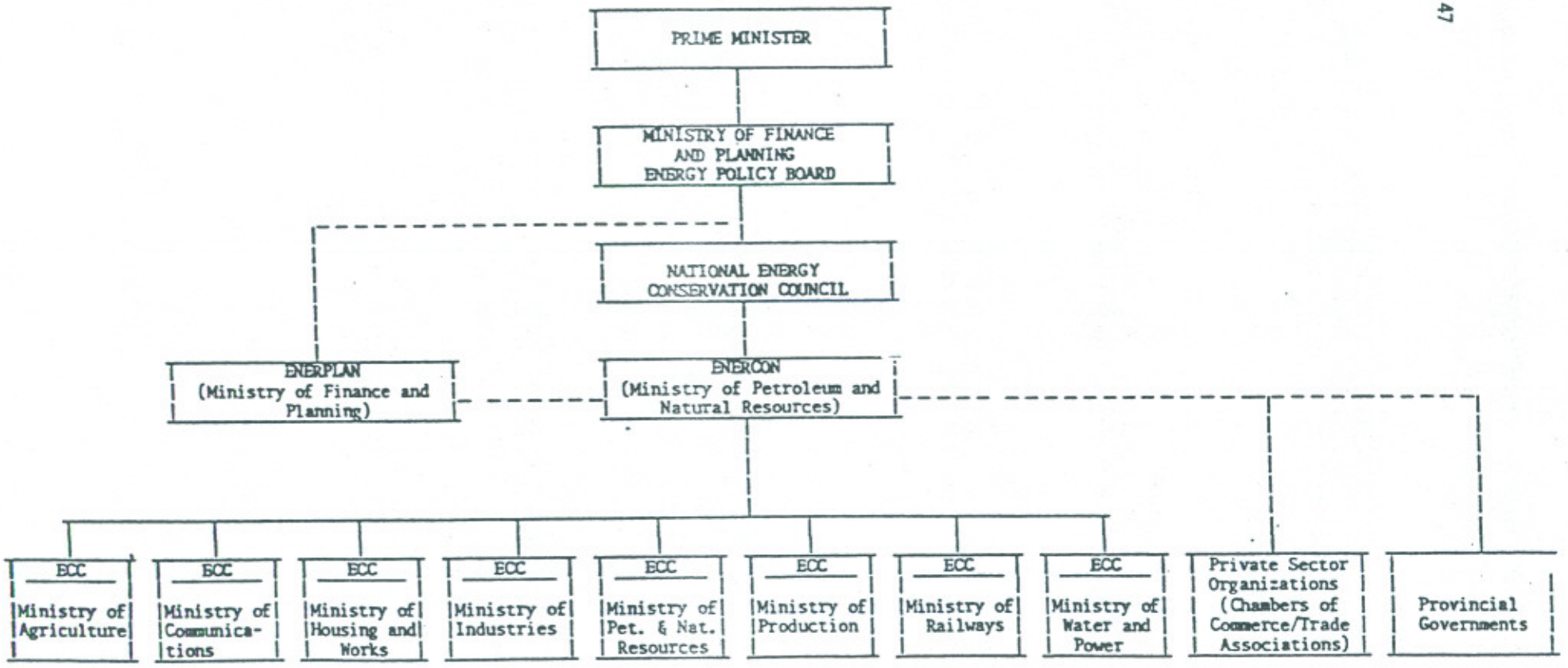


ENERCON

- This autonomous coordinating body will be established within the Ministry of Petroleum and Natural Resources
- Energy Conservation Cells will be established in eight ministries
- Liason will be established with provincial governments and private sector organizations

FIGURE 1

ORGANIZATION CHART



ECC = Energy Conservation Cell

ILLUSTRATIVE ACTIONS: POWER SECTOR

- OPTIMISE GENERATION OUTPUT BY BETTER O & M TECHNIQUES
- ELIMINATE UNECONOMICAL TECHNICAL LOSSES
- INITIATE BETTER BILLING AND COLLECTION
- ADJUST TARIFFS
- MANAGE ENERGY SUPPLY BY STAGGERING LOAD
- OPTIMISE USE OF SINGLE PHASE AS A LOAD SELECTION TECHNIQUE

ILLUSTRATIVE ACTIONS: INDUSTRY SECTOR

- IMPLEMENT RECOMMENDATIONS OF ENERGY AUDITS AND SURVEYS COMPLETED
- UNDERTAKE SELECTIVE DEMONSTRATION PROJECTS
- UNDERTAKE NEW ENERGY AUDITS AND SURVEYS
- IDENTIFY AND IMPLEMENT SOLAR WATER HEATING OPPORTUNITIES
- IDENTIFY AND IMPLEMENT COGENERATION OPPORTUNITIES

ILLUSTRATIVE ACTIONS: TRANSPORT SECTOR

- SET HIGHWAY SPEED LIMITS AT 90 KPH
- REVISE TRUCK/BUS BODY AERODYNAMICS
- INTRODUCE OPERATING/MAINTENANCE CHANGES FOR PASSENGER VEHICLES
- INTRODUCE OPERATING/MAINTENANCE/SCHEDULING TECHNIQUES FOR RAIL TRANSPORT
- PROMOTE INCREASED RAIL TRANSPORT USE

ILLUSTRATIVE ACTIONS: AGRICULTURE SECTOR

- CONDUCT AGRICULTURE PROCESSING AND EQUIPMENT ENERGY USE SURVEY
- CONDUCT TUBEWELL MOTOR AND PUMP ENERGY USE SURVEY

ILLUSTRATIVE ACTIONS: BUILDINGS SECTOR

- PROMOTE INCREASED USE OF HIGH EFFICIENCY LIGHTING
- PERFORM ANALYSES OF THERMAL CONDUCTIVITY AND BUILDING ORIENTATION
- PROMOTE SOLAR WATER HEATING
- CONDUCT BUILDING SYSTEMS EFFICIENCY SURVEY

ILLUSTRATIVE ACTIONS: EDUCATION

- CONDUCT INFORMATION CAMPAIGN THROUGH SCHOOLS, SEMINARS, AND MASS MEDIA

LEGISLATION

- Other countries have adopted legislation in order to ensure successful energy conservation programmes
- Pakistan should also adopt legislation along the same lines as the Philippines, Japan, Korea, and other countries

INCENTIVES/SUBSIDIES

To make energy conservation an attractive programme, the following measures are among those which will be necessary:

- Incentives for conservation equipment and plant modifications, such as concessions in customs duties, and tax holidays
- Subsidies for conservation investments and favorable loan terms
- Adjustment of energy prices to discourage use of scarce fuels

FIRST YEAR ACTION PROGRAMME

- Build on previous work accomplished in areas of energy audits, industrial conservation projects implemented, line loss reduction programme
- Industries and establishments in which audits have been carried out will have high priority for demonstration projects
- Selected energy intensive industries will be audited (e.g. cement, sugar, steel, chemicals, textiles, heavy industries)

REVOLVING FUND

- A revolving fund will be established with ENERCON
- Funds will be disbursed as loans to implement energy conservation projects
- A proposed $5.25 million World Bank grant as part of the Energy Sector Loan will be the initial capital component

TABLE S-i

PROSPECTIVE SOURCES OF FUNDS

AGENDA	PROJECT/PROGRAMME	STARTING YEAR	AMOUNT (million)
USAID	Rural Electrification Project (Line loss reduction)	1984	$ 26.00
USAID	Energy Planning and Development Project (Energy Conservation)	1983	$ 12.00 est.
USAID	Energy Commodity and Equipment Programme (Energy Conservation)	1984	$ 50.00 est.
USAID	Agriculture Commodity and Equipment Programme (Private pumps, tractors etc.)	1984	$ 5.00 est.
WORLD BANK	Refinery Rehabilitation Project	1986	$ 20.00 est.
WORLD BANK	Energy Sector Loan (Conservation Programme in Industry)	1985	$ 5.25
WORLD BANK	WAPDA KESC Rehabilitation Programme	1986	$ 100.00 est.
WORLD BANK	Cement Rehabilitation Project	1986	$ 50.00
WORLD BANK	Various energy conservation projects for public sector industries	1987	$ 60.00 est.
		Approx.	$ 328.25 est.

NOTE:

Asian Development Bank, UN and foreign assistance programmes of West Germany, the Netherlands, UK, Canada and others are additional to the above.