

## OUTLOOK FOR AN ELECTRIC POWER CONSERVATION PROGRAM IN CENTRAL AMERICA

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The investment requirements of the electric power sector in Central America pose a major financial challenge to the region's economies. They account for up to 25 percent of total external debt in the region, and up to 50 percent of public-sector investment programs. The picture is grim: large required investments, lack of foreign exchange to cover the import costs of fuel and equipment, and financial distortions caused by the decline, in real terms, of domestic electricity tariffs combined with rising foreign debt.

With many countries in the region experiencing higher than forecasted electricity demands and anticipated energy demand increases, investment requirements in the power sector in Central America will range from \$ 5 to 10 billion to the year 2000. Multilateral banks have already indicated that the power sector will have difficulty obtaining the capital it needs in the future. Its requirements will be too great for the multilateral and bilateral agencies alone to satisfy, given their limitations on available capital and other priorities in the economy.

A most effective option in dealing with the current financial crisis is to implement an integrated electric power conservation program which would bring about immediate and short-term actions aimed at identifying, evaluating, controlling, and reducing losses in the power system and improving end-use efficiency. Such a program offers impressive benefits: there is a potential to reduce energy investment requirements in power generation by 1/3.

To achieve this goal, a regional effort is required, combining and taking advantage of the experience of each country, the public and private sector. Numerous studies have been carried out, but measures recommended to reduce power system losses have either not been implemented or have proved ineffective. The reasons for these failures must be explored in light of each country experience.

Because of the looming economic and financial crisis, alternatives are needed to delay future investment requirements for power generation. The Central American electric power sector must urgently improve its efficiency. The consequences of the external debt and associated power sector investments must be considered and the potential for efficiency improvements must be defined.

### **The External Debt and the Power Sector**

The external debt in Central America grew from \$ 11 billion in 1980 to nearly \$ 24 billion in 1986 (see Figure --). The energy-sector external debt was on average for the Central American countries, over 20 percent of total external debt. Furthermore, almost all of the energy sector external debt is due to power sector investment requirements (see Figure --).

At current efficiency levels, the Central American region is expected to need between \$ 500 million and \$ 1 billion in capital requirements annually.

According to a recent preliminary analysis, a public-sector investment of some \$ 250 million over the next 5 years in power sector efficiency programs will save roughly one-third of Central America's capital requirements for power services, in addition to reducing the environmental

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impacts of power production. Thus, investment in a  $\frac{1}{2}$  conservation program would have a payback rate of 1 year. The potential impact of an electricity conservation program in Central America is illustrated in Figure 1; the potential impact of such a program in Costa Rica, El Salvador, and Panama is shown in Figures 2,3,4, respectively.

### **Efficiency Improvement Areas**

The savings that can result from adopting energy conservation techniques in the power sector are substantial and well known, providing the highest payback on investment. An aggressive campaign is necessary to reduce the supply and demand imbalance and avoid future rationing.

Efficiency improvements can be realized by adopting load management techniques, and improving the efficiency in production, transmission and distribution, and end-use.

**Load Management.** Changing the shape or characteristics of the power utility's load curve by shifting electricity consumption from peak to off-peak periods could substantially reduce the cost of supply.

In the case of Costa Rica, the argument in favor of load management is rooted in the high cost of generating capacity needed to meet projected electricity demand growth. Generating capacity can be reduced by 1.4 kW for each 1.0 kW reduction in customer peak demand, assuming a 30 percent dry year planning reserve margin and a 10 percent loss factor on-peak. Thus, a 1.0 kW reduction in peak load achieved through a load management program can save \$ 781.20 in generating capacity. Using an annual capital recovery

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factor of 0.2, these savings translate into \$156.24/kW-yr, of \$13.02/kW-month. In addition, savings will accrue annually because fuel requirements will be reduced during peak periods, and capital expenditures will be reduced because of transmission and distribution expenditures are either reduced or delayed. The experience of Costa Rica with load management now needs to be shared with the other countries in Central America.

**Production Efficiency.** The focus for improving the efficiency of electricity production in Central America could be in establishing a thorough power plant rehabilitation program. Generation losses may be reduced by using new technologies, replacing old boilers and generally rehabilitating old thermal generations, using higher efficiency designs in new hydro installations, and replacing older turbines.

In many countries in Central America, the deterioration of thermal power plant equipment has been identified as a major problem. Needed are an exhaustive review of the status of equipment maintenance, and a detailed inventory of all installations producing electricity in the country.

Plant rehabilitation would reduce the future requirements for imported oil used to generate power. Thermal plants built during the period of cheap and plentiful petroleum now have serious operational difficulties such as corroded boiler tubes, inefficient control systems, no multifuel capabilities, and worn-fuelhandling facilities.

Since the Chixoy hydroelectric plant was completed, Guatemala is now turning attention to the rehabilitation of its thermal power plants. And in El Salvador,

as well as other Central American countries, the need for power plant rehabilitation has been voiced.

**Efficiency in Transmission and Distribution System.** Transmission and distribution losses rose from 10 percent of total net generation in the region in 1972 to nearly 14 percent in 1985. The decline in the financial position of many utilities has led to reduced investment and system maintenance.

Meanwhile, system losses drive up supply costs and increase the financial burden of the sector.

Costa Rica has installed high voltage lines in the past few years, reducing transmission losses from 5 percent to 3 percent. It has also reduced distribution losses from 12.6 percent to 7.5 percent. Belize has also taken steps to improve efficiency, reducing its system losses from 25 percent to 15 percent. It will be beneficial to investigate the experience acquired by each country in Central America in reducing system losses, and identify new cost-effective measures applicable to the region.

**End-use efficiency.** End-use conservation programs, if strongly supported by electric utilities, could lower demand growth rates by half. The measures adopted to improve end-use efficiency depend on country-specific conditions. Nonetheless, some general activities may be appropriate in many countries of the region.

The residential sector, which represents roughly 30 percent of total electricity consumption in several Central American countries, uses power for cooking, air conditioning, refrigeration, and lighting. The early establishment of efficiency standards for this equipment is critical, as various surveys have

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indicated that many consumers who are connected to the grid do not yet have these appliances. In Guatemala, for example, only 40 percent of the population with electricity has refrigerators.

In general, an improvement in economic conditions spurs demand for domestic electric appliances on the part of the populace. Thus, now is the time to initiate an integrated end-use efficiency program.

### **Conclusions and Recommendations**

Energy conservation in the power sector is a top priority because of the large capital requirements for new generation capacity and the shortfall in available capital. A significant potential for energy savings in the power sector of Central America exist. Up to 1/3 of power generation investments can be reduced with the appropriate techniques.

Each Central American country should explore potential areas for improving the power sector efficiency. To this end, the countries of Central America should evaluate their electricity losses, identify the potential for load management and promote end-use efficiency. Sharing the information between the countries in the region would achieve economies of scale not possible on an individual country basis. Many countries in Central America have in place power sector efficiency programs, but there has been no mechanism to take advantage of the experiences learned in the region.

**CENTRAL AMERICA POWER SECTOR EFFICIENCY INITIATIVE**

**COUNTRY PROFILES**

**BELIZE, COSTA RICA, EL SALVADOR, GUATEMALA, HONDURAS,  
NICARAGUA, AND PANAMA**

**JANUARY 23, 1989**

## **BELIZE COUNTRY PROFILE**

**Power Sector Overview** As of August 1988, total installed capacity was 30 MW. The Belize Electricity Board (BEB) owns and operates all 10 generating stations and provides electricity to 22,000 customers. All generating units are diesel-fired and overall peak demand for the country is 14 MW.

During the 1970s and early 1980s fuel procurement represented 60 percent of operating costs. As a result, funds were not available for maintenance, skilled management, supervisory staff or spare parts. Generating units deteriorated and there were many outages. In an attempt to improve the financial situation the BEB raised tariffs to about US\$ 0.20/kWh, one of the highest in Central America and the Caribbean. However, the higher tariffs along with inadequate financial and cash management, poor reliability of supply, and sparse population concentration have suppressed load growth, deterring new investments. The need to increase electricity demand under a carefully planned electricity supply within the BEB's long-term financial and expansion plans is the highest priority.

Since FY 1985-1986, the BEB has been generating annual surpluses due to the improvement in the reliability of supply. This turnaround was brought on by rehabilitating generating units, augmenting the generating capacity, reducing technical and non-technical losses from 25 to 15 percent, the fall in fuel costs, and improved organizational management. Some of the measures that have contributed to lowering system losses are improved metering practices, additional high voltage spurs and transformers, reinforcement of distribution networks with larger conductors, and installation of 2x3.5 MW generating units near the main load center (Belize City). The BEB has been able to improve overall generating efficiency with the addition of appropriate personnel, restructuring in the production department, and the implementation of an effective operation and maintenance program for generating units and distribution lines. The result has been an increase in generating efficiency from 11.5 kWh/US gallon in 1983 to 13.5 kWh/US gallon to date.

However, there are still reliability problems due to 5 major reasons:

- the systems were designed without lightning protection
- the systems were designed with ineffective protective devices
- the interconnected systems suffer from poor location and design of substations
- electrical connectors have numerous distribution faults and service deficiencies

- and distribution lines have incompatible voltages

**Current Efforts and Programs** The World Bank is financing an ongoing Power Project (\$7.5 million) covering expansion of generation facilities, improvement and expansion of distribution facilities, and technical assistance. Contracts were expected to be awarded for the procurement of the generation, transmission and distribution components by June 1988. Completion of the transmission and distribution works is expected by the end of 1990.

### **Possible Program Components**

- Power Plant Rehabilitation The BEB has reported that the plants have negligible disparities in efficiencies.
- Transmission and Distribution The BEB has been successful in reducing transmission and distribution losses and is no longer considered a priority.
- End-Use Efficiency For the near future, it is not a priority since the focus is more to increase consumer demand.
- Load Management At the Central American and Caribbean Power Workshop, the BEB expressed that peak reduction is the only area in power efficiency which could be considered in Belize.

COUNTRY PROFILE: BELIZE

KEY SYSTEM CHARACTERISTICS /1

Total Installed Capacity (1988)	30 MW
Thermal	30 MW
Peak Demand (1988)	14 MW
Heat Rate of Thermal Plants	
Total T & D Losses (1982) /2	25%
Consumption Breakdown	
Industry	
Residential	
Commercial	

CURRENT EFFORTS AND PROGRAMS

IBRD /3

IBRD is financing an ongoing Power Project (\$7.5 million) covering expansion of generation facilities, improvement and expansion of distribution facilities, and technical assistance. Contracts were expected to be awarded for the procurement of the generation, transmission and distribution components by June 1988. Completion of the transmission and distribution works is expected by the end of 1990.

POSSIBLE PROGRAM COMPONENTS

Rehabilitation

The BEB has reported that its plants have negligible disparities in efficiencies.

Transmission & Distribution

The BEB has been successful in reducing transmission and distribution losses and is no longer considered a priority.

End-Use Efficiency

For the near future, it is not a priority since the focus is more to increase consumer demand.

Load Management

At the Central American and Caribbean Power Workshop, the BEB expressed that peak reduction is the only area in power efficiency which could be considered in Belize.

APPROXIMATE PROGRAM COSTS (US \$ million) /5

	Needed	World Bank	IDB	Other	Balance
Power Plant Rehabilitation	-	-	-	-	-
T & D Losses	-	4 (4)	-	-	-
End-Use Efficiency	-	-	-	-	-
Load Management	1-2	-	-	-	1-2
TOTAL	1-2	4	-	-	1-2

/1 Source: BEB, August 1988.

/2 Source: 1982 Power Data Sheets for 104 Developing Countries, IBRD, July 1985.

/3 Source: Status of IBRD/IDA Projects in Execution (as of March 31, 1988). Released April 29, 1988.

/4 Source: IBRD Power Project, Loan #2479, \$7.5 million.

/5 These program costs incorporate the associated technical assistance, including prefeasibility studies, institutional strengthening, and operation and maintenance requirements.

## COSTA RICA COUNTRY PROFILE

**Power Sector Overview** Total installed capacity in 1987 was 868 MW, of which 725 was hydro and 142 was thermal. Peak demand was 612 MW and transmission and distribution losses were 11 percent. The residential sector accounted for 50 percent of total electricity consumption, industry 30 percent, and commercial 20 percent. Cooking alone comprises 17 percent of total electricity consumption. The Instituto Costarricense de Electricidad (ICE) supplies 95 percent of total installed capacity. The installed capacity and available power generation profile is as follows: (1)

<u>Hydro</u>	<u>Capacity</u>	<u>Available 1988</u>	<u>Fuel</u>
Corobici (3x58)	174 MW	174 MW	
Arenal (3x52)	157 MW	157 MW	
La Garita (2x15+2x48)	130 MW	n/a	
Rio Macho (2x15+3x30)	120 MW	120 MW	
Cachi (2x32+1x37)	101 MW	101 MW	
Plantas Menores Non-ICE	1.5 MW 41.9	n/a n/a	
<u>Thermal</u>			
San Antonio	48 MW	n/a	Bunk/Dies
Barranca	42 MW	n/a	Diesel
Moin	32 MW	n/a	Bunker
Colima	20 MW	n/a	Diesel
Sistemas Aislados	1.3 MW	n/a	Diesel

The average annual increase in electricity demand between 1985 and 2005 is estimated to be 9 percent. In order to meet this rising demand, ICE has developed an investment plan for the years 1989-1995. According to this program, total expenditures required for the power sector are \$1.5 billion, of which generation accounts for \$1.2 billion (75 percent), transmission and distribution \$209 million (14 percent), and feasibility studies and other activities \$142 million (9 percent). The following plants are scheduled to come on-line under the generation expansion component of the program:

- Miravalles I (55 MW geothermal), operational in 1992
- Miravalles II (55 MW geothermal), operational in 1994
- Sandillal (32 MW hydro), operational in 1993

- Toro (90 MW hydro), operational in 1994

An inadequate tariff structure does not sufficiently cover projected expansion costs. In fact, in December 1987 ICE's total debt amounted \$600 million, 14 percent of Costa Rica's total external debt. Fifty-seven percent of this debt is with development banks. In addition, Costa Rica is burdened with balance of payment difficulties, large external debt, and limited financial resources. Together with the economic crisis affecting the region as a whole, increasing electricity demand, and unreliable hydro capacity due to seasonal fluctuations, these factors have left the system with a gap in supply and demand. ICE has been unable to implement future development projects and proposed geothermal and hydro projects will not provide sufficient capacity to satisfy demand. The result is an increasing dependence on imported petroleum fuels for thermal power generation.

**Current Efforts and Programs** The Inter-American Development Bank is financing the Electricity Development II Project (\$188 million), including hydroelectric, geothermal transmission and distribution, and rehabilitation of thermal units. The total project cost is \$275.4 million and a project progress report is in preparation.

The Energy Sector Management Assistance Program (ESMAP) has proposed a Power Investment Optimization Investment Project (\$100,000), which will most likely be incorporated under an IDB loan. The project will assist ICE in developing comprehensive models to integrate the development of the electric power system and to train ICE personnel in their use. The program will complement a related effort to design and implement a more sophisticated demand forecasting system for the electric power sector. ESMAP has also proposed a Technical Assistance Project for ICE's System Operation (\$50,000) to aid ICE manage its system operations. The project will provide a planning engineer and operation control engineer for 3 man-months to focus on load balancing and dispatch, and frequency oscillations and control.

### **Possible Program Components**

- Power Plant Rehabilitation This is a priority area since at the Central American and Caribbean Power Workshop representatives of the rural electrification cooperatives emphasized their concern in the alarming deterioration of the thermal power plants.
- Transmission and Distribution This is not a priority area since Costa Rica has been effective in reducing all transmission and distribution losses to 11 percent.
- End-Use Efficiency A significant energy savings potential exists and ICE is actively involved in a promotion campaign.

- Load Management This is a priority area which has been initiated with a successful pilot project and now needs to be expanded.

1. Installed capacity figures from Perspectivas del Sector Electrico Costarricense, por Mario Hidalgo (ICE), August 1988.

**COUNTRY PROFILE: COSTA RICA**

**KEY SYSTEM CHARACTERISTICS /1**

Total Installed Capacity (1987)	868 MW
Hydro	725 MW
Thermal	143 MW

HYDRO 2/	CAPACITY (MW)	AVAILABLE 1988	FUEL
Corobici	174	174	
Arenal	157	157	
La Garita	130		
Rio Macho	120	120	
Cachi	101	101	
Plantas menores	1.5		
Non-ICE	42		
<b>THERMAL</b>			
San Antonio	48		Bunker/Diesel
Barranca	42		Diesel
Moin	32		Bunker
Colima	20		Diesel
Sistemas Aislados	1.3		Diesel

Peak Demand (1987) /3	612 MW
Heat Rate of Thermal Plants	
Total T & D Losses (1988) /4	11%

Consumption Breakdown (1987) /5	
Industry	30%
Residential	50%
Commercial	20%

**CURRENT EFFORTS AND PROGRAMS**

**IDP /6**

Electricity Development II (\$188 million). Total project cost is \$275.4 million. Project includes hydroelectric, geothermal distribution, transmission and rehabilitation of thermoelectric units. Status of procurement/consulting services: pending definition. Progress report in preparation.

**Other /7**

ESMAP Optimization of Power Investments (\$100,000). Purpose is to assist ICE in developing a comprehensive model or models to integrate the development of the electric power system and to train ICE's personnel to use them. The study will complement a related effort to design and implement a more sophisticated demand forecasting system for the electric power sector.

ESMAP Technical Assistance in ICE's System Operation (\$50,000). Objective is to provide technical assistance to ICE in resolving problems with managing its system operations. Activity will require a system planning engineer and operation control engineer for about three man-months to focus on load balancing and dispatch, and frequency oscillations and control.

**POSSIBLE PROGRAM COMPONENTS**

**Rehabilitation**

This is a priority area since at the Central American and Caribbean Power Workshop representatives from the rural cooperatives emphasized their concern in the alarming deterioration of the thermal power plants.

**Transmission & Distribution**

This is not a priority area since Costa Rica has been effective in reducing all transmission and distribution losses to 11%.

**End-Use Efficiency**

A significant energy savings potential exists and ICE is actively involved in a promotion campaign.

**Load Management**

This is a priority area which has been initiated with a successful pilot project and now needs to be expanded.

APPROXIMATE PROGRAM COSTS (US \$ million) /9

	Needed 20-30 (8)	World Bank	IDB 10-20	Other	Balance 0-20
Power Plant Rehabilitation	-	-	-	-	-
T & D Losses	-	-	-	-	-
End-Use Efficiency	15-30	-	-	-	-
Load Management	5-10	-	-	-	5-10
<b>TOTAL</b>	<b>40-70</b>	<b>-</b>	<b>10-20</b>	<b>-</b>	<b>30-50</b>

/1 Source: ICE, agosto 1988.

/2 Source: All installed capacity figures from "Perspectivas del Sector Electrico Costarricense," por Mario Hidalgo (ICE), August 1988.

/3 Source: CEPAL, febrero 1988.

/4 Source: ICE, agosto 1988. Transmission losses are 3% and distribution losses are 10.5%.

/5 Source: Plan Nacional de Energia, Ministerio de Industria, Energia y Minas, diciembre 1986.

/6 Source: Inter-american Development Bank monthly report on status of loan applications and technical cooperation requirements and status of procurement. Released October 24, 1988.

/7 Source: ESMAP Information and Status Report. April 1988.

/8 Source: IDB Electricity Development II, Loan #CR0029, \$188 million.

/9 These program costs incorporate the associated technical assistance, including prefeasibility studies, institutional strengthening, and operation and maintenance requirements.

## EL SALVADOR COUNTRY PROFILE

**Power Sector Overview** Total installed capacity as of 1987 was 650 MW, of which 388 MW was hydro, 167 MW thermal, and 95 MW geothermal. In 1987 peak demand was 380 MW. Transmission and distribution losses were 13 percent in 1982. In 1986, the industrial sector accounted for 31 percent of total electricity consumption, residential 34 percent, commercial 15 percent, and government 17 percent. The installed capacity and available power generation profile for the Comision Ejecutiva Hidroelectrica del Rio Lempa (CEL) is as follows:

<u>Hydro</u>	<u>Capacity</u>	<u>Available 1988</u>	<u>Fuel</u>
Guajoyo (1x15)	15 MW	15 MW	
Cerron Grande (2x67.5)	135 MW	135 MW	
5th of Nov. (4x15+1x22)	82 MW	75 MW	
15th of Sept. (2x78)	157 MW	157 MW	
<u>Geothermal</u>			
Ahuachapan (2x30+1x35)	95 MW	51 MW	
<u>Thermal</u>			
Acujutla (1x30+1x33+1x7)	70 MW	30 MW	Bunk.
Soyapango (2x17+1x20)	54 MW	28 MW	Dies.
San Miguel	25 MW	20 MW	Dies.
Miravalle (3x6)	19 MW		Bunk.

Power demand growth rates to the year 2000 have been estimated to vary between 6.1 and 9.1 percent. Assuming a growth rate of 6.1 percent, CEL's installed generating capacity would double in 2000. El Salvador increasingly relies on thermal power generation, not only due to demand above the levels projected, but also because up to 75 percent of its power line towers have been damaged as a result of the internal conflict, interrupting the hydropower-based supply.

Thus, in order to cover a 6.1 percent annual growth rate power demand in the period 1988-2000, it will be necessary to invest \$800 million in generation and transmission projects. However, CEL faces serious financial constraints. Tariffs do not cover the costs of production, contracted debt and future expansion plans. Indeed, CEL would need to increase tariffs 100 percent to meet these financial demands. The economic aspects that have had the strongest impact on CEL's financial situation since 1980 are devaluation of the colon, system damage, high cost of fuel imported to replace lost hydro capacity due to droughts in 1987-88, revaluation of the Japanese yen, and arrears in electricity bills. Together these factors have cost CEL \$264.6 million.

**Current Efforts and Programs** The Inter-American Development Bank (IDB) is currently negotiating (the cost has not yet been defined) with CEL for a loan rehabilitating the 5th of November hydroelectric plant (82 MW installed). A prefeasibility study is being carried out to determine the condition of the plant and make recommendations. The IDB is also currently negotiating a separate project on expanding the same plant. The project is expected to cost \$74.5 million and involves increasing installed capacity with a new enginehouse and two 60 MW Francis turbines.

The Central American Bank for Economic Integration (CABEI) is financing an Electrical Interconnection Feasibility Study between Honduras and El Salvador. The project costs \$555,000 and includes estimates of electricity demand and updating generation expansion plans. Studies in El Salvador have started with local funds and additional resources are being requested from CABEI. CABEI, along with the Kreditanstalt fur Wiederaufbau in West Germany, is also financing the Honduras-El Salvador Interconnection project (\$25.2 million). This project will modify the September 15th hydroelectric substation (157 MW installed) and install transmission lines. The project is in the early stages.

#### **Possible Program Components**

- Power plant rehabilitation This is a priority area since much of the hydropower supply is interrupted by the civil disturbance. Some preliminary discussions on plant rehabilitation have taken place with the World Bank and IDB. Their involvement is limited, however, due to the civil conflict.
- Transmission and Distribution The problem is more that the lines are being blown-up.
- End-Use Efficiency Incentives for end-use efficiency are limited as indicated above due to low tariffs. However, it can be considered a priority area because of high electricity demand growth rates.
- Load Management At the Central American and Caribbean Power Workshop, CEL expressed interest in reducing peak demand through load management techniques.

**COUNTRY PROFILE: EL SALVADOR**

**KEY SYSTEM CHARACTERISTICS /1**

Total Installed Capacity (1987)			650 MW
Hydro			388 MW
Thermal			160 MW
Geothermal			95 MW

HYDRO	CAPACITY (MW)	AVAILABLE 1988	FUEL
Guaajo	15	15	
Cerron Grande	135	135	
5th of November	82	75	
15th of September	157	157	
<b>GEOHERMAL</b>			
Ahuachapan	95	95	
<b>THERMAL</b>			
Acujutla	70	30	Bunker
Soyapango	54	28	Diesel
San Miguel	25	20	Diesel
Miravalle	19		Bunker

Peak Demand (1987)		380 MW
Heat Rate of Thermal Plants		
Total T & D Losses (1982) /2		13%

<b>Consumption Breakdown (1986) /3</b>		
Industry		31%
Residential		34%
Commercial		15%
Government		17%

**CURRENT EFFORTS AND PROGRAMS**

**IDB /4**

IDB is currently negotiating (the cost has not yet been defined) with CEL for a loan rehabilitating the 5th of November hydroelectric plant (82 MW installed). A prefesibility study is being conducted to determine the condition of the plant and make recommendations.

IDB is also currently negotiating a separate project on expanding the same plant. The project is expected to cost \$74.5 million and involves increasing installed capacity with a new enginehouse and two 60 MW Francis turbines.

Regional Activities Program for the Electricity Subsector in Central America - Operation System (\$2.7 million). Program responds to necessity of repairing differences in the operation of interconnected systems on the Isthmus. Project in feasibility stage.

**CABEI /4**

Electrical Interconnection Feasibility Study: El Salvador-Honduras (\$555,000). Includes estimates of electricity demand, and updating generation expansion plans. Studies in El Salvador have started with local funds and additional resources are being requested from CABEI.

Honduras-El Salvador Interconnection (\$25.2 million). Modifying the 15th of September substation and installation of transmission lines. Project in outline stage. Additional financing source is the Kreditanstalt fur Wiederaufbau in West Germany.

**POSSIBLE PROGRAM COMPONENTS**  
**Rehabilitation**

Priority area since much of the hydropower supply is interrupted due to the civil disturbance. Some discussions have taken place with the World Bank and IDB, although because of the internal conflict Bank staff travel is very limited.

**Transmission & Distribution**

The problem is more that the lines are being blown-up.

**End-use Efficiency**

Tariffs are very low, and an increase of about 130% would be required to reach economic levels. The incentive for end-use efficiency is limited, although it is a priority because of high (9%) electricity demand growth rates.

**Load Management**

At the Central American and Caribbean Power Workshop, CEL expressed interest in reducing peak demand.

**APPROXIMATE PROGRAM COSTS (US \$ million) /6**

	Needed	World Bank	IDB	Other	Balance
Power Plant Rehabilitation	10-20	-	2-3 (5)	-	7-18
T & D Losses	-	-	-	-	-
End-Use Efficiency	10-15	-	-	-	10-15
Load Management	5-10	-	-	-	5-10
<b>TOTAL</b>	<b>25-45</b>	<b>-</b>	<b>2-3</b>	<b>-</b>	<b>22-43</b>

/1 Source: Comision Economica para America Latina y el Caribe (CEPAL), febrero 1988.

/2 Source: 1982 Power Data Sheets for 104 Developing Countries. IBRD, July 1985.

/3 Source: CEL, 1986.

/4 Source: "Sector Electrico de El Salvador," CEL, octubre 1987.

CABEI = Central American Bank for Economic Integration.

IDB = Inter-American Development Bank

/5 IDB loan in negotiation process. Total value undetermined.

/6 These program costs incorporate the associated technical assistance, including prefeasibility studies, institutional strengthening, and operation and maintenance requirements.

## GUATEMALA COUNTRY PROFILE

**Power Sector Overview** Total installed capacity as of 1987 was 778 MW, of which 486 MW was hydro and 292 MW was thermal. The heat rate of thermal plants was 9.61 kWh/gallon. Peak demand in 1987 was 375 MW and transmission and distribution losses were 16 percent. The Instituto Nacional de Electrificación (INDE) generates and distributes power throughout Guatemala. The Empresa Electrica de Guatemala, S.A. (EEGSA) purchases and distributes about 70 percent of the power from INDE, especially in the populous states of Guatemala, Escuintla, and Sacatepequez. In 1987 the industrial sector accounted for 31 percent of total electricity consumption, residential 26 percent, commercial 20 percent, and government 3 percent. The installed capacity and available power generation profile for INDE is as follows:

<u>Hydro</u>	<u>Capacity</u>	<u>Available 1988</u>	<u>Fuel</u>
Chixoy (5x60)	300 MW	280 MW	
Aguacapa (3x30)	90 MW	60 MW	
Jurun Marinala (3x20)	60 MW	60 MW	
Esclavos (2x7)	13 MW	13 MW	
Menores	23 MW	14 MW	
<u>Thermal (steam)</u>			
Escuintla (1x30+1x42)	83 MW	0 MW	Bunker
Laguna (2x4+2x13)	33 MW	30 MW	
<u>Turbines &amp; Internal Combustion</u>			
Escuintla (2x13+2x25+1x42)	117 MW	82 MW	Diesel
Laguna (1x13+2x24)	60 MW	42 MW	Diesel

As a result of the completion of the 300 MW Chixoy hydropower plant, Guatemala has an overall power surplus in the short-term. However, electricity demand is projected to grow 7 percent annually in the period 1985-1993. As a result, INDE is now focusing on the rehabilitation of its thermal plants.

The 1988-2000 power investment program provides for expenditures of \$2.1 billion: \$1.8 billion for generation, \$242 million for transmission, \$56 million for distribution, and \$5.5 million for institutional programs. (1) INDE estimates that 372 MW of new generation capacity will be needed, including

252 MW hydro, 70 MW geothermal, and 50 MW thermal (steam turbine). In addition, INDE is very conscious of improving its institutional capabilities and is interested in training, management, and on-the-job counterpart training programs. But due to significant electricity tariff subsidies, the power sector has difficulty in recovering financial resources for future investments and payment of external debt.

The Ministerio de Energia y Minas (MEM) places a priority on thermal energy since it constitutes a significant portion of national energy consumption (especially fuelwood). MEM is also interested in rural electrification and small hydro projects, and supports purchasing surplus private power resulting from cogeneration (sugar mills and coffee plantations). The Ministry has expressed a willingness to work with the private sector to develop the framework for these purchases.

The Central American Technical and Industrial Research Institute (ICAITI) continues to conduct energy audits for large industries and commercial establishments on a full cost basis. Demand control savings are identified in most of the audits. EEGSA is running an advertising campaign offering operating- and energy-saving tips for appliances (eg. refrigerators) with the objectives of energy savings and improving its image.

**Current Efforts and Programs** The World Bank loan for the Power Distribution Project (\$81 million) is in the negotiation process. The project provides financing for additional EEGSA transmission lines, feasibility studies of geothermal fields and the Chulac and Xelala hydroelectric plants, provision of construction equipment, 45 MW gas turbines (2x20 and 2x10), thermal power plant rehabilitation, dispatch center, training of EEGSA personnel, communications, preinvestment studies, and a training program and technical assistance for INDE. Total project financing is \$132.2 million.

The Inter-American Development Bank is financing a power project (\$52.6 million) providing feasibility studies for 3 hydroelectric plants (Samala, Chixoy Medio, and Rio Grande de Zacapa), construction equipment for the Zunil geothermal plant (15 MW), prefeasibility and feasibility studies for the Zunil II and Amatitlan geothermal plants, rehabilitation of thermal plants, and technical assistance.

The Swiss government is providing \$50 million (35 percent grant and 65 percent commercial credit) for a national load dispatch center, the San Sebastian substation, and rehabilitation of 4 hydroelectric plants (two 60 MW, 2 MW, and 3 MW). Venezuela is financing (\$16 million) a loan for the construction of a 230 kV transmission line and design and construction of the 8 MW Rio Bobos hydroelectric plant. Italy will be supplying \$5 to \$10 million for the repair/rehabilitation of the two Escuintla thermal plants, repair of the "El Jute" drainage outlet at the Chixoy hydroelectric plant, technical assistance

for Chixoy operation, support to INDE for planning, and feasibility studies for 2 geothermal fields. The Japanese government is in the process of negotiating a project for a new steam plant (capacity and cost still undefined).

### Possible Program Components

- Power Plant Rehabilitation This is considered a priority, and is part of World Bank, IDB, Swiss and Italian loans and grants.
- Transmission and Distribution The Government of Guatemala has expressed interest in a loss reduction program.
- End-Use Efficiency Potential benefits are available in lighting, motors, and refrigerators -- air conditioning is not widespread. The energy costs for all consumers are the lowest in Central America, and need to be increased by 60 percent to meet expenses. However, a tariff increase is extremely sensitive politically and will require a major effort on the part of the government, risking possible confrontation with the private sector. There is also a need for standardized norms for electric appliances.
- Load Management Potential exists to reduce the daily peak at 7 PM. No tariff incentives currently exist aside from a demand charge for industrial and commercial users.

(1) Figures originally given in quetzales converted to dollars at a rate of 1 US \$ = 2.59 Quetzales, a 4th quarter 1987 period average tertiary exchange rate (a "banking rate" utilized for miscellaneous transactions including repatriation of profits, tourism and invisibles). Sources: International Financial Statistics, December 1988, International Monetary Fund, and Foreign Economic Trends and Their Implications for the United States, U.S. Department of Commerce, October 1987.

COUNTRY PROFILE: GUATEMALA

KEY SYSTEM CHARACTERISTICS /1

Total Installed Capacity (1987)			778 MW
Hydro			486 MW
Thermal			292 MW

HYDRO	CAPACITY (MW)	AVAILABLE 1988	FUEL
Chixoy	300	280	
Aguacapa	90	60	
Jurun Marinala	60	60	
Esclavos	13	13	
menores	23	14	
THERMAL (steam)			
Escuintla	83	0	Bunker
Laguna	33	30	
TURBINES & INTERNAL COMBUSTION			
Escuintla	117	82	Diesel
Laguna	60	42	Diesel

Peak Demand (1987)	375 MW
Heat Rate of Thermal Plants (1987)	9.61 kWh/gal.
Total T & D Losses (1987)	16%

Consumption Breakdown (1987)

Industry	31%
Residential	26%
Commercial	20%
Government	3%

CURRENT EFFORTS AND PROGRAMS

IBRD

The Power Distribution Project (\$81 million) is in the negotiation process. Project provides financing for additional EEGSA transmission lines, thermal plant rehabilitation, dispatch center, communications, preinvestment studies, and a training program and technical assistance for INDE. Total project financing is \$132.2 million. /2

IDB

The Inter-American Development Bank is financing a power project (\$52.6 million) providing feasibility studies for 3 hydroelectric plants (Samala, Chixoy Medio, and Rio Grande de Zacapa), construction equipment for the Zunil geothermal plant (15 MW), prefeasibility studies for the Zunil II and Amatitlan geothermal plants, rehabilitation of thermal plants, and technical assistance.

Other

The Swiss government is providing \$50 million (35 percent grant and 65 percent commercial credit) for a national load dispatch center, the San Sebastian substation, and rehabilitation of 4 hydroelectric plants (two 60 MW, 2 MW, and 3 MW).

Venezuela is financing (\$16 million) a loan for the construction of a 230 kV transmission line and design and construction of the 8 MW Rio Bobos hydroelectric plant.

Italy will be supplying \$5 to \$10 million for the repair/rehabilitation of the Escuintla thermal plant, repair of the the "El Jute" drainage outlet at Chixoy, technical assistance for the Chixoy operation, support to INDE for planning, and feasibility studies for 2 geothermal fields.

The Japanese government is in the process of negotiating a project for a new steam plant (capacity and cost still undefined).

EEGSA is running an advertising campaign offering operating- and energy-saving tips for appliances (eg. refrigerators) with the objectives of saving energy and improving its image.

**POSSIBLE PROGRAM COMPONENTS**

**Rehabilitation**

This is considered a priority, and is part of World Bank, IDB, Swiss and Italian loans and grants

**Transmission & Distribution**

The Government of Guatemala has expressed interest in a loss reduction program.

**End-use Efficiency**

Potential benefits are available in lighting, motors, and refrigerators -- air conditioning is not widespread. The energy costs for all consumers are the lowest in Central America, and need to be increased by 60 percent to meet expenses. However, a tariff increase is extremely sensitive politically and will require a major effort on the part of the government, risking possible confrontation with the private sector. There is also a need for standardized norms for electric appliances.

**Load Management**

Potential exists to reduce the daily peaks at 7 PM. No tariff incentives currently exist aside from a demand charge for industrial and commercial users.

**APPROXIMATE PROGRAM COSTS (US \$ million) /5**

	Needed	World Bank	IDB	Other	Balance
Power Plant Rehabilitation	25-50	20-30 (3)	-	-	5-30
T & D Losses	5-10	1-45 (4)	-	-	4-6
End-Use Efficiency	15-30	-	-	-	15-30
Load Management	5-10	-	-	-	5-10
<b>TOTAL</b>	<b>50-100</b>	<b>21-34</b>	<b>-</b>	<b>-</b>	<b>29-76</b>

/1 Source: CEPAL, febrero 1988.

/2 Source: Status of IBRD/IDA Projects in Execution (as of March 31, 1988). Released April 29, 1988. Also, Monthly Operational Summary of Bank and IDA Proposed Projects (as of November 30, 1987). Released December 24, 1987.

/3 IBRD Power Distribution, \$81 million. Not yet signed.

/4 IBRD Power VI Project. Proposed.

/5 These program costs incorporate the associated technical assistance, including prefeasibility studies, institutional strengthening, and operation and maintenance requirements.

## HONDURAS COUNTRY PROFILE

**Power System Overview** Total installed generating capacity as of February 1988 was 562 MW, of which 427 MW (76 percent) was hydro and 135 MW (24 percent) thermal. Most of the thermal plants are diesel-fired. Peak demand in 1987 was 266 MW and transmission and distribution losses were 15 percent in 1984. The installed capacity and available power generation profile for Honduras is as follows:

<u>Hydro</u>	<u>Capacity</u>	<u>Available 1988</u>	<u>Fuel</u>
Cajon (4x75)	300 MW		
Canaveral 2x14)	29 MW		
Rio Lindo (4x20)	80 MW		
Nispero (1x22)	22 MW		
<u>Thermal</u>			
Ceiba (4x5)	20 MW		
Alsthom (4x8)	30 MW		
Sulzer (4x8)	30 MW		
Santa Fe (2x3)	5 MW		
<u>Gas</u>			
La puerta (1x15)	15 MW		
Miraflores (1x14)	14 MW		

In 1987 all of the electricity in Honduras was generated from hydro sources. Since El Cajon came on-line in 1985, Honduras has lessened its dependence on energy imports and now has surplus power, which is expected to last until 1992. Honduras exports some of its surplus to Nicaragua and Costa Rica through the Central American interconnection line. However, the conflict in Nicaragua has constrained these exports.

The Empresa Nacional de Energia Electrica (ENEE), which is responsible for all generation, transmission, and distribution, provides electricity to 260,000 customers. In 1986 the electricity consumption breakdown was 34 percent in the industrial sector, 28 percent residential, 16 percent commercial, and 7 percent government.

ENEE projects demand to increase 7 percent per year in the period 1986-1995, necessitating the use of thermal capacity currently out of service for use in the 1990s. In addition, there is a need to expand the transmission and distribution system to accommodate the increase in demand and the additional generating capacity, as well as to service rural areas where only 14.5 percent of the population has access to electricity. Even though relatively high tariffs (US \$.09/kWh) have allowed ENEE to earn a reasonable financial return (7.6 percent in 1985), small market size, large debts, and public sector arrears on

electricity bills have placed ENEE in a critical financial situation, unable to secure the investments required to meet these needs.

**Current Efforts and Programs** The Inter-American Development Bank (IDB) is currently financing a \$35 million loan to ENEE for support to the electricity sector. The project calls for a program of expansion and improvement of the transmission and distribution system of energy generated by the El Cajon hydroelectric plant. The loan is in its early stages, awaiting final documentation and project component definition.

The World Bank is in the early stages of negotiating a loan for the restructuring of ENEE. The Energy Sector Management Assistance Program (ESMAP) identified the need for a power systems operations project (\$105,000), which will most likely be incorporated under the IDB loan. The objective of this activity is to analyze the factors influencing system stability, recommend steps to avoid associated problems, and to assist ENEE develop rational guidelines for load dispatch.

#### **Possible Program Components**

- Power Plant Rehabilitation Given the expected increase in dependence on diesel power generation to satisfy rising electricity demand, ENEE has expressed interest in technical assistance for power plant rehabilitation.
- Transmission and Distribution Improvement in the transmission and distribution system is included under the IDB loan.
- End-Use Efficiency ENEE has not expressed interest in end-use efficiency methods. The energy sector priority is instead to increase electricity use in the next 4 years.
- Load Management ENEE also expressed interest in load management at the Central American and Caribbean Power Workshop.

COUNTRY PROFILE: HONDURAS

KEY SYSTEM CHARACTERISTICS /1

Total Installed Capacity (1988)	562 MW
Hydro	427 MW
Thermal	135 MW

HYDRO /2	CAPACITY (MW)	AVAILABLE 1988	FUEL
Cajon	300		
Canaveral	29		
Rio Lindo	80		
Nispero	22		

THERMAL	
Ceiba	20
Alsthom	30
Sulzer	30
Santa Fe	5

GAS	
La Puerta	15
Miraflores	14

Peak Demand (1987) /2	266 MW
Heat Rate of Thermal Plants	
Total T & D Losses (1984) /3	15%

Consumption Breakdown (1986) /4	
Industry	34%
Residential	28%
Commercial	16%
Government	7%

CURRENT EFFORTS AND PROGRAMS

IDB  
Support to Electricity Sector (\$35 million). Project calls for a program of expansion and improvement of the transmission and distribution system of energy generated by the El Cajon hydroelectric plant. Status of procurement/consulting services: pending definition. Stage of overall processing: awaiting documentation. /5

IBRD  
ENEE restructuring: in negotiation process.

The Energy Sector Management Assistance Program (ESMAP) has identified a Power Systems Operations project (\$105,000), which will most likely be incorporated under an IDB loan. Objective of this activity is to analyze the factors influencing system stability, recommend steps to avoid associated problems and to assist the utility develop rational guidelines for load dispatch. /6

POSSIBLE PROGRAM COMPONENTS

Rehabilitation  
In the 1990s, Honduras will have to rely more on diesel power generation to satisfy increasing electricity demand. ENEE has expressed interest in obtaining technical assistance in this area.

Transmission & Distribution  
Component of improvement of the transmission and distribution system included under IDB loan.

End-use Efficiency  
ENEE has not expressed interest in this area. Energy sector priority is instead to increase electricity use in the next four years.

Load management  
ENEE expressed interest in this area at the Central American and Caribbean Workshop.

APPROXIMATE PROGRAM COSTS (US \$ million) /8

	Needed	World Bank	IDB	Other	Balance
Power Plant Rehabilitation	5-10	-	-	-	5-10
T & D Losses	20-30 (7)	-	20-30 (7)	-	0
End-Use Efficiency	5-10	-	-	-	5-10
Load Management	5-10	-	20-30	-	15-30
<b>TOTAL</b>	<b>35-60</b>	<b>-</b>	<b>20-30</b>	<b>-</b>	<b>15-30</b>

/1 Source: ENEE, agosto 1988.

/2 Source: (for capacity of all units) Comision Economica para America Latina (CEPAL), febrero 1988.

/3 Source: Honduras: Issues and Options in the Energy Sector, IBRD/UNDP, August 1987.

/4 Source: "El Sector Electrico de Honduras," ENEE, octubre 1987.

/5 Source: Inter-American Development Bank monthly report on status of loan applications and technical cooperation requirements and status of procurement. Released October 24, 1988.

/6 Source: ESMAP Information and Status Report. April 1988.

/7 IDB support to ENEE. Expansion of systems, \$35 million. In early stages.

/8 These program costs incorporate the associated technical assistance, including prefeasibility studies, institutional strengthening, and operation and maintenance requirements.

## NICARAGUA COUNTRY PROFILE

**Power Sector Overview (1)** Total installed capacity in 1987 was 325 MW, of which 190 MW was thermal, 100 MW hydro, and 35 MW geothermal. All of the installed capacity is operated by the government-owned utility Instituto Nicaraguense de Energia (INE). Peak demand was 234 MW, and in 1985 transmission and distribution losses were 15.7 percent. As of 1985, the residential and commercial sectors accounted for 35 percent of total electricity consumption, and industry and agriculture 44 percent. The installed capacity and available power generation profile for INE is as follows:

<u>Hydro</u>	<u>Capacity</u>	<u>Available 1988</u>	<u>Fuel</u>
Centroamericana (2x25)	50 MW		
Carlos Fonseca (2x25)	50 MW		
<u>Thermal</u>			
Nicaragua (2x50)	100 MW		Bunker
Managua (2x15+1x45)	75 MW		Bunker
German Pomares (1x15)	15 MW		Diesel
<u>Geothermal</u>			
Patricio Arguello (1x35)	35 MW		

According to the 1988 edition of the International Directory of Electric Utilities (2), INE's expansion plans for the next decade center on its Asturias-Larreynaga hydro project. This includes a pumping station at Asturias and a 50 MW powerplant at Larreynaga. In addition, 3 small run-of-river plants (totaling 31 MW) will be built downstream of the Larreynaga station. Construction of the first stage of the 656 MW Copalar hydro station may begin in 1988. This 164 MW stage should be completed in 5 years. Three geothermal stations (35 MW each) also will be built, one on Momotombo and 2 in the El Hoyo field.

### Current Efforts and Programs

#### Possible Program Components

- Power Plant Rehabilitation
- Transmission and Distribution

- End-Use Efficiency
- Load Management

(1) All data in this section from CEPAL.

(2) International Directory of Electric Utilities, Lee Catalano, editor.  
(McGraw-Hill, New York 1988).

COUNTRY PROFILE: NICARAGUA

KEY SYSTEM CHARACTERISTICS /1

Total Installed Capacity (1987)	325 MW
Hydro	100 MW
Thermal	190 MW
Geothermal	35 MW

HYDRO	CAPACITY (MW)	AVAILABLE 1988	FUEL
Centroamericana	50		
Carlos Fonseca	50		

THERMAL	
Nicaragua	100
Managua	75
German Pomares	15

GEO THERMAL	
Patricio Arguello	35

Peak Demand (1987)	234 MW
Heat Rate of Thermal Plants	
Total T & D Losses (1985)	15.7%

Consumption Breakdown (1985)	
Industry/Agriculture	44%
Residential/Commercial	35%

CURRENT EFFORTS AND PROGRAMS

POSSIBLE PROGRAM COMPONENTS

APPROXIMATE PROGRAM COSTS (US \$ million) /3

	Needed	World Bank	IDB	Other	Balance
Power Rehabilitation					
T & D Losses					
Load Management					
End-use Efficiency					
TOTAL					

/1 Source: Comision Economica para America Latina (CEPAL), febrero 1988.

/2 Source: 1982 Power Data Sheets for 104 Developing Countries. IBRD, July 1985.

/3 These program costs incorporate the associated technical assistance, including prefeasibility studies, institutional strengthening, and operation and maintenance requirements.

## PANAMA COUNTRY PROFILE

**Power Sector Overview** Total installed capacity in 1987 was 848 MW, of which 551 MW was hydro and 297 MW was thermal. Peak demand was 475 MW and transmission and distribution losses amounted to 13 percent. The heat rate of thermal plants was 11.2 kwh/gallon. The installed capacity and available power generation profile for the Instituto de Recursos Hidraulicos y Electrificacion (IRHE) is as follows:

<u>Hydro</u>	<u>Capacity</u>	<u>Available 1988</u>	<u>Fuel</u>
Fortuna (3x100)	300 MW	300 MW	
Bayano (2x75)	150 MW	150 MW	
Estrella (2x21)	42 MW	42 MW	
Los Valles (2x24)	48 MW	48 MW	
Menores	11 MW	11 MW	
<u>Thermal (steam)</u>			
Bahia las Minas (1x24+3x40)	144 MW	105 MW	
San Fransisco U3 (1x11)	11 MW	11 MW	
<u>Thermal (gas)</u>			
Panama (2x21)	43 MW	36 MW	
Pielstick (4x7)	28 MW	21 MW	
San Fransisco (1x12)	12 MW	11 MW	
Bahia Las Minas U5	5 MW	5 MW	
Menores Diesel	43 MW	30 MW	

Because of insufficient rainfall, only 30 percent of annual hydroelectric production is available during the summer. This situation is aggravated by high temperatures that increase the demand for air conditioning. The only hydro plant that has water storage capacity for use in the dry season is Bayano.

Thermal electricity supply is also inadequate and unreliable due to scheduled and unscheduled plant shutdowns for maintenance. IRHE's lack of funds has made the purchase of equipment and spare parts for planned maintenance programs impossible. In addition, an inefficient and obsolete fiscal management system has generated inadequate procurement procedures. Finally, sabotage of the Central American interconnection system has caused interruptions in the transmission of electricity to the Panamanian network.

The result of the situation described above is that there is clearly an insufficient supply of electricity to meet demand.

**Current Effort and Programs** (1) The World Bank is financing the Sixth Power Project (\$32.1 million), of which \$13.4 million has been disbursed, and the Seventh Power Project (\$51 million), of which \$0.8 million has been disbursed. The Inter-American Development Bank (IDB) is financing a project (\$22 million) to rehabilitate the Bahia las Minas thermal plant, conduct a preventive maintenance study, and implement measures to reduce transmission and distribution losses. Local counterpart contributions to the above programs amount to approximately \$10 million, and supplier credits (for diesel and gas turbines) account for \$10-20 million.

### **Possible Program Components**

- Power Plant Rehabilitation This is included under World Bank and IDB projects.
- Transmission and Distribution This is included under World Bank and IDB projects.
- End-Use Efficiency Very Large benefits are expected from a program aimed at improving the end-use efficiency of air-conditioning, refrigeration, electric motors, and water heaters.
- Load Management There is little short-term potential, unlike Costa Rica. The load curve does not exhibit sharp peaks and it is unlikely that adequate tariffs would be implemented in the short-term.

(1) These programs are now on hold due to the political crisis in Panama.

COUNTRY PROFILE: PANAMA

KEY SYSTEM CHARACTERISTICS /1

Total Installed Capacity (1987)	848 MW
Hydro	551 MW
Thermal	297 MW

HYDRO /2	CAPACITY (MW)	AVAILABLE 1988	FUEL
Fortuna	300	300	
Bayano	150	150	
Estrella	42	42	
Los Valles	48	48	
menores	11	11	
THERMAL (steam)			
Bahia las Minas	144	105	
San Fransisco	11	11	
THERMAL (gas)			
Panama	43	36	
Pielstick	28	21	
San Fransisco	12	11	
Bahia las Minas	5	5	
menores diesel	43	30	

Peak Demand (1987)	475 MW
Heat Rate of Thermal Plants (1987)	11.2 (kWh/Gallon)
Total T & D Losses (1987)	13%

Consumption Breakdown (1987)	
Industry	18%
Residential	30%
Commercial	32%
Government	20%

CURRENT EFFORTS AND PROGRAMS /3

World Bank /4

Sixth Power Project (\$32.1 million). Execution of this project has been delayed 18 months due mainly to problems in the approval of the power company's procurement documents by the government. Efforts are being made to improve the situation and a request for extension of the closing date by 1 year is under consideration pending agreement with the government on a program to improve IHRE's finances. About \$13.4 million has been disbursed. Closing date is 12/31/88.

Seventh Power Project (\$51 million). Raising the Fortuna Dam has been started and the study of medium-size hydroelectric projects is advancing well. It is expected that loan savings arising from estimated reductions in civil works costs could be utilized to finance transmission lines to connect the power station to Panama City, which would assist in system loss reduction. The Loan Agreement will be amended when the government and IHRE have taken actions to: improve IHRE's liquidity position by reducing receivables, meet the covenanted rates of return, and meet the covenanted performance levels for electricity losses. Disbursement total is \$0.8 million.

IDB /1

Total project cost is \$22 million. Activities include the rehabilitation of the Bahia las Minas thermal plant, a preventive maintenance study, and measures to reduce transmission and distribution losses.

Other

Local counterpart contribution to the above programs for approximately \$10 million and supplier credits (diesel and gas turbine) for \$10-20 million.

**POSSIBLE PROGRAM COMPONENTS****Rehabilitation**

Included under World Bank and IDB projects

**Transmission & Distribution**

Included under World Bank and IDB projects.

**End-use Efficiency**

Very large benefits are expected from a program aimed at improving the end-use efficiency of air-conditioning, refrigeration, electric motors and water heaters.

**Load management**

There is little short-term potential unlike Costa Rica. The load curve does not exhibit sharp peaks and it is unlikely that adequate tariffs would be implemented in the short-term.

**APPROXIMATE PROGRAM COSTS (US \$ million) /5**

	Needed	World Bank	IDB	Other	Balance
Power Plant Rehabilitation	30-50	32	19	5	5-10
T & D Losses	25-35	20	3	5	0-10
End-Use Efficiency	25-35	-	-	-	25-35
Load Management	n/a	n/a	n/a	n/a	n/a
<b>TOTAL</b>	<b>80-120</b>	<b>52</b>	<b>22</b>	<b>10</b>	<b>30-55</b>

/1 Source: IHRE Estudio de Perdidas: Informe Ejecutivo. Enero 1988.

/2 Source: CEPAL, febrero 1988.

/3 These programs are on hold due to the political crisis in Panama.

/4 Source: Status of IBRD/IDA Projects in Execution (as of 3/31/88).

Also, Statement of Loans 9/30/88: Vol. II EMENA and LAC Regions. IBRD.

/5 These program costs incorporate the associated technical assistance, including prefeasibility studies, institutional strengthening, and operation and maintenance requirements.

**CENTRAL AMERICA POWER SECTOR EFFICIENCY INITIATIVE**

**RANKING OF PRIORITY AREAS AND APPROXIMATE PROGRAM COSTS**

**JANUARY 23, 1989**

PRIORITY AREAS

TYPE OF ACTION	BELIZE	COSTA RICA	EL SALVADOR	GUATEMALA
Power Plant Rehabilitation	(-) The Belize Electricity Board (BEB) has reported that the plants have negligible disparities in efficiencies.	(+) This is a priority area since at the CACW representatives from the rural electrification cooperatives emphasized their concern in the alarming deterioration of the thermal power plants.	(+) This is a priority area since much of the hydro-power supply is interrupted by the civil disturbance. Some preliminary discussions have taken place with IBRD & IDB. Their involvement is limited, however, due to the civil conflict.	(+) This is considered a priority and is part of IBRD, IDB, Swiss and Italian loans and grants.
Transmission & Distribution	(-) The BEB has been successful in reducing T & D losses and is no longer considered a priority.	(-) This is not a priority area since Costa Rica has been effective in reducing all transmission & distribution losses to 11 percent.	(-) The problem is more that the lines are being blown-up.	(+) The Government of Guatemala has expressed interest in a loss reduction program.
End-Use Efficiency	(-) For the near future, it is not a priority since the focus is more to increase consumer demand.	(+) A significant energy savings potential exists and the Insituto Costarricense de Electricidad (ICE) is actively involved in a promotion campaign.	(+) Incentives for end-use efficiency are limited due to low tariffs. However, it can be considered a priority area because of high electricity demand growth rates.	(+) Potential benefits are available in lighting, motors, and refrigerators -- AC is not widespread. The energy costs for all consumers are the lowest in Central America, and need to be increased by 60 percent to meet expenses. However, a tariff increase is extremely sensitive politically and will require a major effort on the part of the government, risking possible confrontation with the private sector. There is also a need for standardized norms for electric appliances.
Load Management	(0) At the Central American and Caribbean Workshop (CACW) BEB expressed that peak reduction is the only area in power efficiency which could be considered in Belize	(+) This is a priority area which has been initiated with a successful pilot project and now needs to be expanded.	(+) At the CACW, the Comision Ejecutiva del Rio Lempa (CEL) expressed interest in reducing peak demand through load management techniques.	(+) Potential exists to reduce the daily peak at 7 PM. No tariff incentives currently exist aside from a demand charge for industrial and commercial users.

+ = high priority  
 0 = medium priority  
 - = low priority

**PRIORITY AREAS**

TYPE OF ACTION	HONDURAS	NICARAGUA	PANAMA
Power Plant Rehabilitation	(+) Given the expected increase in dependence on diesel power generation to satisfy rising electricity demand, the Empresa Nacional de Energia Elctrica (ENEE) has expressed interest in technical assistance for power plant rehabilitation.		(+) Rehabilitation components are included under World Bank and IDB projects.
Transmission & Distribution	(-) Improvement in the T & D system is included under an IDB loan.		(+) Transmission and distribution components are included under World Bank and IDB projects.
End-Use Efficiency	(-) ENEE has not expressed interest in end-use efficiency methods. The energy sector priority is instead to increase electricity use in the next 4 years.		(+) Very large benefits are expected from a program aimed at improving the end-use efficiency of air-conditioning, refrigeration, electric motors and water heaters.
Load Management	(0) ENEE also expressed interest in load management at the Workshop.		(-) There is little short-term potential unlike Costa Rica. The load curve does not exhibit sharp peaks and it is unlikely that adequate tariffs would be implemented in the short-term.

+ = high priority  
 0 = medium priority  
 - = low priority

APPROXIMATE PROGRAM COSTS (1)  
(US\$ millions)

	Needed	World Bank	IDB	Other	Balance
=====					
<b>BELIZE</b>					
Power Plant Rehabilitation	-	-	-	-	-
Transmission & Distribution	-	4 (2)	-	-	0
End-Use Efficiency	-	-	-	-	-
Load Management	1-2	-	-	-	1-2
<b>TOTAL</b>	<b>1-2</b>	<b>4</b>	<b>-</b>	<b>-</b>	<b>1-2</b>
-----					
<b>COSTA RICA</b>					
Power Plant Rehabilitation	20-30 (3)	-	10-20	-	0-20
Transmission & Distribution	-	-	-	-	-
End-Use Efficiency	15-30	-	-	-	15-30
Load Management	5-10	-	-	-	5-10
<b>TOTAL</b>	<b>40-70</b>	<b>-</b>	<b>10-20</b>	<b>-</b>	<b>30-50</b>
-----					
<b>EL SALVADOR</b>					
Power Plant Rehabilitation	10-20	-	2-3 (4)	-	7-18
Transmission & Distribution	-	-	-	-	-
End-Use Efficiency	10-15	-	-	-	10-15
Load Management	5-10	-	-	-	5-10
<b>TOTAL</b>	<b>25-45</b>	<b>-</b>	<b>2-3</b>	<b>-</b>	<b>22-43</b>
-----					
<b>GUATEMALA</b>					
Power Plant Rehabilitation	25-50	20-30 (5)	-	-	5-30
Transmission & Distribution	5-10	1-45 (6)	-	-	4-6
End-Use Efficiency	15-30	-	-	-	15-30
Load Management	5-10	-	-	-	5-10
<b>TOTAL</b>	<b>50-100</b>	<b>21-34</b>	<b>-</b>	<b>-</b>	<b>29-76</b>
-----					
<b>HONDURAS</b>					
Power Plant Rehabilitation	5-10	-	-	-	5-10
Transmission & Distribution	20-30 (7)	-	20-30 (7)	-	0
End-Use Efficiency	5-10	-	-	-	5-10
Load Management	5-10	-	20-30	-	15-30
<b>TOTAL</b>	<b>35-60</b>	<b>-</b>	<b>20-30</b>	<b>-</b>	<b>15-30</b>
-----					

-----  
**NICARAGUA**  
**Power Plant**  
**Rehabilitation**

**Transmission &**  
**Distribution**

**End-Use**  
**Efficiency**

**Load Management**

**TOTAL**

-----					
<b>PANAMA</b>					
<b>Power Plant</b>	<b>30-50</b>	<b>32</b>	<b>19</b>	<b>5</b>	<b>5-10</b>
<b>Rehabilitation</b>					
<b>Transmission &amp;</b>	<b>25-35</b>	<b>20</b>	<b>3</b>	<b>5</b>	<b>0-10</b>
<b>Distribution</b>					
<b>End-Use</b>	<b>25-35</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>25-35</b>
<b>Efficiency</b>					
<b>Load Management</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>	<b>n/a</b>
<b>TOTAL</b>	<b>80-120</b>	<b>52</b>	<b>22</b>	<b>10</b>	<b>30-55</b>
-----					

- (1) These program costs incorporate the associated technical assistance, including prefeasibility studies, institutional strengthening, and operation and maintenance requirements.
- (2) IBRD Power Project, Loan # 2479, \$7.5 million.
- (3) IDB Electricity Development II, Loan # CR0029, \$188 million.
- (4) IDB Loan in negotiation process. Total value undetermined.
- (5) IBRD Power Distribution, \$81 million. Not yet signed.
- (6) IBRD Power VI Project. Proposed.
- (7) IDB support to ENEE. Expansion of system, \$35 million. In early stages.

**CENTRAL AMERICA POWER SECTOR EFFICIENCY INITIATIVE**

**DONOR ORGANIZATION POWER PROJECTS**

**JANUARY 23, 1989**

**DONOR ORGANIZATION POWER PROJECTS  
IN CENTRAL AMERICAN COUNTRIES**

**Belize**

IBRD Power Project. Loan # 2749-0-BEL - Ongoing. (1)

Approval Date: 8/5/86  
Agreement Date: 8/22/86  
Effective Date: 6/4/87  
Closing Date: 12/31/93

Amount: \$7.5 million.

This project covers expansion of generation facilities, improvement and expansion of distribution facilities as well as technical assistance. Project implementation is progressing satisfactorily. The procurement process for the generation, transmission and distribution components is underway and contracts are expected to be awarded by June 1988. Completion of the transmission and distribution works is expected to be completed by the end of 1990 as forecasted during the appraisal.

**Costa Rica**

IDB Electricity Development II. Loan # CR0029 - In early stages. (2)

Application: 5/8/88/  
Project Com.: 9/8/88

Amount: \$188 million

Project includes hydroelectric, geothermal distribution, transmission and rehabilitation of thermoelectric units.

Total Cost: \$275.4 million.

Status of procurement/consulting services:  
Pending Definition

Stage of processing: progress report in preparation.

ESMAP Optimization of Power Investments. - Original Proposal on hold pending IDB involvement and prioritization of all activities. (6)

The current schedule for implementing power sector investments in Costa Rica may have to be adjusted to reflect the financial constraints of the country and ICE. Because the power investment program is large and has a great impact on the total public investment program, steps must be taken to optimize the composition and phasing of investments in the sector. The purpose of this ESMAP study is to assist ICE in developing a comprehensive model or models to integrate the development of electric power system and to train ICE's personnel to use them. The study will complement a related effort to design and implement a more sophisticated demand forecasting system for the electric power sector. Consultants will be contracted to provide technical direction and training for the study, which will cost about \$100,000. (Italy is the full sponsor).

ESMAP Technical Assistance in ICE's System Operation - Will most likely be incorporated under an IDB loan. (6)

ICE has reported problems in load dispatch management and oscillations in frequency which may adversely affect its system and the recent interconnection with Nicaraguan and Honduran systems. The objective of this activity would be to provide technical assistance to ICE in resolving problems with managing its system operations. The activity will require the assistance of a system planning engineer and an operation control engineer for about three man-months to focus on (a) load balancing and dispatch and (b) frequency oscillations and control. The activity is expected to cost about \$50,000.

**El Salvador**

IDB Loan

Amount: The cost has not yet been defined

The IDB is currently negotiating with CEL for a loan rehabilitating the 5th of November hydroelectric plant (82 MW installed). A prefeasibility study is being carried out to determine the condition of the plant and make recommendations.

### IDB Loan

Amount: \$74.5 million

The IDB is also currently negotiating a separate project on expanding the same plant, involving an increase in installed capacity by providing a new enginehouse and two 60 MW Francis turbines.

### CABEI Electrical Interconnection Feasibility Study

Amount: \$550,000

This project includes estimates of electricity demand and updating generation expansion plans. Studies in El Salvador have started with local funds and additional resources are being requested from CABEI.

### CABEI Loan Honduras-El Salvador Interconnection Project (in early stages)

Amount: \$25.2 million

The Kreditanstalt fur Wiederaufbau in West Germany is also financing this project, which will modify the September 15th hydroelectric substation (157 MW installed) and install transmission lines.

### Guatemala

#### IBRD Chixoy Power. Loan # 1605-1-GUA - Final Stages. (1)

Approval Date: 3/19/85

Agreement Date: 3/22/85

Effective Date: 6/20/85

Closing Date: 12/31/88

Amount: \$44.6 million.

This supplemental loan helped complete the foreign exchange financing of the project. The first generating unit started operation in December 1985. The remaining generating units were subsequently commissioned by February 1986, which permitted Guatemala to meet nearly all of its electric power generation requirements through hydropower. Construction of a 69 kV subtransmission component is scheduled for completion in the last quarter of the year. US

\$3.6 million remains undisbursed by February 29, 1988. Expected distribution to be completed June 30, 1988.

IBRD Power Distribution. Loan # 2724-GUA - As of 5/31/88 this project was not yet signed. (1,3)

Approval Date: 6/23/86

Agreement Date: 6/7/88

Closing Date: 6/30/96

Amount: \$81 million.

Project calls for the expansion and training of EEGSA, thermal plant rehabilitation, dispatch center, communications, preinvestment studies, training program and technical assistance for INDE. Total project financing requirements estimated at \$133.2 million of which \$100 million is in foreign exchange.

IBRD Power VI Project. - Proposed project. (3)

Amount: \$40 million.

Technical assistance for power sector organization, including definition of distribution and rural electrification. General facilities to support changes are also provided. The project also calls for transmission, distribution and rural electrification expansion.

UNDP Energy Planning Project. Loan # GUA-81-002 (5)

Approval Date: 3/81

Est. Completion Date: 12/87

Amount: From UNDP: \$276,940

Third Party Contribution: \$91,229

Govt. Contribution: \$44,540

USAID Rural Electrification Project No. 520-0248 (7)

FY of initial oblig.: 1979  
FY of final oblig.: 1983

Amount: \$10.6 million

Expenditures through 1986: \$7 million  
Actual Expend. FY 1987: \$1.1 million  
Estim. Expend. FY 1988: \$2.2 million  
Proposed Expend. FY 1989: \$74,000

USAID Electrical Power Reserve Project No. 520-0344 (7)

FY of initial oblig.: 1985  
FY of final oblig.: 1985

Amount: \$7 million

Expenditures through 1986: \$6.4 million  
Actual Expend. FY 1987: \$136,000  
Estim. Expend. FY 1988: \$120,000  
Proposed Expend. FY 1989: \$343,000

USAID Rural Electrification III Project No. 520-0353 (7)

FY of initial oblig.: 1988  
FY of final oblig.: 1990

Amount: \$10 million

Estimated expendit. FY 1988: \$300,000  
Proposed expend. FY 1989: \$3,450,000

USAID Electrical Sector Improvement Project 520-0378 (7)

FY of initial oblig.: 1987  
FY of final oblig.: 1987

Amount: \$600,000

Expend. FY 1987: \$0.00  
Estimated expend. FY 1988: \$500,000  
Proposed expend. FY 1989: \$100,000

### IDB Loan

Amount: \$52.6 million

The IDB is financing a power project which provides feasibility studies for 3 hydroelectric plants (Samala, Chixoy Medio, and Rio Grande Zacapa), construction equipment for the Zunil geothermal plant (15 MW), prefeasibility and feasibility studies for the Zunil II and Amatitlan geothermal plants, rehabilitation of thermal plants, and technical assistance.

### Swiss Loan/Grant

Amount: \$50 million (35% grant and 65% commercial credit)

This Swiss-financed project provides for a national load dispatch center, the San Sebastian substation, and rehabilitation of 4 hydroelectric plants (two 60 MW, 2 MW, and 3 MW).

### Venezuela Loan/Grant

Amount: \$16 million

Venezuela is financing a a loan for the construction of a 230 kV transmission line and design and construction of the 8 MW Rio Bobos hydroelectric plant.

### Italian Loan/Grant

Amount: \$5 to \$10 million

Italy will be supplying this loan for the repair/rehabilitation of the two Escuintla thermal plants, repair of the "El Jute" drainage outlet at the Chixoy hydroelectric plant, technical assistance for the Chixoy operation, support to INDE for planning, and feasibility studies for 2 geothermal fields.

Japanese Loan/Grant

Amount: (cost still undefined)

This project is still being negotiated for a new steam plant (capacity to be determined).

**Honduras**

IDB Support to Electricity Sector (ENEE). Loan # H00044 - Ongoing. (2)

Amount: \$35 million.

This project calls for a program of expansion and improvement of the transmission and distribution of energy generated by the El Cajon Hydroelectric plant.

Status of procurement/consulting services:  
Pending Definition

Stage of processing: awaiting documentation and/or INF

UNDP Geothermal Prefeasibility Study in the Central Region Loan # HON-

85-001 - Final stages. (5)

Approval Date: 1/85  
Est. Date of Completion: 12/88

Amount from UNDP: \$589,549  
Third Party (Italy): \$1,700,450  
Govt. Contribution: \$670,000

IBRD ENEE Restructuring - In negotiating process.

IBRD El Cajon Power Project La # 1805-0 - Completed (4)

Borrower: ENEE

Approval Date: 3/11/80  
Agreement Date: 3/27/80  
Effective Date: 9/25/89  
Closing Date: 2/28/87

Amount: \$105 million

ESMAP Power System Operations - Will most likely be incorporated under an IDB loan. (6)

The national power company has reported problems in load dispatch management and with the stability of system frequency. The objective of this activity is to analyze the factors influencing system stability, recommend steps to avoid associated problems and to assist the utility to develop rational guidelines for load dispatch. The activity would be executed by a two-man team and is estimated to cost \$105,000. Italy is the sole sponsor

#### **Panama**

**IBRD Sixth Power Project Ln 2313-PAN (1,4)**

**Borrower: Inst. Recursos Hidr. y Elec.**

Approval Date: 6/19/83  
Agreement Date: 9/20/83  
Effective Date: 3/12/84  
Closing Date: 12/31/88

Amount: \$32.1 million

Execution of this project has been delayed by about 18 months due mainly to delays in the approval of the Power company's procurement documents by the Government. Efforts are being made to improve the situation and a request for extension of the closing date by 1 year is under consideration, pending agreement with the government on a program to improve IRHE's finances. About \$13.4 million has been disbursed.

IBRD Seventh Power Project Ln 2506-PAN (1,4)

**Borrower: Inst. Recursos Hidr. y Elec.**

Approval Date: 3/19/85  
Agreement Date: 9/23/85  
Effective Date: 1/3/86  
Closing Date: 12/31/90

Amount: \$51 million

Raising the Fortuna Dam has been started, and the study of medium-size hydroelectric projects is advancing well. It is expected that loan savings arising from estimated reductions in civil works costs could be utilized to finance transmission lines to connect the power station to Panama City, which would assist in system loss reduction. The Loan Agreement will be amended when the Government and IHRE have taken actions to: a. improve IRHE's liquidity position by reducing receivables; b. meet the covenanted rates of return and c. meet the covenanted performance levels for electricity losses. Disbursement total is \$0.8 million.

#### IBRD Fourth Power Project. (4)

Borrower: Inst. recursos Hidr. y Elec.

Approval Date: 3/29/83  
Agreement Date: 5/3/83  
Effective Date: 6/29/83  
Closing Date: 4/30/86

Amount: \$31.3 million

#### IDB Loan

Amount: \$22 million

The IDB is financing this project to rehabilitate the Bahia las Minas thermal plant, conduct a preventive maintenance study, and implement measures to reduce transmission and distribution losses.

#### ESMAP Power System Efficiency Study 004/83 (6)

Published: 6/83

This study identified measures to reduce power distribution losses, some of which were incorporated in the World Bank's second power distribution loan.

## **Regional**

### **ESMAP Central America Power Efficiency Seminar (6)**

The proposed seminar would aim to sensitize utility managers to the economic costs of losses, provide training in loss reduction, provide an opportunity for utilities to share experiences and ideas, and to encourage innovative solutions to efficiency problems. It is proposed for sometime in 1989 and is tentatively estimated to cost \$220,000, including participant travel, subsistence and facilities.

### **ESMAP Rehabilitation and Maintenance of Power Plants in Central America. - Proposal**

Expected Start Date: July 1989

Amount: \$858,000

The objective of this activity is to assist the power utilities in Central American countries in pre-investment activities on a generation, rehabilitation and operations assistance project that would rehabilitate or modify plants as necessary to recover capacity and extend their lives, improve the operation and maintenance of all generating units, establish a coordinated maintenance and rehabilitation program on a regional basis that would ensure a high level of system security and lower costs of generation than if carried out independently, and prepare a training component for the power utilities staff to institutionalize the maintenance and rehabilitation program. Total cost is \$858,000, of which \$600,000 would be provided under a Japanese grant.

The following projects are under the auspices of the USAID Regional Office for Central America (ROCAP) (7)

### **Regional Industrial Energy Efficiency #596-0095**

FY of initial oblig.: 1982

FY of final oblig.: 1986

Amount: \$5.85 million (authorized)

FY 1988 expenditures: \$1.2 million  
FY 1989 proposed expend.: \$0.00

The purpose of this project is to improve energy efficiency in industry and reduce industrial consumption of petroleum by (a.) conducting energy audits, (b.) implementing conservation measures, and (c.) introducing energy efficient equipment.

Rural Electrification Support #596-0146 (8)

FY of initial oblig.: 1987  
FY of Final oblig.: 1987

Amount: \$5 million (authorized): \$10 million planned

FY 1988 expenditures: \$1 million  
FY 1989 proposed expenditures: \$2 million

AID has provided a \$5 million grant to the National Rural Electric Cooperative Association to increase private sector involvement in power utilities and develop a more integrated rural electrification planning and policy structure in the region.

Central America Energy Resources #596-0134

FY of initial oblig.: 1985  
FY of final oblig.: 1989

Amount: \$21.2 million

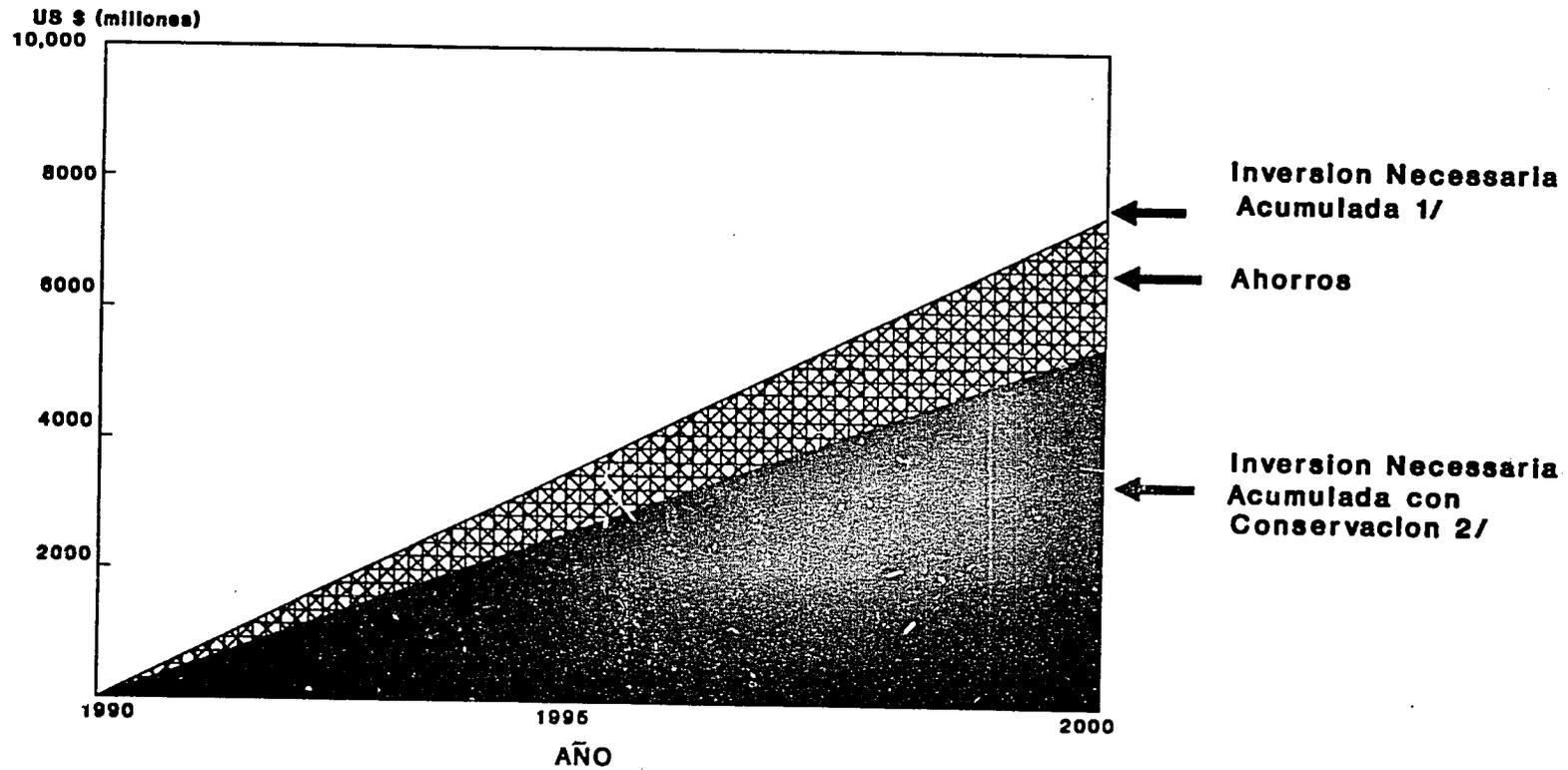
FY 1988 expenditures: \$5 million  
FY 1989 proposed expenditures: \$1.7 million

1. Source: Status of IBRD/IDA Projects in Execution (as of March 31, 1988). Released April 29, 1988.
2. Source: Inter-American Development Bank monthly report on status of loan applications and technical cooperation requirements and status of procurement. Released October 24, 1988.

3. Source: Monthly Operational Summary of Bank and IDA Proposed Projects (as of November 30, 1987). Released December 24, 1987.
4. Source: Statement of Loans 9/30/88: Vol. II EMENA and LAC Regions. IBRD.
5. Source: Compendium of Approved Projects (as of 30 September 1987). United Nations Development Programme.
6. Source: ESMAP Information and Status Report. April 1988.
7. Source: Congressional Presentation Fiscal Year 1989: Annex III, Latin America and the Caribbean. AID.
8. Source: Private Power Database: October 28, 1988. RCG/Hagler, Bailly, Inc.

# CUADRO 1

## Proyecciones de Inversion de Generacion Electrica Acumuladas Para Cada Año: Centro America

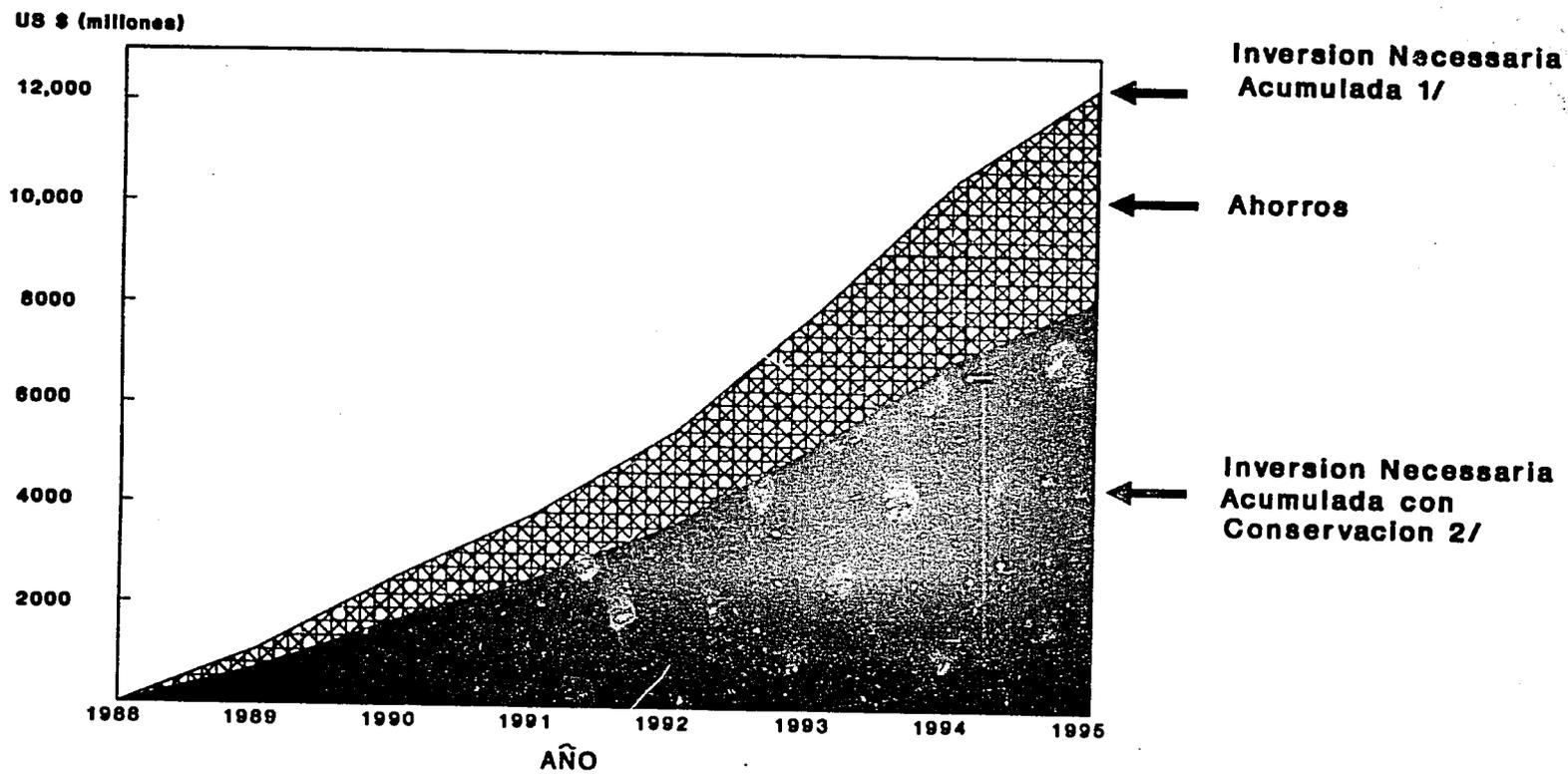


1/ La inversion total ha sido estimada entre \$5,000 y \$10,000 millones en el periodo 1988-2000. En este cuadro se presenta una hipotesis de \$7,500 millones.

2/ Con ahorros de 1/3.

## CUADRO 2

### Proyecciones de Inversion de Generacion Electrica Acumuladas Para Cada Año: Costa Rica

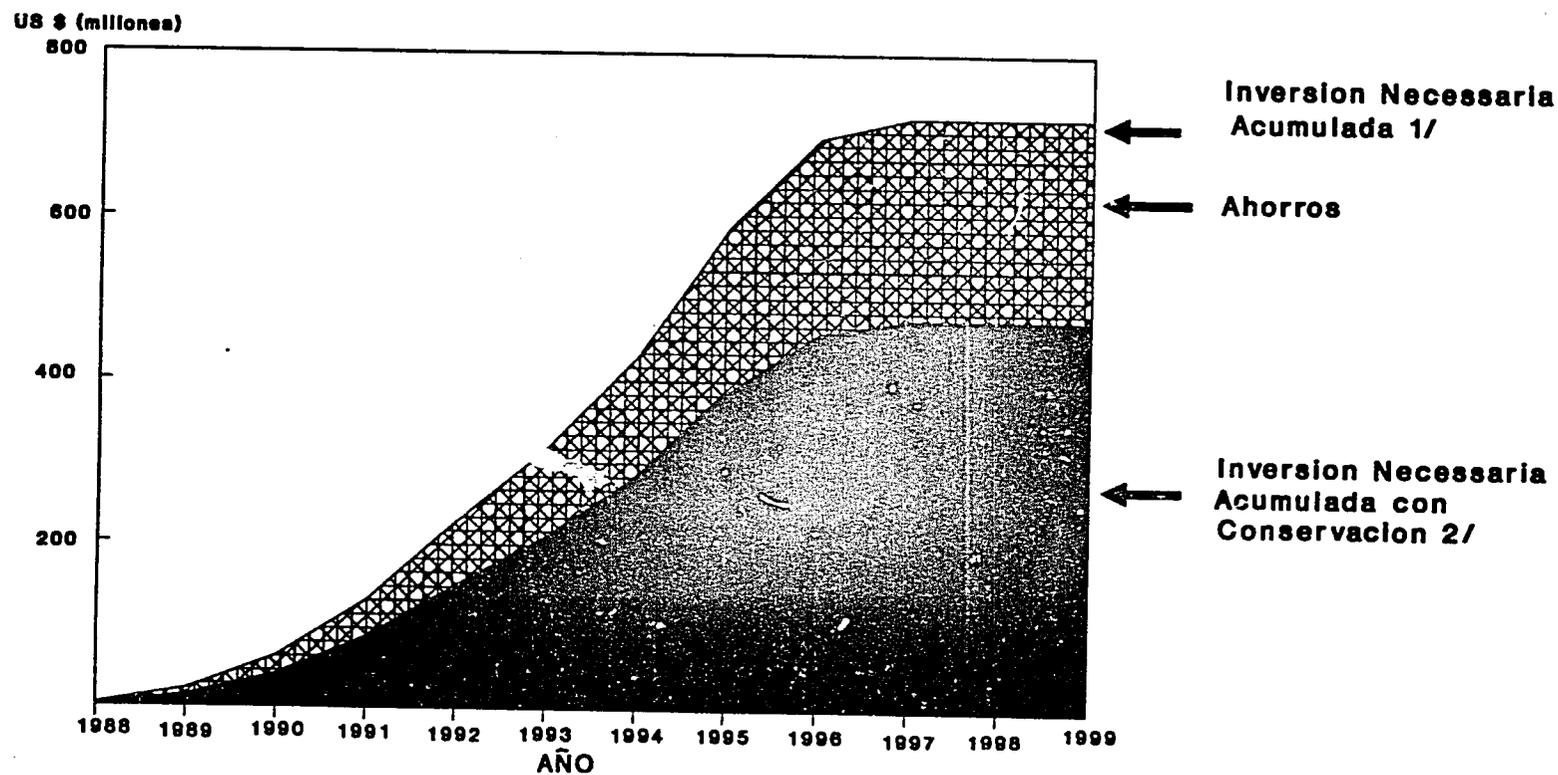


1/ Fuente: ICE.

2/ Con ahorros de 1/3.

### CUADRO 3

## Proyecciones de Inversion de Generacion Electrica Acumuladas Para Cada Año: El Salvador

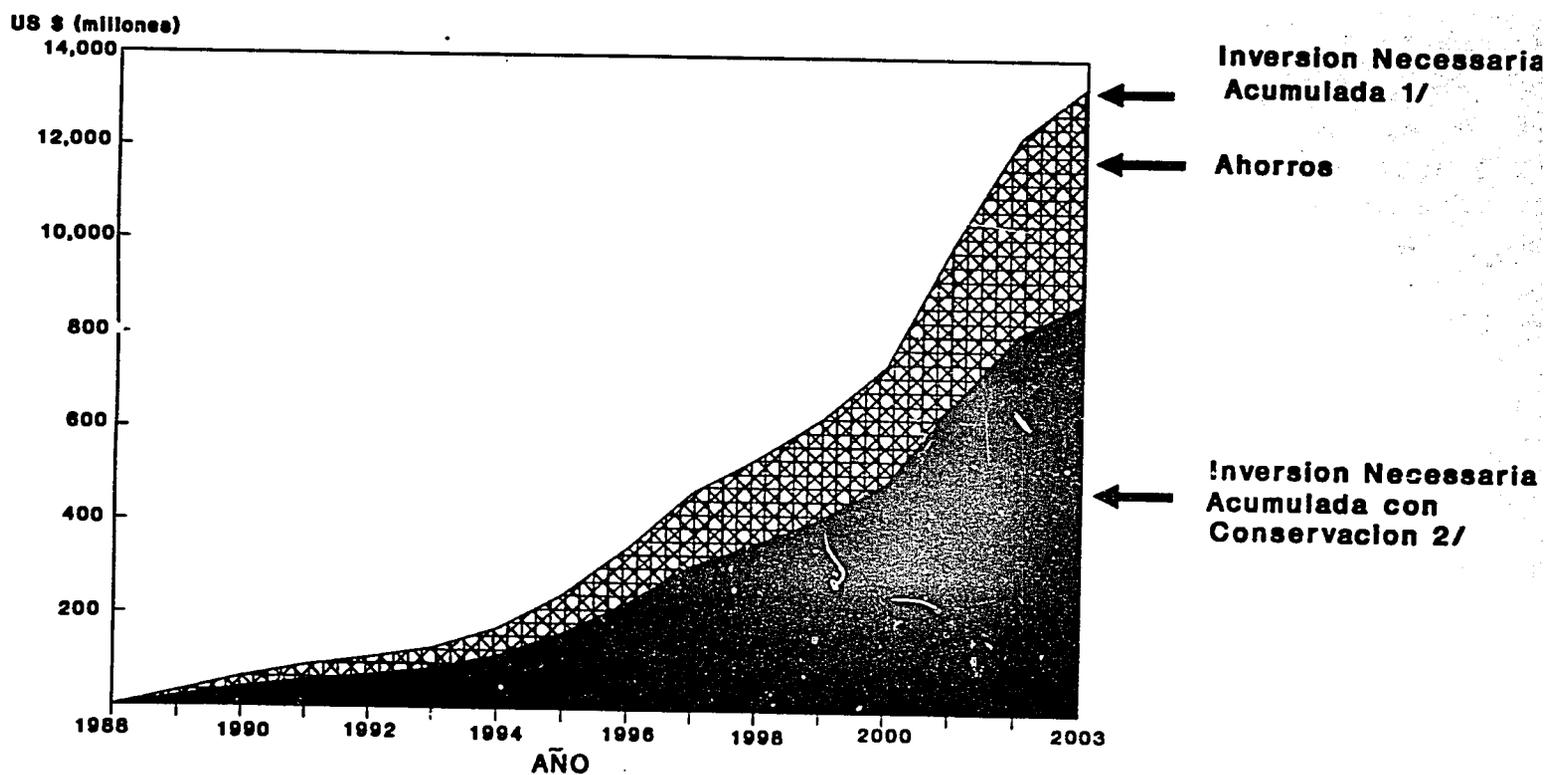


1/ Fuente: ELECTROCEL.

2/ Con ahorros de 1/3.

# CUADRO 4

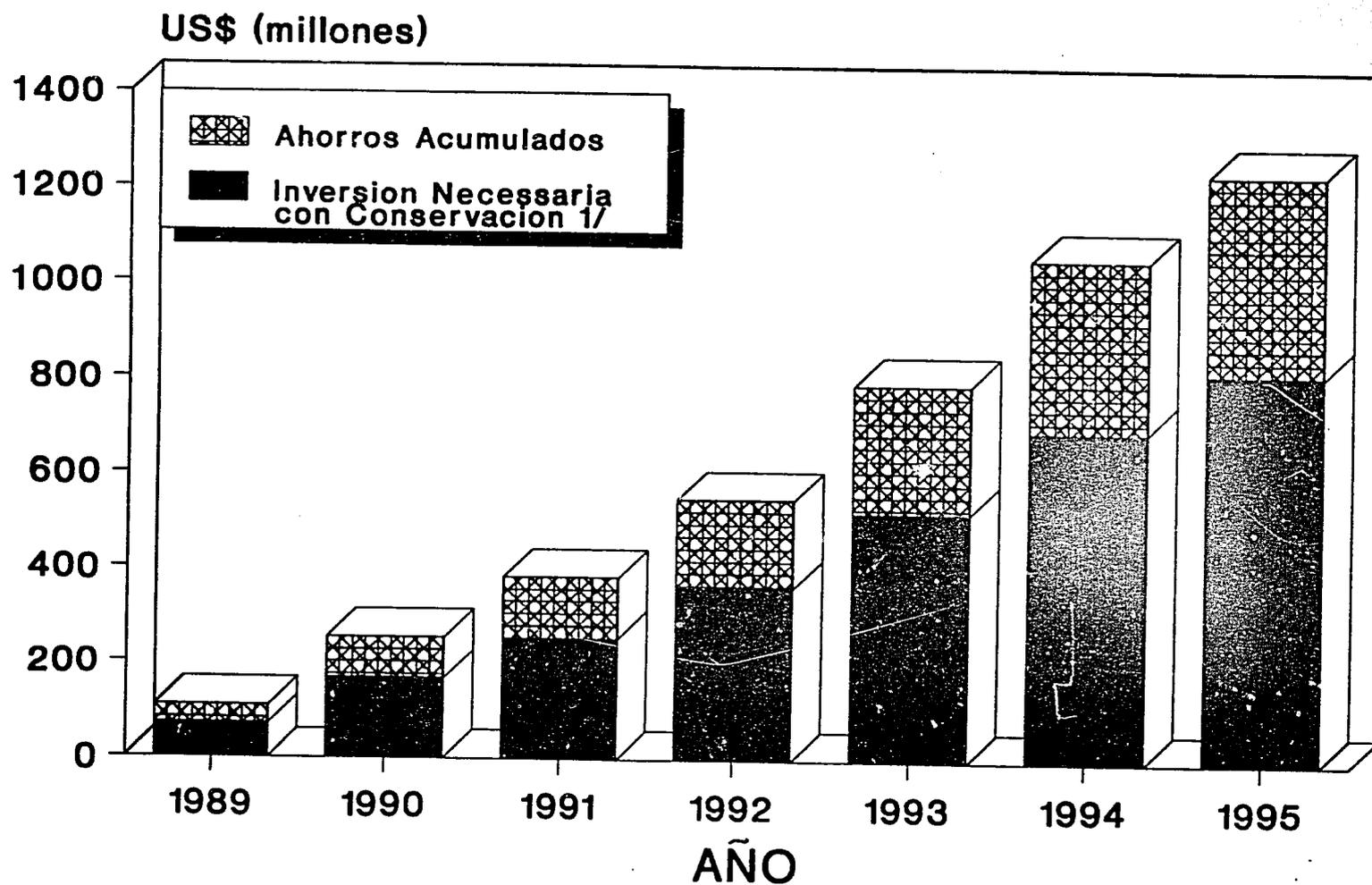
## Proyecciones de Inversion de Generacion Electrica Acumuladas Para Cada Año: Panama



1/ IRHE.

2/ Con ahorros de 1/3.

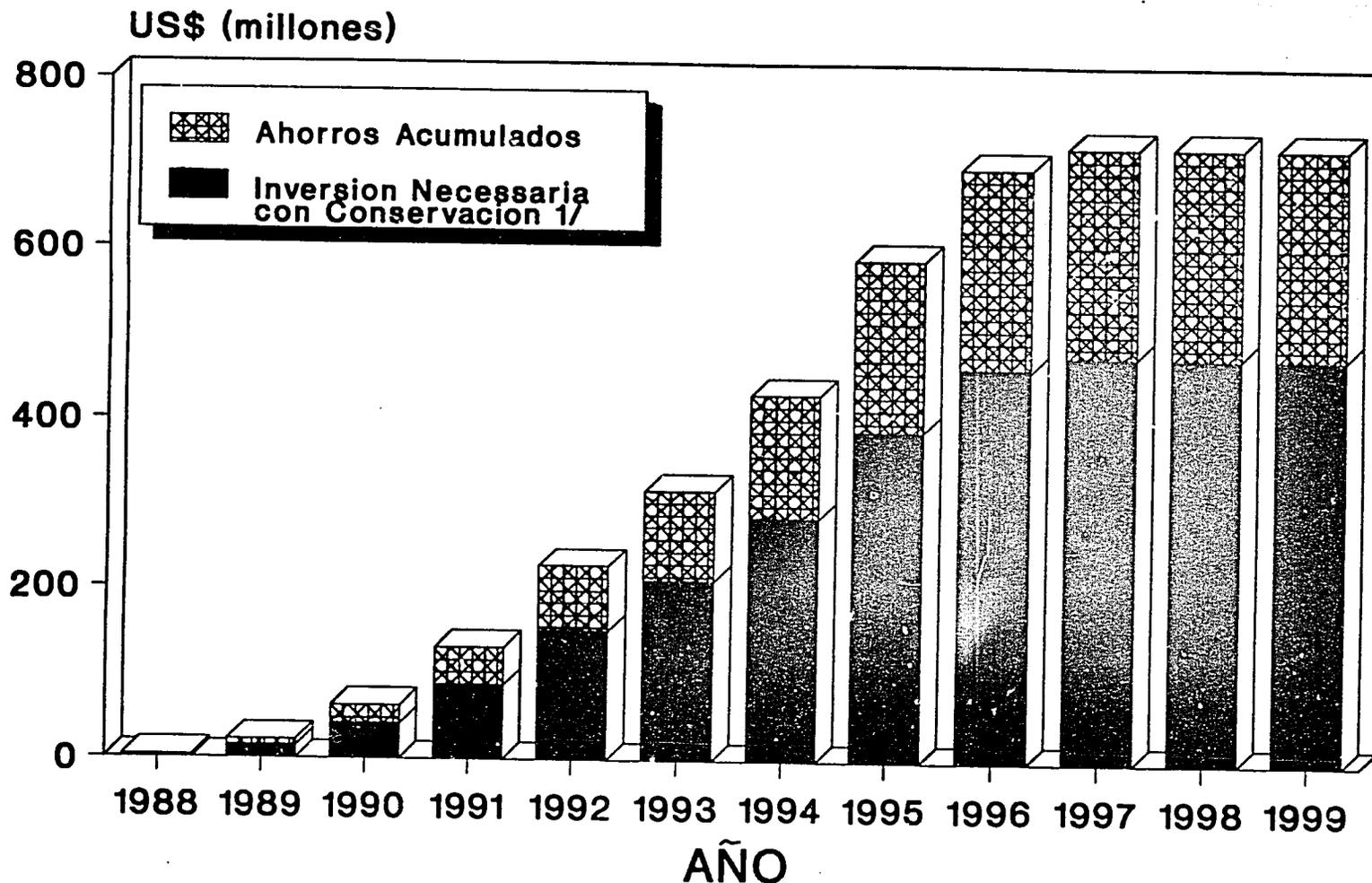
# Proyecciones de Inversion de Generacion Electrica Acumuladas Para Cada Año: Costa Rica



Fuente: ICE.

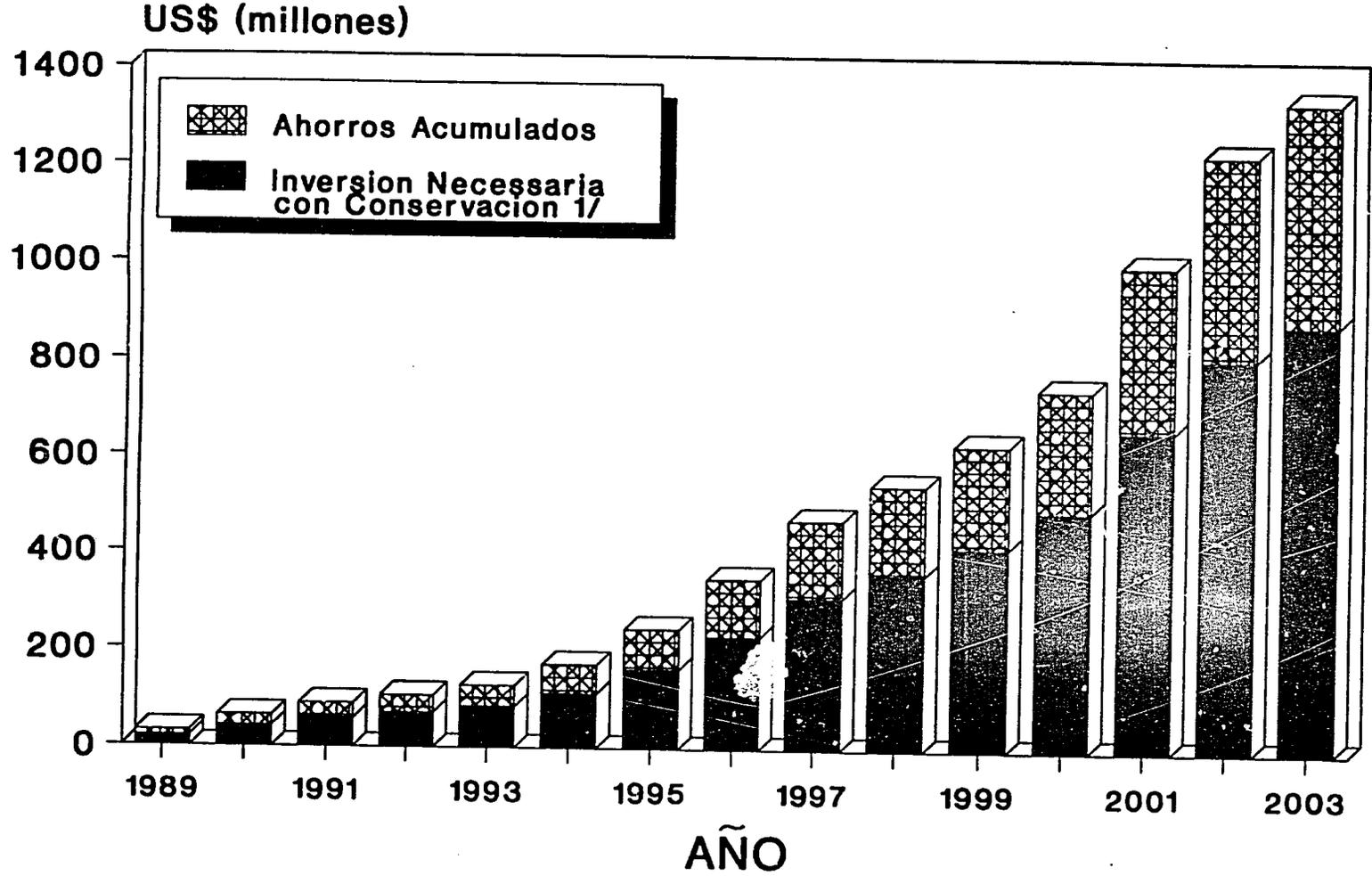
1/ Con ahorros de 1/3.

**Proyecciones de Inversion de Generacion  
Electrica Acumuladas Para Cada Año:  
El Salvador**



Fuente: ELECTROCEL.  
1/ Con ahorros de 1/3.

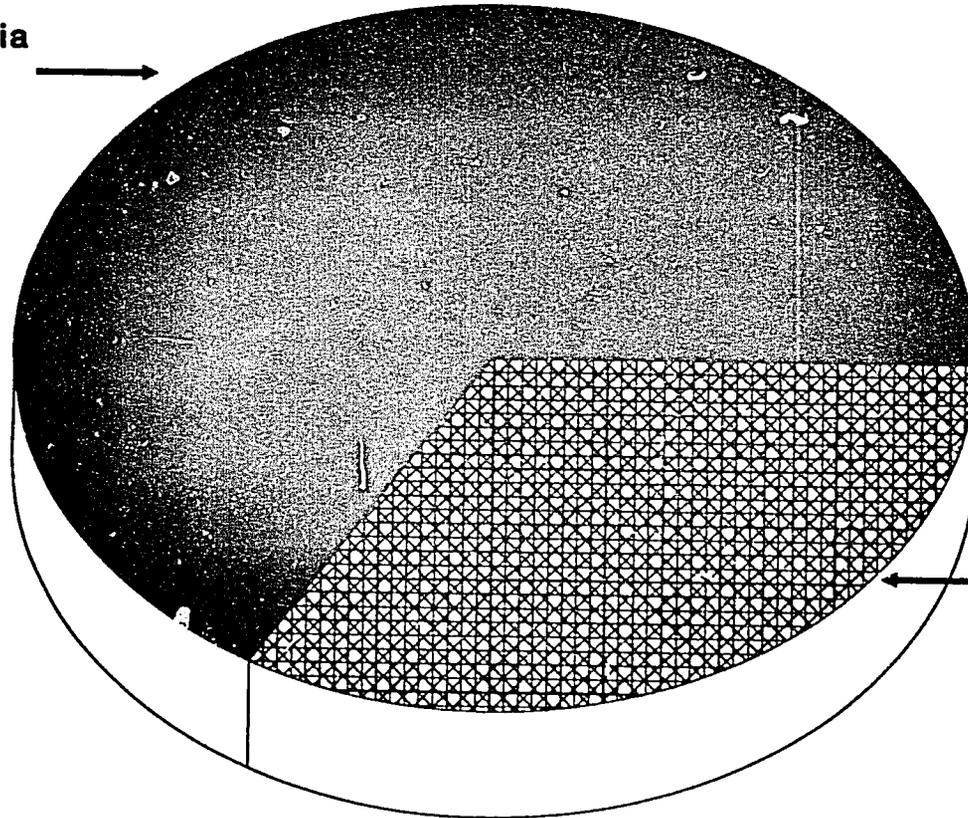
## Proyecciones de Inversion de Generacion Electrica Acumuladas Para Cada Año: Panama



Fuente: IRHE.  
1/ Con ahorros de 1/3.

**Posible Impacto de un Programa de Conservacion  
de Energia Electrica en el Programa de Inversion  
de Generacion Electrica: Centro America**

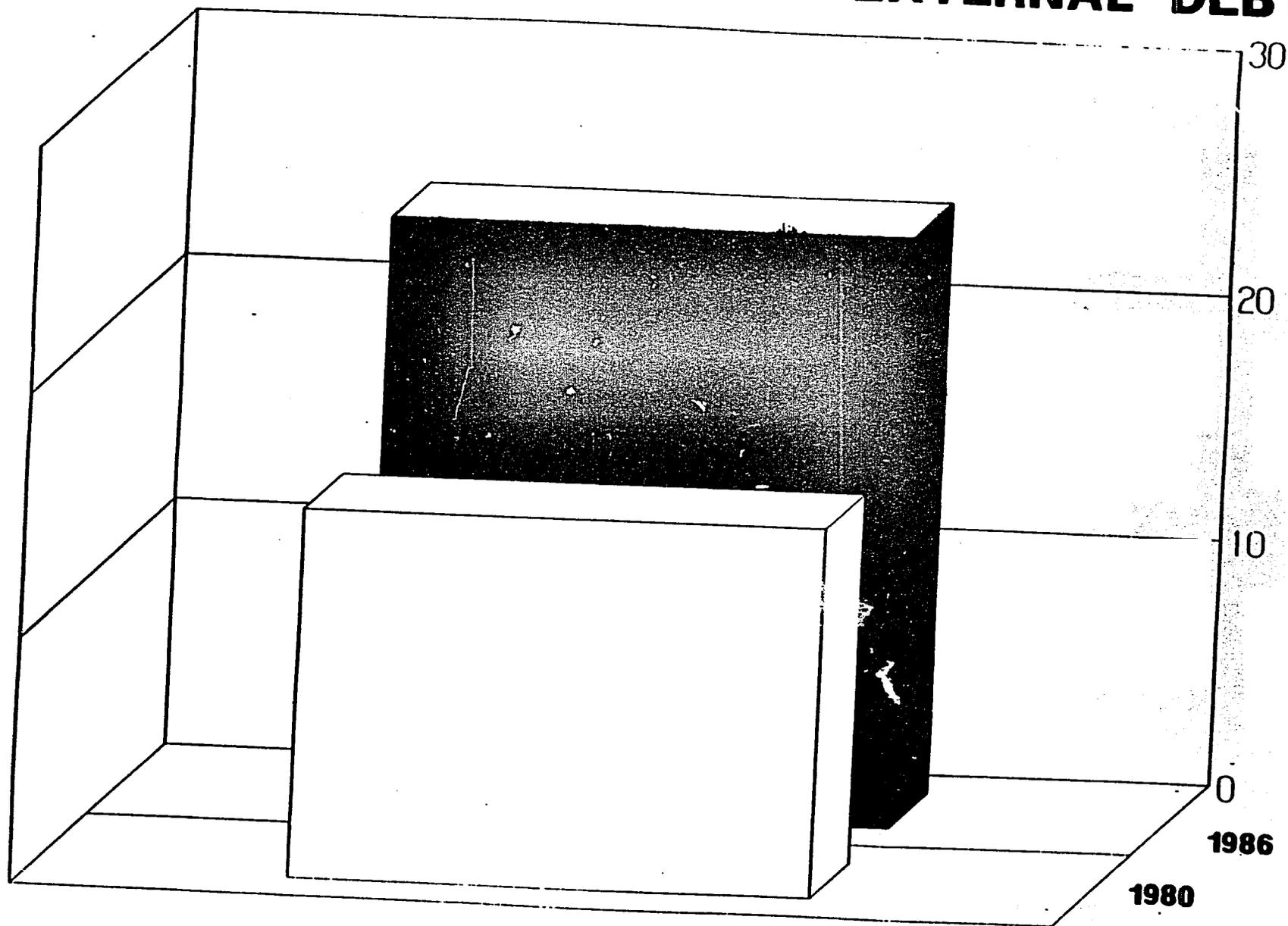
**Inversion necesaria  
total con con-  
servacion**



**Ahorros**

**Inversion total al año 2000: US\$7,500 millones  
sin conservacion.**

# CENTRAL AMERICA EXTERNAL DEBT

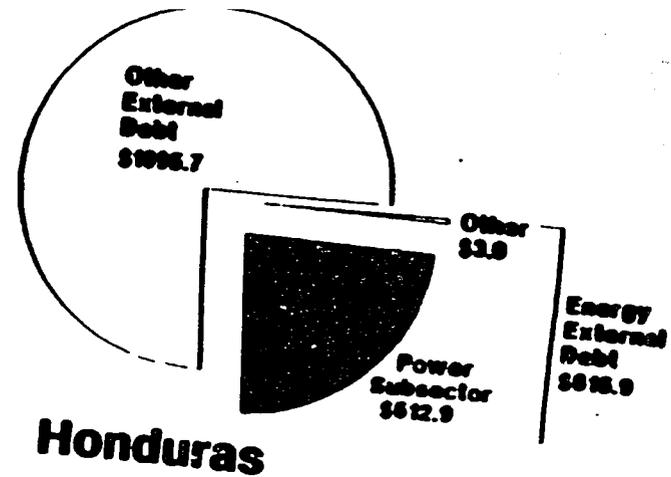
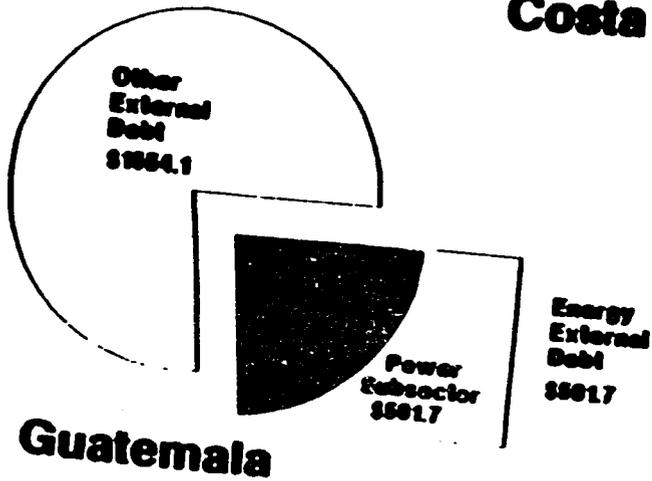
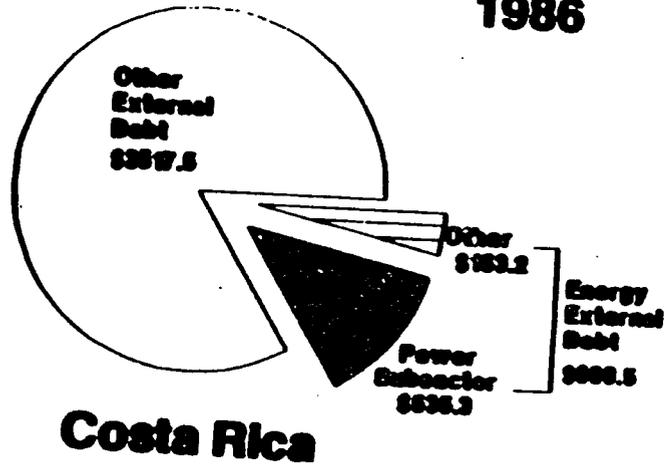


Source: OLADE

Billions of U.S. Dollars

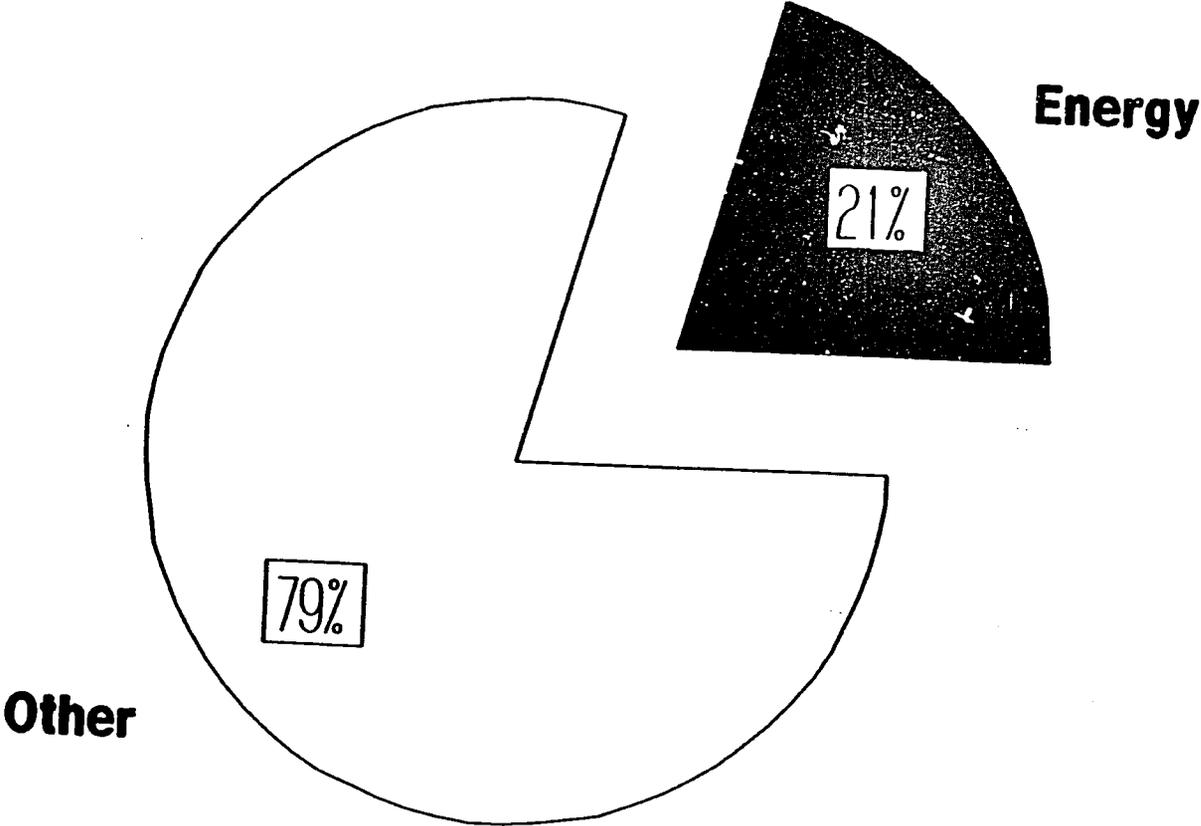
# EXTERNAL DEBT AND THE ENERGY SECTOR (In Millions of U.S. Dollars)

1986



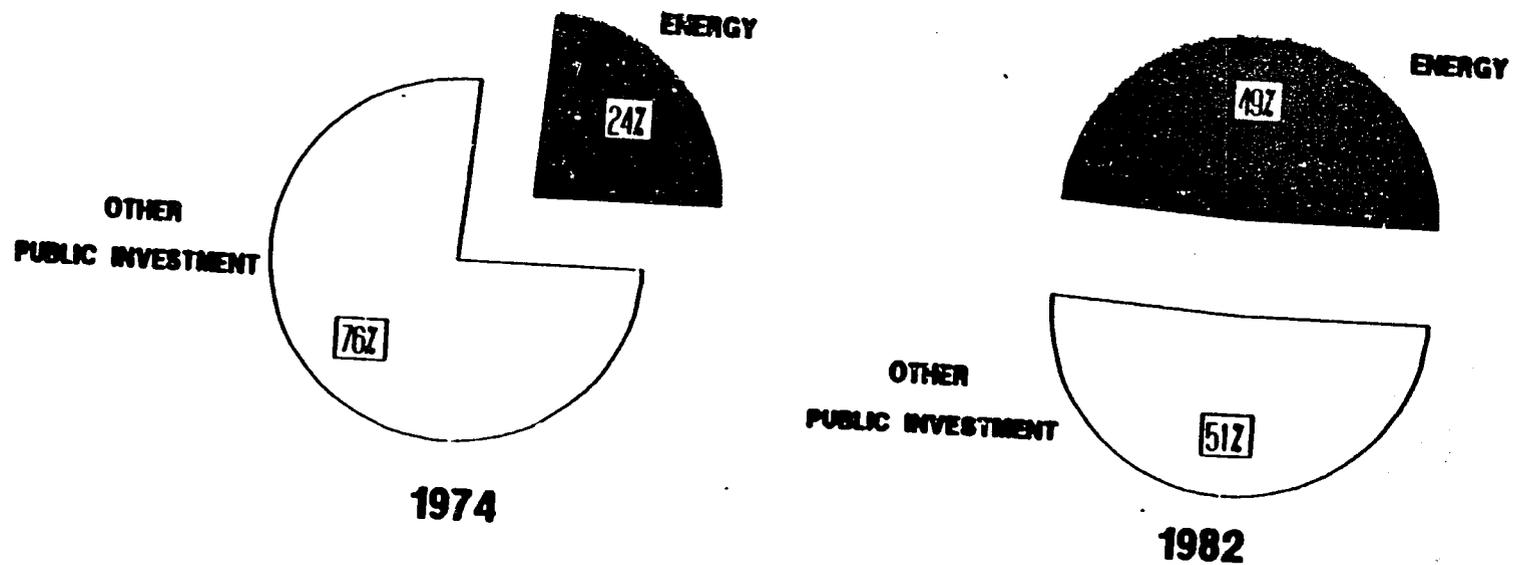
Source: OLADE

**RELATION OF ENERGY EXTERNAL DEBT SERVICE  
TO TOTAL EXTERNAL DEBT SERVICE  
LATIN AMERICA AND THE CARIBBEAN  
1986**



Source: OLADE

# ENERGY INVESTMENT AS RELATED TO PUBLIC INVESTMENT FOR LATIN AMERICA AND THE CARIBBEAN



Source: OLADE