United Mexican States
Banco Nacional de Obras y Servicios Publicos

High Efficiency Lighting Pilot Project

Project Document
March 1994

THE WORLD BANK

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GEF Documentation

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Reports by the Chairman - identified by a blue band - are prepared by the Office of the GEF Administrator in collaboration with the three GEF implementing agencies for the biannual Participants' Meetings.

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CURRENCIES AND EQUIVALENT UNITS

(Exchange Rates as of January, 31, 1994)

US$ 1.00 = N$ 3.11 (New Mexican Peso)
US$ 1.00 = NKr 7.50 (Norwegian Krone)
US$ 1.38 = SDR 1.00 (Special Drawing Rights)

UNITS AND MEASURES

1 Metric ton (mt or ton)	=	1,000 kg
1 MW (Mega-watt)	=	1,000 kW
1 MWh (Mega-watt-hour)	=	1,000 kWh
1 GWh (Giga-watt-hour)	=	1,000 MWh
1 TWh (Tera-watt-hour)	=	1,000 GWh

ACRONYMS AND ABBREVIATIONS

ACRONYMS

BANOBRAS	-	Banco Nacional de Obras y Servicios Públicos (National Bank of Public Works and Services)
CFE	-	Comisión Federal de Electricidad (Federal Electricity Commission, a Government-owned Power Utility)
FCCC	-	United Nations Framework Convention on Climate Change
FIDE	-	Fideicomiso de Apoyo al Programa de Ahorro de Energía del Sector Eléctrico (Trust Fund for the Program of Energy Conservation of the Power Sector)
GEF	-	Global Environment Facility
GET	-	Global Environment Trust Fund
ILUMEX	-	Spanish Acronym for the Project ("Proyecto de Uso Racional de Iluminación en Mexico")
INE	-	Instituto Nacional de Ecología (National Environmental Institute)
PCU	-	Project Coordination Unit
SEDESOL	-	Secretaría de Desarrollo Social (Ministry of Social Development)
SEMIP	-	Secretaría de Energía, Minas e Industria Paraestatal (Ministry of Energy, Mines and Parastatal Industry)
SHCP	-	Secretaría de Hacienda y Crédito Público (Ministry of Finance and Public Credit)
STAP	-	Scientific and Technical Advisory Panel
UNEP	-	United Nations Environment Programme
UNDP	-	United Nations Development Programme

ABBREVIATIONS

CETES	-	Government of Mexico Treasury Bills
FLs	-	Fluorescent Light Bulbs (Include Compact and Circular Fluorescent Light Bulbs)
CO_2	-	Carbon Dioxide
DSM	-	Demand Side Management
GHG	-	Green House Gases
IRR	-	Internal Rate of Return
LRMC	-	Long Run Marginal Cost
NO_x	-	Nitrogen Oxide
SO_2	-	Sulphur Dioxide

Government of Mexico's Fiscal Year
January 1 - December 31

MEXICO

HIGH EFFICIENCY LIGHTING PILOT PROJECT

GRANT AND PROJECT SUMMARY

Guarantor: United Mexican States

Recipient: Banco Nacional de Obras y Servicios Públicos - BANOBRAS

Executing Agency: Comisión Federal de Electricidad - CFE

Beneficiary: CFE

Cofinancier: Kingdom of Norway

Amount: SDR 7.3 million (equivalent to US$10.0 million)

Terms: Grant

Financing Plan	Local Cost	Foreign Cost	Total Cost
	----------In US$ Million (Equivalent)----------		
CFE Funds	4.3	5.7	10.0
GET Grant	0.0	10.0	10.0
Kingdom of Norway Grant	0.0	3.0	3.0
Total Funds	4.3	18.7	23.0

Economic Rate of Return: 32% (minimum)

MAP: IBRD No. 25270

This report is based on the findings of an appraisal mission that visited Mexico on October 13, 1993, and was composed by Messrs. Luis Luzuriaga (Principal Power Engineer, Task Manager), Richard Clifford (Financial Analyst), Rudolf Van Puymbroeck (Legal Counsel), Luis Cosenza (Power Engineer, Consultant) and included John Skjelvic (Economist) and Rolf Selrod (Environment Economist), representing the government of the Kingdom of Norway. Department Director: Edilberto Segura, Division Chief: Martin Staab.

MEMORANDUM AND RECOMMENDATION OF THE DIRECTOR
MEXICO, CENTRAL AMERICA AND PANAMA DEPARTMENT
TO THE REGIONAL VICE PRESIDENT
OF THE LATIN AMERICAN AND CARIBBEAN REGION

Country and Sector Background

1. Mexico's GDP growth was 3.6% in 1991 and 2.6% in 1992; per capita GDP was US$3,030 and US$3,470 in 1991 and 1992, respectively. Since per capita GDP was US$1,990 in 1989, Mexico is eligible for Global Environment Facility (GEF) financing.

2. The proposed Project underscores Mexico's commitment to environmental protection. The country has a satisfactory national environmental policy framework, and with the assistance of the Bank it is preparing an environmental action plan[1], which is expected to be completed in mid-1994. In particular, and also with assistance from the Bank, Mexico has begun to take firm steps to reduce contamination from vehicles, including the introduction of unleaded gasoline, mandatory use of catalytic converters for all new vehicles, and strict vehicle emission inspections twice a year. Mexico is a signatory of the United Nations Framework Convention on Climate Change (FCCC) and the Government is committed to formulate and implement national and regional programs to mitigate climate changes. Under the Montreal Protocol, Mexico has decided to phase out ozone depleting substances, agreeing to meet timetables for industrialized countries; this initiative is being supported through two projects financed with Montreal Protocol funds for which the Bank is the implementing agency. More importantly perhaps, public awareness of environmental problems has been growing and the Government's concern for the environment is widely supported by the public at large.

3. In May of 1992, SEDUE (the ex-Ministry of Urban Development and Ecology), was absorbed within the newly created Secretaría de Desarrollo Social, SEDESOL (Ministry of Social Development), which made it possible, among other things, to have a better coordination of the government's environmental policy. Within SEDESOL, the development and implementation of Mexico's environmental policy is the responsibility of two decentralized agencies: (a) the Instituto Nacional de Ecología, INE (National Environmental Institute) and (b) the Procuraduría de Protección Ambiental (Environmental Protection Office). The Bank is assisting Mexico in strengthening its environmental institutional capacity through the Mexico Environmental Project which also includes a US$ 25 million biodiversity component financed by GET.

4. Demand for electric energy in Mexico is high: it was 100 TWh in 1992 and is projected to grow at 5.3% per annum, resulting therefore in the need to add 14,000 MW over the next ten years. Massive investments, on the order of US$3 billion per year for generation, transmission and distribution will be needed to meet this growing demand, part of

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[1] A detailed description and assessment of Mexico's environmental issues can be found in the Bank' report "Mexico: Environmental Issues Strategy Paper" dated August, 1992.

which is expected to be financed by the private sector, as the Electricity Law, amended in 1992, now permits independent power generation. Since Mexico's installed generating capacity is about 80% thermal, there is concern over the gaseous emissions from thermo-electric power plants and their deleterious effect on the environment. Current estimated carbon dioxide (CO_2) emissions from thermal power stations amount to 57 million tons per year; similarly emissions of sulphur dioxide (SO_2) and nitrogen oxide (NO_x) amount to 1,070,000 tons p.a. and 115,340 tons p.a., respectively. The federally owned electric power utility, CFE, has implemented (with Bank assistance under Loan 3083-ME) supply-side management and demand-side management (DSM) actions. It is also expected that the newly created Energy Regulatory Agency will establish policies to further enhance DSM activities and require Integrated Resource Planning as opposed to Least Cost Planning now practiced by CFE.

5. Electricity tariff increases over the last three years have resulted in an average price for 1993 of US cents 6.92/kWh, or about 83% of long run marginal costs (LRMC). The average price for residential consumers was US cents 6.65/kWh, with a range that varied between 5.3 and 15.3 US cents per kWh, involving a significant cross subsidy from residential consumers, with medium to large consumption, to other consumers. This situation is being corrected, as CFE is committed to gradually eliminate by 1997 the existing large cross subsidies among different types of consumers and to raise its average price to reach LRMC by the same year.

6. In August of 1990, CFE established a trust fund (FIDE) with funds provided by power utilities, labor unions, contractors and suppliers to support and finance programs related to energy conservation in the power sector. To date, FIDE has managed funds totalling approximately US$16 million, which has been used to finance pilot and demonstration projects, the dissemination of their results and training in energy conservation. In addition to partially funding FIDE, CFE has directly promoted and financed several energy conservation projects, such as: (a) the use of more efficient light bulbs (sodium vapor) in the public lighting system; (b) the financing, through a trust fund, of the thermal insulation of homes in areas with hot weather to reduce the air conditioning load; (c) assistance to the private sector to identify measures to improve energy efficiency, and (d) seven small pilot projects to replace incandescent bulbs with FLs in Hermosillo (two projects), Puebla, Querétaro, Valladolid, Chetumal and Mexico City.

7. Project Objectives: (a) demonstrate the technical and financial feasibility of reducing emissions of Green House Gases (GHG) and simultaneously reduce local environmental contamination through the widespread installation of high efficiency lighting; (b) build the institutional capacity for technological change and energy conservation; (c) provide a replicable model for DSM in Mexico and elsewhere in the developing world, and (d) strengthen CFE's capacity to practice DSM on a sustainable basis.

8. The members of the FCCC have agreed that the policies and measures to reduce emissions of GHG may be implemented jointly with other FCCC member countries. The criteria for the mechanism of joint implementation are, however, yet to be developed and decided upon by the parties. To assist in the development of possible criteria, the Norwegian Government has decided to co-finance this Project, which might serve as a demonstration vehicle for elements of a joint implementation scheme. The agreement of the Governments of Mexico and Norway on the co-financing of this Project in no way implies the positions that

both Governments might take in relation to the subject of joint project implementation under the FCCC.

9. Project Description: The Project will replace approximately 1.7 million incandescent bulbs with fluorescent light bulbs in the cities of Guadalajara and Monterrey. FLs require only about 25% of the energy needed by incandescent bulbs to produce the same lighting level and last up to 13 times longer (up to 10,000 hours). Guadalajara and Monterrey are Mexico's second and third largest cities with approximately 550,000 residential electricity consumers each; they also have different climates and economic structures and should, therefore, provide valuable information for extending the program to other areas. CFE is responsible for the distribution of electricity in both cities, where there are customer service centers that are in daily contact with the consumers, a necessary condition for the successful implementation of the proposed Project.

10. The Project includes: (a) the acquisition of FLs (77% of project cost, including contingencies); (b) the purchase of vehicles, metering equipment, personal computers, office equipment and sales stands (2%); (c) consultant services for canvassing, marketing, testing, auditing and project evaluation (4%); (d) the cost of engineering, monitoring and evaluation, billing and accounting (8%); and (e) the direct costs of implementing the Project, including fully dedicated staff in both cities, and office and administrative expenses (9%).

11. There are no policy or institutional reforms needed to ensure effective Project implementation. However, experience gained from the small pilot projects (para. 7) points to the need for baseline assessments and a comprehensive evaluation procedure. For the proposed Project, a baseline assessment will be carried out through specialized consultants. Their work should provide the basis for a suitable evaluation process, particularly with respect to induced sales that result from project related activities ("free driver effect").

12. The Project incorporates the following features: (a) the benefits will be shared with the participants, as is common in many other countries, through a rebate of approximately 63% (on average) of the total cost of the FL (which includes overhead costs); (b) participants will pay for FLs either in cash or under a deferred payment plan of 24 months (as part of their electricity bill), paying an interest rate equivalent to that prevailing for Government treasury bills (CETES) (at the end of the present Project, the balance of reflows of funds would be approximately US$ 9.0 million); (c) technical standards and specifications have been developed to ensure that the FLs will operate properly and reach their projected lifetime despite a power system that is subject to significant voltage variations, and (d) acceptable FL performance guarantees will be provided for both the customer and CFE.

13. Rationale for GET Funding: The GEF classifies projects into three Types. Type 1 include projects economically viable on the basis of domestic benefits and costs to the country itself. These type of projects are normally not eligible for GEF financing, unless the GEF Participants agree that a compelling case has been made that, despite attractive rates of return, the operation would not proceed without GEF involvement. The proposed Project has attractive rates of return, and it could be expected that it would be implemented purely for its cost-effectiveness, and that the use of the FLs would spread, even in the absence of the Project. However, experience confirms that unless consumers are shown how they can benefit from FL use, the process of change is extremely slow. A major problem is the high initial investment (since FLs typically cost at least ten times as much as the incandescent bulb that they replace). Furthermore, there is a need to inform, and more importantly, convince

the consumers that they will in fact eventually reap the expected benefits. CFE's own small pilot projects have demonstrated that, given a suitably designed project, consumers will accept the use of FLs. However, these projects have been too small to have an impact on the nation-wide use of FLs. GEF participation is therefore essential to demonstrate that the benefits to the global environment and to Mexico can be realized.

14. Based on the above considerations, the proposed Project has been designated as a Type 1 project. The Project has been considered and endorsed by the GEF Scientific and Technical Advisory Panel (STAP), and has been authorized as part of a work program approved by the GEF Participants at their December, 1991 meeting.

15. Project Cost and Financing: Total Project cost (including price and physical contingencies) has been estimated at US$ 23.0 million equivalent, of which: (a) US$ 17.63 million will be required to purchase the FLs; (b) US$ 0.41 million for the purchase of vehicles, metering equipment, computers, office equipment and sale stands; (c) US$ 1.01 million for consultant services (interviewing, marketing, monitoring and evaluation, laboratory testing and auditing); (d) US$ 1.93 million for engineering and project support; and (e) US$ 2.02 million for direct project implementation. The Project will be financed with a grant from the GET, equivalent to US$ 10 million, a grant from the Kingdom of Norway of Nkr 20.25 million, and the equivalent of US$ 10 million from CFE's own resources. The grant funds will be used to finance partly the purchase of FLs and subsequently be transferred to the participants of the program as rebates for the purchase of FLs. The details of project cost and financing may be found in Schedule A.

16. Project Implementation: For the design of the proposed Project, CFE has relied on the results of market studies made in Guadalajara and Monterrey, and on the experience gathered on residential lighting in the pilot energy conservation projects, as well as in the thermal insulation improvement projects. These projects have illustrated the advantages of proceeding through implementing units financed through trust accounts ("Fideicomisos") set up with BANOBRAS; the system has been shown to be efficient and low cost, and has allowed CFE to retain control of the projects and to introduce timely adjustments to ensure their success. It also guarantees that the funds, including those resulting from the credit sales to the participants, are kept separate from those that enter into CFE's own treasury and that they only be used for the purposes of the Project. The Project will therefore be implemented through two Implementing Units (one for each city) that will administer trust accounts opened in BANOBRAS. Each Implementing Unit will be directed by a Technical Committee with five members, of which four are CFE's staff members. The Technical Committee will appoint a Manager for each Unit who will be responsible for the day-to-day management of the Project in each city; the Manager, and the personnel under his responsibility, will be hired by, and paid with funds from each trust account. CFE will also establish a project support and monitoring group to provide guidance to the Project and to provide day-to-day support and supervision through a Project Coordination Unit, PCU. A high level Project Advisory Committee will oversee the execution of the Project. FLs will be sold in the sale stands that CFE will install in every customer center in the two cities were consumers pay their electricity bills and in selected shopping centers, and as required, using door-to-door sales. Billing and collection of payments for FLs sold on terms will be done using CFE's customer service facilities and will be included in the customer's electricity bill. CFE's systems and experience on these matters are more than adequate to ensure that there will be no problems in the areas of billing and accounting. The proposed Project Organization is explained in detail in Annex 1. The execution of the Project will be guided by the Operating Guidelines

described in Annex 6, and the proposed Project monitoring and evaluation methods are shown in Annex 5.

17. CFE has proposed to restrict the Project to the residential sector on the basis that the other sectors, which include industrial and commercial users, do not require special incentives to make the installation of FLs attractive; in addition, CFE does not wish to be seen by the commercial distributors of FLs in Mexico as their competitors. In order to promote the use of FLs more widely, the Project will fund a marketing campaign to foster use of FLs, sold through normal retail outlets, among the commercial and industrial customers. CFE further plans to direct the Project to the low consumption users in the residential sector to provide a relief, by means of more efficient use of electricity for lighting, when future tariff increases are implemented. This should not reduce the energy savings produced by the Project, as experience shows that while low consumption users have fewer light bulbs in their homes, they make equal or more intensive use of them compared to high consumption users because low consumption users spend more time in their limited number of rooms lit by FLs. At present, electricity sales to these customers result in a net loss for each kWh, and CFE understandably wishes to reduce its losses. Nonetheless, since energy rates for low consumer users are heavily subsidized, these customers would normally be the least inclined to participate in the Project. Consequently, sales will be monitored closely to ensure that they do not proceed painstakingly slowly while waiting for these low consumption customers to participate. Targets have therefore been developed and failure to reach them will trigger more aggressive marketing strategies, including to high consumption users.

18. It is estimated that all the FLs will be purchased and installed in two and a half years after project start, that the evaluation of the operation will be completed six months later, and that a final project survey among the participants will be carried out a year after completion. Consequently, the duration of the Project has been estimated to be three and a half years. However, as some of the FLs will be sold on deferred payment terms, recovery of funds will require up to four and a half years. BANOBRAS will be responsible for the management of the grant funds, for keeping Project accounts, for arranging audits by independent auditors, and for sending annual audit reports to the Bank. The project completion date is estimated to be December 31, 1997. Schedule C shows a timetable of key Project processing events, and Annex 9 lists the documents of the Project file.

19. Procurement and Disbursement: In order to profit from economies of scale, FLs will be purchased using both GET and Norwegian grant funds, in no more than three bid packages of not less than US$ 4 million each, under ICB in accordance with Bank guidelines for procurement and using Bank standard bidding documents. Procurement documents will be subject to prior review by the Bank. The first contract is expected to be awarded early in 1994, and the second and third before the stock of FLs is depleted. Technical specifications for the various types of FLs to be purchased are shown in Annex 2. It is expected that there will be keen competition among manufacturers, including local companies that at present produce about five million FLs annually, mainly for the export market. Purchase of vehicles, computers, metering equipment, sales stands and office equipment will be financed with funds provided by CFE and will follow local procedures. The hiring of consultants will also follow local regulations as they will be financed with CFE's contribution; the proposed terms of reference are shown in Annex 7. In view of the limited number of expected contracts to be financed by the grants, disbursements will be by direct Bank payment to suppliers. Disbursement of both grants will be made on a pari passu basis, and would be completed in three years; closing date of the grant will be December 31, 1996. Administration and

disbursement of the grant from the Kingdom of Norway will be carried out by the Bank together with the GET grant. The proportion of the goods and services to be financed by each party, and the disbursement calendar are shown in Schedule B.

20. Project Sustainability: The Project could be replicated using the reflow of funds from the sale of the FLs, provided that CFE would continue sharing its savings with the participants and also contribute fresh funds for the subsequent projects. CFE has (a) agreed to expand the scope of the Project, if required, until all funds from both grants have been transferred to the participants in the form of rebates for the purchase of FLs, and (b) agreed that if the Project is successful, the Implementing Units will continue their activities beyond the scope of the present Project, until the balance of the reflow on funds (about US$ 9.0 million) is completely exhausted.

21. Lessons from Previous GEF Projects and Previous Bank Involvement: CFE's experience in its previous small pilot projects indicates that: (a) it is necessary to share a significant part of the benefits of the project with the users through a rebate; otherwise, the cost of the FLs is perceived as too high by potential participants; (b) it is important to have a well defined marketing and promotional strategy; (c) certain types of FLs are preferred, particularly the 22 watt circular lamp; (d) to penetrate the low consumption residential market, door-to-door sales are most effective. Furthermore, Bank's experience in the power sector indicates that: (e) agreement should be reached early on draft ICB documents and (f) the Ministry of Finance and Public Credit must be committed to the project in order to allow CFE to include it in its investment program. Agreement on bid documents for ICB was reached, the Ministry's commitment has been secured, and the other mentioned lessons have been incorporated in the project design (Annex 8).

22. Agreed Actions: Agreements were reached on: (a) the final text of the Operating Guidelines for the Project, which will constitute the norm for the execution of the Project. Among other things, the Guidelines: i) provide guidance to CFE, BANOBRAS and the IUs for the execution of the Project; ii) establish the percentage of the rebates and provide flexibility for adjusting them and for shifting emphasis among the various categories of participants, considering the results of the periodic reviews of the Project; iii) permit the funds to be distributed differently than the original plan if the Project in one of the two cities is seriously lagging; and iv) define clearly the periodic goals to be achieved, and the monitoring and evaluation plan. Any modifications to the Operating Guidelines have to be satisfactory to the Bank; (b) the text of the document that will establish the trust deeds for the Implementing Units in Guadalajara and Monterrey, which include their obligation to observe the Operating Guidelines; (c) the obligation of holding together with the Bank annual reviews and a mid-term review, and the targets to be achieved; at the time of the mid-term review, the Bank will have the option of canceling the balance of both grants if sales have not reached at least 70% of the agreed targets (as a percent of the total FLs to be installed); (d) the commitment of CFE of preparing semi-annual progress reports for the Project, a project completion report, and of disseminating the results of the Project through a seminar directed to Mexican and international audiences; and (e) the obligation of CFE to expand the geographic area of the Project, if needed, to sell more FLs until the full amount of the grants has been transferred to the participants of the Project. In the event of misprocurement or any misuse of the grant funds, the Bank may require the repayment in whole or in part of both grants.

23. Condition for Signature of Grant and Project Agreements: delivery by CFE to the Bank of a Supplemental Letter, presenting the final version of the Project Operating Guidelines. Conditions of Effectiveness: (i) execution of the trust deeds for the Implementing Units for Guadalajara and Monterrey; (ii) establishment and staffing of the central Project Advisory Committee and the local Technical Committees, and appointment of local managers, with qualified personnel satisfactory to the Bank; and (iii) execution of the Norwegian grant agreement.

24. Environmental Aspects: As a signatory of the FCCC, Mexico is committed to contribute to the objectives of the Convention; this Project will be a positive step in that direction. Due to the benefits that it produces for the environment, the Project has been classified as Category C. The Project will result in: (a) global environmental benefits through a reduction in carbon dioxide emissions of about 118,000 tons annually, thus producing climate related benefits mostly for Mexico. This figure is likely to increase through the "free driver effect" (or induced sales) of the project throughout Mexico; and (b) national environmental benefits through reduced emissions of sulphur dioxide (3,000 tons annually), nitrogen oxides (205 tons annually) and particulates. These reductions will improve local air quality and result in positive health effects and less damage to crops, vegetation and buildings. The reduction of emissions from power stations in the Project areas will add favorably to the national initiatives to deal with these environmental problems. A more detailed analysis of the environmental benefits of the Project, particularly of the GHG, is presented in Annex 4.

25. Project Benefits: The execution of the Project will result in substantial economic benefits to: i) the Project participants who will enjoy a comparable or higher lighting level at reduced cost; and ii) society at large and CFE, which will be able to postpone investments for about 100 MW and save about 169 GWh (or 311,000 barrels of Bunker C and 34,000 tons of coal) annually. The economic evaluation of the Project, including a risk analysis, is included as Annex 3. The results show that for Mexico the internal rate of return, IRR, exceeds 56% for the various sensitivity tests considered; for CFE alone, the IRR exceeds 32% for all probable events, and for the participants the minimum IRR calculated was over 100%. The Project thus has very attractive internal rates of return for all parties involved and the results are very robust even under very pessimistic assumptions.

26. Project Risks: The main risks associated with the Project are: (a) market penetration might be slower than expected, which might result in higher Project costs as more costly marketing strategies would have to be pursued; (b) the FLs might be installed in places where they are used for less than four hours a day on average, as assumed. However, the Project remains viable even assuming an average use of only two hours per day; (c) the voltage fluctuations in the Mexican power system might be such as to significantly reduce the lifetime of the FLs; in order to reduce this risk, the specifications will require that fluctuations of up to plus and minus 10% have no effect on the lifetime of the lamps (voltage regulation is smaller than this in Guadalajara and Monterrey); and (d) the FLs might fail to reach their projected lifetime, even if there were no excessive voltage fluctuations. Given that the lifetime of the FL is expected to extend over several years, CFE will perform standard accelerated tests that will be complemented with adequate supplier guarantees. For its part, CFE will guarantee to program participants, replacement of any FL that fails within two years of the date of purchase; experience has shown that most defective FLs will fail within this period of time.

MEXICO

HIGH EFFICIENCY LIGHTING PILOT PROJECT

Project Organization

1. The organization chosen for the Project is similar to that currently used successfully by CFE for the home thermal insulation improvement project, i.e, the trust account "Fideicomiso para el Programa de Aislamiento Térmico" (FIPATERM), which is being implemented in Baja California (Mexicali) and Sonora (San Luis Río Colorado) to reduce the air conditioning load. To implement the "Proyecto de Uso Racional de Iluminación en Mexico" (ILUMEX) project (Spanish acronym for the Project), two Implementing Units (IUs) will be established in Guadalajara and Monterrey to administer the trust accounts opened in BANOBRAS. The IUs will be known as FILUMEX Guadalajara and FILUMEX Monterrey. To set policy and supervise compliance with Project objectives, a Project Coordination Unit (PCU) has been set up in CFE's Headquarters in Mexico City.

2. The Head of the PCU or Project Coordinator, is the Subgerente de Evaluación (Deputy Manager for Project Evaluation) of the Subdirección de Distribución (Directorate for Distribution). The Project Coordinator will have full time dedication to the Project; other members of the PCU include a representative of "Programa de Ahorro de Energia del Sector Eléctrico" (PAESE), a representative of the engineering staff of CFE (responsible for the preparation of the technical specifications of the FLs) and a consultant specialized in economic analysis of projects. This group has been in charge of the Project to date and is familiar with its background, objectives and goals. Their members have also been involved in the small pilot lighting projects implemented by CFE with its own funds and can therefore apply the lessons learned in those projects to the ILUMEX project.

3. The main functions of the PCU are the following: (a) support the Distribution Divisions in Jalisco and Golfo Norte (which serve Guadalajara and Monterrey, respectively) as well as the Managers of the corresponding Implementing Units; (b) supervise Project implementation; (c) propose the strategy and studies (marketing, technical and economic) to monitor and evaluate Project results; (d) based on the reports submitted by the Managers of the IUs, prepare the progress reports needed during Project implementation (including those typically required by the Bank); (e) procure the goods and services that will be required by the ILUMEX project; (f) prepare the Operating Guidelines for the Project, and (g) inform the authorities of CFE (through the Project Committee mentioned in next paragraph) of the advances in Project implementation.

4. CFE will supervise the Project through a high level Project Advisory Committee whose members will be the Deputy Director for Distribution, the Director General of FIDE, the Distribution Manager of CFE and the Commercial Manager of

CFE. The President of the Committee will be the Deputy Director for Distribution. The functions of the Committee will include the following: (a) appoint the members of the PCU; (b) approve the strategy for Project implementation developed by the PCU; (c) approve the details of the two trust accounts to be opened in BANOBRAS to finance the two Implementing Units; (d) appoint the presidents of the Technical Committees of each of the two Implementing Units, and (e) meet periodically to review the progress reports prepared by the PCU and recommend those measures that it deems necessary to reach the goals of the Project.

5. CFE will also provide technical support to the Project. The specifications for the procurement of the FLs have been prepared by CFE's Engineering Department in consultation with CFE's Procurement Office. CFE will also be responsible for the bidding process and the procurement of the FLs, which will then be handed over to the two Implementing Units in Guadalajara and Monterrey. Finally, for deferred term sales, CFE's Service Centers at Guadalajara and Monterrey will be responsible for including in the customer's electricity bill the amount financed to purchase the FLs.

6. In order to implement the Project, two decentralized IUs will be established, one in Guadalajara and one in Monterrey. To ensure the administrative and financial independence needed for the expeditious implementation of the ILUMEX project, these units will be financed through two trust accounts ("Fideicomisos") opened in BANOBRAS. All funds provided for the project, as well as the payments made by the participants who purchase the FLs on credit, will be deposited in these trust accounts. The regulations applicable to these trust accounts will establish that the funds shall only be used for the purposes of the ILUMEX project. The trust accounts operating regulations will allow the use of funds in any city in the two Distribution Divisions that serve Guadalajara and Monterrey (Jalisco and Golfo Norte, respectively), although efforts will be concentrated initially in these two cities which together have about 1.1 million residential consumers. Nevertheless, the proposed arrangement will allow for the Project to be extended to the two regions, which in essence would double the number of potential participants (there are about 2.5 million residential consumers in both regions). This option would be exercised if the demand in both cities does not develop as forecasted.

7. The administration of each IU will be the responsibility of a Technical Committee whose members will be: (a) the Manager of the Regional Distribution Division (Jalisco or Golfo Norte); (b) the Deputy Manager of the same Division; (c) the Deputy Manager of the Commercial Division of the same Region; (d) the Head of PAESE of the same Division, and (e) a representative of BANOBRAS who will be a non-voting member of the Committee. The President of the Committee will be the Manager of the Regional Distribution Division.

8. The functions of the Technical Committee will include the following: (a) approve: (i) the annual program and budget; (ii) the agreement to be signed between

BANOBRAS and CFE for collection of the amounts owed by customers for the credit sales of FLs, and (b) monitor the flow of funds for the Project, including CFE's contributions. The Committee will meet at least once a month and since all its voting members are part of CFE's staff, it is expected that there will be very close coordination with the PCU.

9. To benefit from the local expertise that is available, the Technical Committee may decide to establish a local Advisory Committee whose members would include representatives of: (a) the State (Monterrey or Guadalajara) Energy Conservation Commission; (b) the National Chamber of Contractors; (c) the National Chamber of Commerce; (d) the National Chamber of Electrical Equipment Manufacturers; (e) the local University or Technical Institute, and (f) FIDE. This Committee would meet when convened by the Technical Committee and would act strictly as an advisory group.

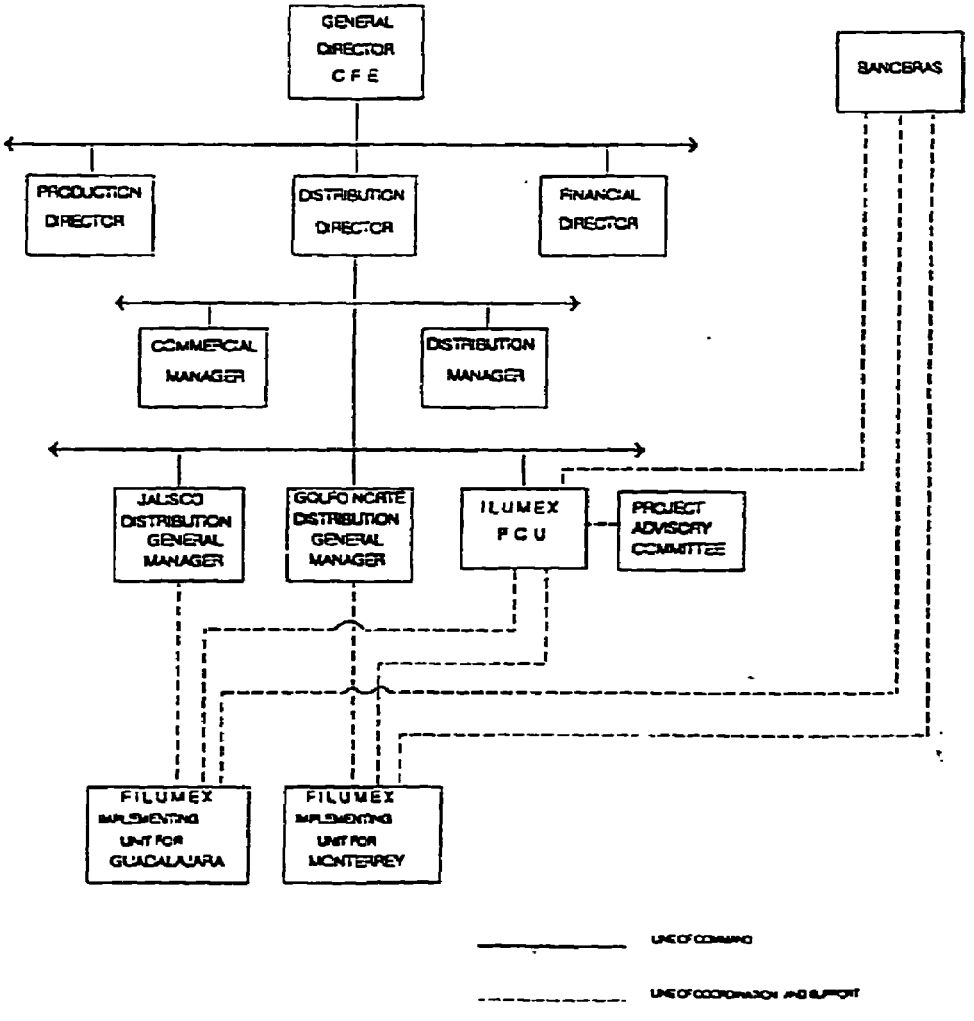
10. The day-to-day administration of each trust fund will be the responsibility of a Project Manager. The Project Manager will be appointed by the Technical Committee, and he will then proceed to select the staff needed for Project implementation. It is estimated that the staff will include at least the following: (a) an administrative manager; (b) a commercial manager; (c) a warehouse manager; (d) sales supervisors (to supervise sales at CFE's service centers as well as door-to-door sales); (e) sales agents and (f) secretaries. The administrative and commercial managers and the remaining staff will be appointed by the Project Manager.

11. The main functions of the Project Manager will include the following: (a) propose for approval by the Technical Committee: (i) the annual program and budget for the Implementing Units, and (ii) the agreement to be signed between BANOBRAS and CFE authorizing the collection from customers the bi-monthly payments for FLs; (b) monitor Project implementation progress and propose, and when necessary take appropriate measures to ensure Project success; (c) prepare all reports specified in the Operating Guidelines to keep all interested parties informed of the progress in Project implementation; (d) prepare procedures for the storage, distribution, sale and installation of FLs; (e) answer customer's queries and, based on the Operating Guidelines, settle complaints related to the performance of the FLs; (f) authorize payments to contractors that provide marketing, evaluation and installation services for the Project, and (g) appoint the administrative and commercial managers, as well as the rest of the required staff.

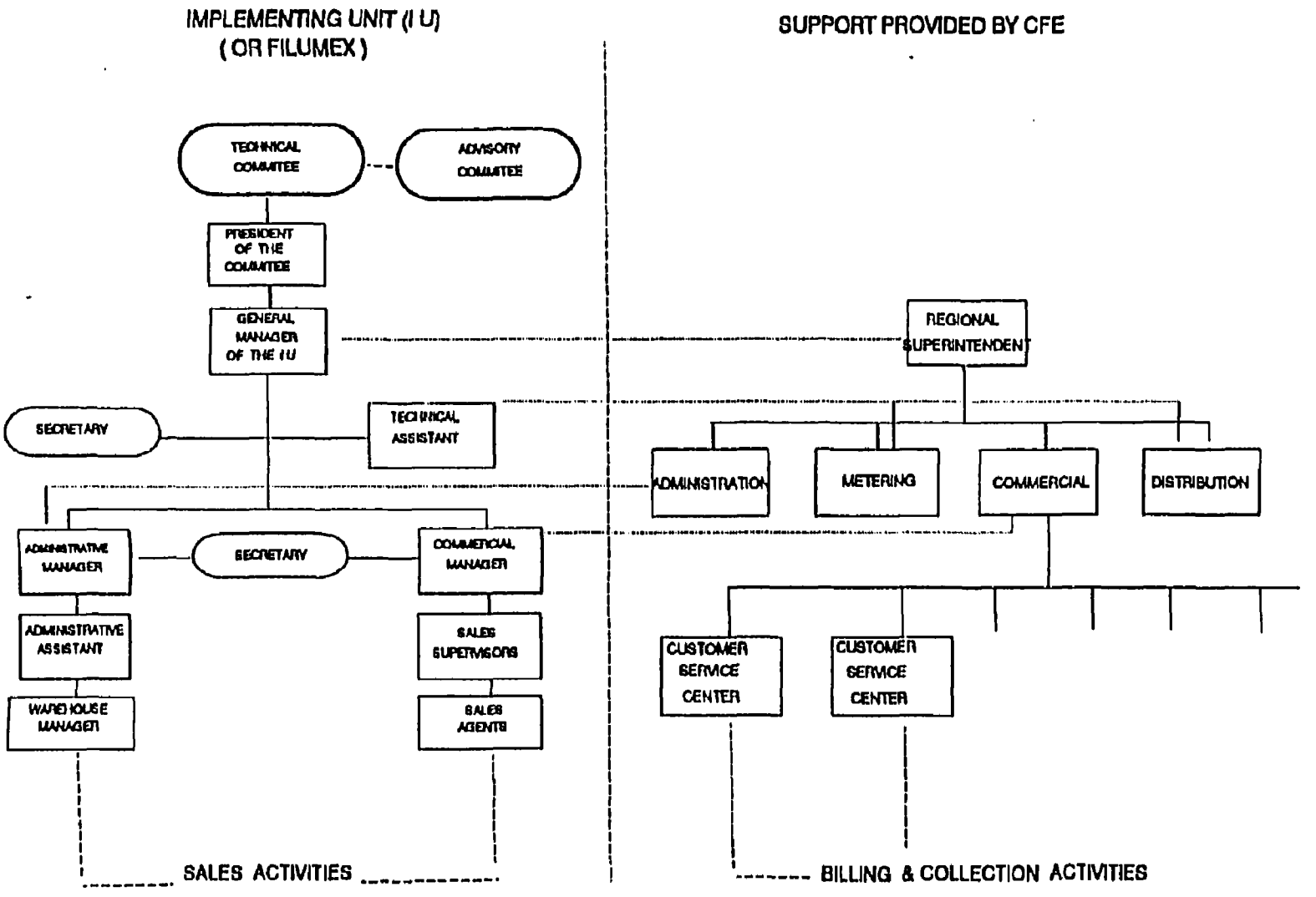
12. For a better appreciation of the proposed organization, the organization charts of the structures to be adopted in Headquarters and in the field are shown in pages 4 and 5.

HIGH EFFICIENCY LIGHTING PILOT PROJECT

Project Organization



HIGH EFFICIENCY LIGHTING PILOT PROJECT



MEXICO

HIGH EFFICIENCY LIGHTING PILOT PROJECT

Technical Specifications for the FLs

1. Since FLs are a relatively new product, the corresponding technical specifications have been evolving and will probably continue to do so. In order to prepare its specifications, CFE drew on the experience of other utilities, mainly those in the United States of America, as well as on the results of the small pilot projects that it has recently implemented. CFE also profited from the comments and suggestions offered by several manufacturers of FLs. For the purpose of this Project, the term "FLs" includes compact fluorescent light bulbs and circular fluorescent bulbs.

2. Given the nature of the product, experience shows that its appearance and dimensions are as important as its technical characteristics; otherwise, it will not be accepted by the public. Similarly, and for the same reason, color rendering is very important. Both the appearance and the color rendering of the FLs must be pleasing to the eye.

3. Technically, it is very important that the FLs deliver the expected efficiency measured in lumens per watt, that they reach their expected lifetime, that they have a high power factor and that the harmonic distortion that they introduce into the system be as small as possible. Since FLs to be procured under the Project are to some extent "tailor made", some of these factors have been requested in the specifications, while others will be the subject of a bonus or a penalty in the evaluation of the tenders to be received.

4. The specifications require that the FLs be manufactured in accordance with the following standards: American National Standards Institute, ANSI, the International Electrotechnical Commission, IEC, and the Illumination Engineering Society, IES. The specifications also state that other internationally recognized standards that provide the same performance, or exceed it, will also be acceptable.

5. The specifications cover three **Types** of FLs (in accordance with their luminous output in lumens), and two **Categories** (in accordance to the color of their light or internal temperature). The main technical characteristics specified by CFE are the following:

(a) Operating voltage: 120 volts plus/minus ten percent for Monterrey, and 127 volts plus/minus ten percent for Guadalajara.

(b) Efficiency: minimum 47 lumens per watt.

(c) Luminous flux (at 25 degrees Celsius): (i) **Type 1**: From 750 to 900 lumens; (ii) **Type 2**: From 1,000 to 1,200 lumens, and (iii) **Type 3**: From 1,400 to 1,700 lumens. The luminous flux must be equal or greater than 90% of the nominal value during 1,000 hours of operation.

(d) Color temperature (degrees Kelvin): (i) **Category A**: 4,000 to 4,200, and (ii) **Category B**: 2,600 to 2,800.

(e) Color Rendering Index: Greater than 80.

(f) Operating life: 10,000 hours.

(g) Power factor: Equal to or greater than 90%.

(h) Harmonic distortion: Not greater than: (i) third harmonic: 30%; (ii) fifth harmonic: 10%; (iii) seventh harmonic: 7%; (iv) ninth harmonic: 5%; (v) eleventh through forty ninth harmonic: 3%, and (vi) total harmonic distortion: 33%.

(i) Total length: Not more than 8 inches for all Types.

6. Each FL will be provided with a thermal overload protection device that will automatically turn it off in case it overheats and that will automatically turn it back on when it cools off. The specifications will accept both electronic and electromagnetic ballasts, as well as a single piece (ballast and lamp integrated in a single unit) or two piece FLs (ballast and lamp manufactured as two independent units that can be separated and reconnected at will). In case a two piece FL is quoted, the bidder will guarantee that the complete unit will operate as required in the specifications.

7. Bidders will be requested to furnish three samples for each type of FL quoted. These samples will be tested in the Lighting Laboratory of Mexico City, widely recognized as of high quality, with respect to: (a) operating voltage; (b) efficiency; (c) luminous flux; (d) color temperature; (e) power factor, and (f) harmonic distortion. CFE has reserved the right to declare non-responsive any tender that, as a result of the tests, fails to meet the specifications.

8. Tender evaluation will include a bonus for exceeding the required efficiency (47 lumens per watt) and power factor (90 %). The tender documents include two formulas for these purposes, so that all prospective bidders will know beforehand how these two factors will be evaluated and design their product accordingly. Those bids that do not meet the minimum efficiency and power factor (47 lumens/watt and 90%, respectively) will be rejected.

9. CFE will choose at random 20 lamps from the first delivery made by the selected contractor, and these FLs will be subjected to the same tests mentioned in paragraph 7, as well as a test to confirm that the luminous flux will be maintained as

required by the specifications. If the tests show that the FLs fail to meet the specifications, CFE reserves the right to reject the first delivery or to cancel the contract. CFE will also use a standard procedure to test the life of the FLs. For this purpose the lamps operate continuously, except for the periods in which the standards call that they shall be turn off. This procedure will allow CFE to know the results in about 15 months after the start of the test. If the test shows that the FLs have failed to meet the standards, the contractor will deliver, free of charge, a number of FLs equal to the number originally delivered multiplied by a factor equal to the difference between 51% (as established by the applicable standard) and the percentage of FLs that lasted 10,000 hours. This obligation will be guaranteed by a provision included in the model for the performance security included in the tender documents.

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HIGH EFFICIENCY LIGHTING PILOT PROJECT

Project Economic Analysis

1. The project entails costs and produces benefits for Mexico, CFE and the consumers, consequently, three different analyses have been prepared and are discussed in the following paragraphs.

Economic Analysis from the Perspective of Mexico.

2. From this perspective, the costs correspond to the project costs, which, as is the norm in economic analysis, are expressed in constant terms (price level of October, 1993). Given the relative openness of the Mexican economy, the project costs have been taken as economic costs free of distortions. The basic premises of the analysis are the following:

(a) The FLs are assumed to be procured and installed over a two year period; however, during the first year, only 15% of the benefits accrue. This increases to 60% during the second year and to 100% the third year.

(b) Although the expected life of the FLs is 10,000 hours, for the purposes of the analysis it is assumed conservatively that they will last only 8,760 hours.

(c) The incandescent lights that would be replaced by the FLs are assumed to have a life of 750 hours and, on the basis of the prevailing local market conditions, to cost about US$0.32.

(d) Energy losses in the Mexican power system amount to 18%, while capacity losses at peak time are 22%. These figures include losses in generation, transmission and distribution.

(e) Studies carried out by CFE show that the peak coincidence factor for the use of FLs in the residential sector is 0.82 when they are used four hours daily, and 0.7 when used two hours daily.

(f) Based on pro-forma quotations received by CFE, the average cif price of the FLs has been taken as US$8. The additional indirect costs, which include all other costs needed to implement the project, amount to 48% of the direct cost of the FLs.

(g) Based on studies recently completed for CFE by specialized consultants, the long run marginal costs (LRMC) at the distribution level and during peak hours are US$132.50 per kW/year and US$0.062 per kWh.

3. The benefits of the project from the point of view of Mexico are three: (a) the value of the capacity that need not be added to the system due to the installation of the FLs; (b) the value of the energy that will not be generated for the same reason, and (c) the value of the incandescent bulbs that will not be installed. The capacity and energy savings are valued at their LRMC. The cost corresponds to the procurement and installation of the FLs, including all the indirect costs needed to implement the project. Assuming that the FLs are used on average four hours daily, that the cost is as estimated, and on the basis of the above mentioned assumptions the calculated internal rate of return is 135%.

4. A risk analysis was performed considering two risk factors: variations in project cost and the number of hours that the FLs are used. The different events and their associated probabilities are as follows:

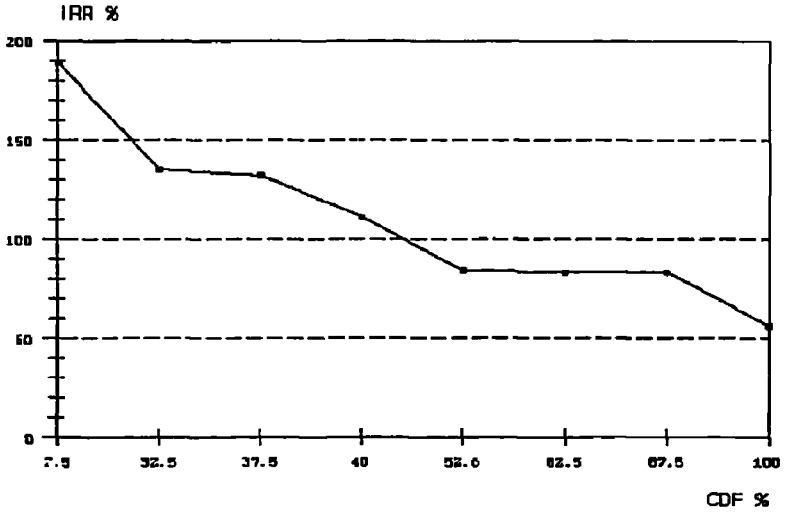
Cost related events	Probability
a. The cost is as estimated	60%
b. There is a cost overrun of 20%	25%
c. There is a cost overrun because 10% of the FLs fail and must be replaced annually	10%
d. There is a cost underrun of 20%	5%

Time of usage related events	Probability
g. FLs are used four hours daily	50%
h. FLs are used two hours daily	50%

5. The internal rate of return (IRR) calculation for each combination of events and the cumulative distribution function (CDF) are the following:

Combined Event	Combined Probability	IRR	CDF
d&g	3%	189%	3%
a&g	30%	135%	33%
c&g	5%	132%	38%
d&h	3%	111%	40%
b&g	13%	84%	53%
a&h	30%	83%	83%
c&h	5%	83%	88%
b&h	13%	56%	100%

PROBABILITY DISTRIBUTION FUNCTION OF IRRs
NATIONAL PERSPECTIVE



6. The expected value of the economic IRR is 101%, while the Cumulative Distribution Function (CDF) vs the IRR shows that with a probability of 83% percent the IRR will equal or exceed 83%. Furthermore, in all cases it will exceed 56%. Clearly, the project is very attractive for Mexico and its internal rate of return is very robust.

Economic Analysis from the Perspective of CFE.

7. In order to estimate the economic benefit for CFE, the FL distribution among the different customer classes must first be determined. The sales program envisioned by CFE is be the following:

FLs Sold per Customer Category

Category	Consumption per month	Monterrey	Guadalajara	Total
U1	0-25 kWh	86,557	120,120	206,677
U2	26-50 kWh	60,847	83,720	144,566
U3	51-75 kWh	98,555	108,290	206,844
U4	76-100 kWh	124,266	133,770	258,035
U5	101-200 kWh	331,659	318,500	650,160
U6	≥201 kWh	155,118	145,600	300,717
TOTAL		857,000	910,000	1,767,000

8. The number of customers, average monthly consumption per customer class and applicable energy charges are as follows:

Cate-gory	Consumers Guadalajara	Consumers Monterrey	Average Consumption Guadalajara	Average Consump-tion Monter-rey	Energy Charge US$/ kWh[1]
U1	74,830	55,451	10 kWh	6 kWh	0.02
U2	52,037	39,035	41 kWh	37 kWh	0.03
U3	67,888	63,038	70 kWh	61 kWh	0.03
U4	83,323	79,629	87 kWh	88 kWh	0.04
U5	199,908	212,799	127 kWh	143 kWh	0.04
U6	90,581	99,333	284 kWh	464 kWh	0.14

9. The assumptions for the analysis from the point of view of CFE are the same as those listed in paragraph 2 above; however, an additional factor must be included in this case. To make the project attractive to the participants, and to share with them the benefits of the project, CFE has decided to introduce a rebate in the program. On average, the magnitude of this rebate amounts to 63% of the total cost of the FLs, which includes all indirect costs of implementing the ILUMEX project.

10. In this analysis, the benefits to CFE are the capacity that need not be installed and the energy that will not be generated, valued at their LRMC. The cost is given by the rebate to be absorbed by CFE and by the foregone income, as the energy saved by the FLs will not be consumed by the participants. In order to reflect the situation as perceived by CFE, this energy is valued at what CFE charges its consumers. The rate of return to be calculated therefore corresponds to a financial internal rate of return.

11. As in the previous case, a risk analysis was conducted, but there is now an additional risk factor as the participation of the different categories of consumers might be different than that anticipated by CFE. Two different events have been included in the risk analysis to account for consumer participation, as follows:

Consumer participation related events	Probability
e. Participation is as expected by CFE	50%
f. Only consumers in categories U4, U5 and U6 participate	50%

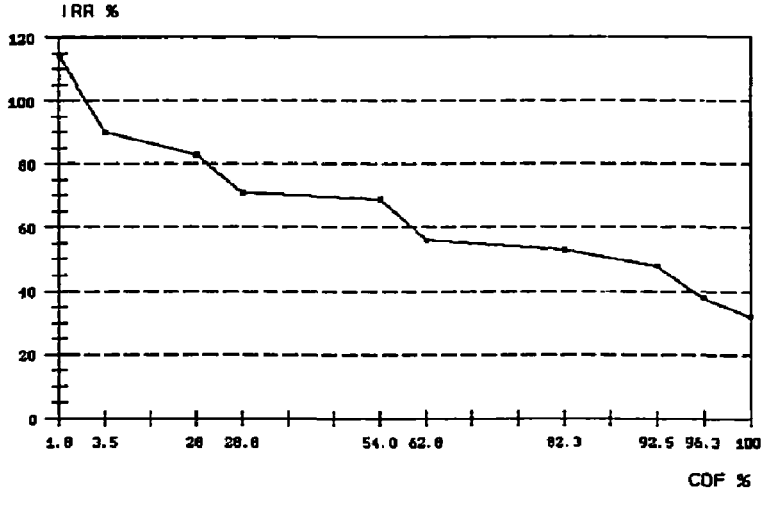
1. This figure does not include the maintenance charge that is independent of consumption and in addition to it.

12. When it is assumed that only consumers in categories U4, U5 and U6 participate, it has also been assumed that the FLs originally assigned to customers in categories U1, U2 and U3 are distributed among categories U4, U5 and U6. For this purpose, it has been assumed that 10% of the FLs originally assigned to other categories are now sold to customers in category U4, and another 10% to customers in category U5. The rest, 80%, is sold to customers in category U6.

13. An internal rate of return (IRR) calculation was prepared for each combination of events with the following results:

Combined Event	Combined Probability	IRR	CDF
d&e&g	2%	114%	2%
d&e&h	2%	90%	4%
a&e&g	21%	86%	25%
c&e&g	4%	83%	28%
d&f&g	1%	71%	29%
d&f&h	1%	71%	30%
a&e&h	21%	70%	51%
c&e&h	4%	69%	54%
b&e&g	9%	56%	63%
a&f&h	9%	55%	72%
a&f&g	9%	54%	81%
c&f&g	2%	53%	82%
c&f&h	2%	51%	84%
b&e&h	9%	48%	93%
b&f&h	4%	38%	96%
b&f&g	4%	32%	100%

PROBABILITY DISTRIBUTION FUNCTION OF IRRs
C F E PERSPECTIVE



14. The expected value of the IRR is 66%, while the Cumulative Distribution Function (CDF) vs the IRR shows that with a probability of 81% percent the IRR will equal or exceed 54%. Furthermore, in all cases it will exceed 32%. Quite clearly, the project is very attractive for CFE, even assuming a rebate of 63% of the total cost of the FLs, and its internal rate of return is very robust.

Economic Analysis from the Perspective of the Participant.

15. In this case, the benefits to the participants are the energy that will be saved by the FLs and therefore not consumed or paid for by the participants, as well as the value of the incandescent bulbs that the participants will replace with FLs. The cost is given by the portion of the total cost of the FL (37%) that will be borne by the participants, financed over 24 months. In order to reflect the situation as perceived by the participants, the energy saved is valued at what CFE charges its consumers. The rate of return to be calculated therefore corresponds to a financial internal rate of return.

16. As in the previous cases, a risk analysis was conducted which included the risk factor related to the participation of the different categories of consumers. The analysis was carried out for the participants as a group. This understates the IRR for those in the higher consumption groups and overstates it for those in the lower consumption groups. However, since the IRR is so high, there is no need to refine the analysis. In fact, the lowest IRR calculated was 151% and it corresponded to event b&e&h.

17. The IRRs for the rest of the events are even higher and therefore not listed here. It is clear that under the worst case scenario, the IRR for the participants as a group is 151% and this event has a probability of only 8.75%. Therefore, with a probability of 91.25% the IRR will be even greater. It can be therefore said that the ILUMEX project is very attractive for the participants as a group and that this is so under all events considered in the analysis.

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HIGH EFFICIENCY LIGHTING PILOT PROJECT

Environmental Aspects

1. The Project's benefits for the environment include the reduction of emissions of green house gases (GHGs), methane and CO_2, as well as other contaminants such as SO_2 and NO_x. The Project will also help decrease the volume of particles in the air and the volume of coal ashes produced by the coal-fired thermal power stations. Some of the Project benefits, such as the reduction in SO_2, NO_x, particulate and ash accrue to the local environment, while others, such as the reduction of GHGs (CO_2 and methane) have global repercussions. However, even local effects might have international consequences if they occur in the neighborhood of international borders. Such is the case of acid rain, which might fall on a neighboring country or might fall in the drainage area of rivers that later drain into rivers or lakes that separate, or run through, two or more countries.

2. To quantify the benefits to the environment, CFE drew on the work recently completed by their consultants, UITESA of Spain, who evaluated the contaminants emitted by CFE's eight thermal power stations, among others, NO_x, SO_2 and particulate in the air. For the GHGs, CFE used typical figures provided in the Feasibility Study for the ILUMEX project prepared by another consultant, the International Institute for Energy Conservation, IIEC. With these figures, CFE simulated the operation of the system assuming that the load in Monterrey and Guadalajara is reduced because of the installation of the FLs; a load reduction in these two cities will affect mainly the power stations nearby the two cities, including a thermal power station near Monterrey which has emissions above the level produced by the remaining seven power stations.

3. On the basis of UITESA's work, IIEC's figures and CFE's own load dispatch simulation, the annual reduction of different contaminants due to the ILUMEX project has been calculated by CFE. This resulted in an annual reduction of CO_2 equal to 118,000 tons, while those of SO_2 and NO_x would reach 3,000 and 205 tons, respectively. Finally, the reduction in particulate and methane will be 200 and 250 tons, respectively. These calculations are based on replacing 1.7 million incandescent light bulbs with FLs, on an average use of four hours daily for each FL and on energy losses of 18%.

4. The total direct emission reductions attributable to the Project is rather robust to changes in Project parameters. Delays in the replacement of failed FLs and the use of the FLs for less than 4 hours a day will only delay the emission reductions, but the total benefits will be the same as long as the useful life of the FLs is not affected. In addition to the emission reductions that will result directly from the Project, there will be an indirect benefit due to the "free driver effect" (induced sales of FLs caused by the Project). However, over the longer term, there will also be behavior adjustments by the consumers, which could lead to diminished emission reductions. For example, consumers might decide to install FLs with a greater lighting level than the incandescent bulb that they replaced. It is also not clear that

after the FLs reach the end of their useful life the consumers will replace them with other FLs purchase at full cost (which however will almost certainly be lower in real terms than that prevailing in the market today as the use of these bulbs becomes more widespread in Mexico and elsewhere). Finally, the fuel mix of the Mexican thermal power stations is likely to change in the future towards fuel with less carbon content due to local environmental considerations. Given the uncertainty surrounding the longer term effects, they have not been incorporated in the analysis presented herein.

5. The economic analysis of the ILUMEX project presented in Annex 3 shows that it is very attractive even if its environmental benefits are not considered. Therefore, it could be expected that it should be implemented by the local beneficiaries. There are, however, several informational and institutional barriers to the diffusion of the FL technology for residential use, which the ILUMEX project will contribute to overcome. The most important of these barriers are: i) lack of information about the benefits of the FLs, ii) high initial investments, and iii) investment constraints imposed on CFE for macroeconomic reasons. For these reasons, the participation of the GEF and other donors is essential to obtain the reductions of GHGs and the other benefits such as the reduction of local contamination and the dissemination of energy efficient technology.

6. Although there is no consensus on how to evaluate the economic benefits of reducing GHGs and other contaminants, Data Resources Inc., (DRI) has estimated the cost per ton of CO_2 to stabilize emissions at their 1988 level in the year 2000, reduce them by 10 % in 2010 and by 20 % in 2020 in several OECD countries[1]. These costs are in addition to taxes that have already been put into effect by the countries concerned. The costs estimated by DRI in 1989 US$ per ton of CO_2 for the years 1995 and 2000 are the following:

COUNTRY	1995	2000
United States	9	33
Canada	9	39
Japan	43	110
Australia	20	55
Germany	30	80
France	38	95
Italy	22	54
UK	7	20
Sweden	6	16
Spain	50	121
Netherlands	18	46
Greece	27	69

1. "Economic Effects of Using Carbon Taxes to Reduce CO_2 Emissions in Major OECD Countries", Data Resources Inc. (McGraw-Hill, 1992).

5. These figures would have to be converted to 1993 US$ in order to fully capture the benefit of the ILUMEX project. However, even in 1989 prices and based on the average of the 1995 figure (US$23 per ton), the annual benefits of CO_2 reduction attributable to the project would have a value of US$2.7 million. This figure will almost triple if the average corresponding to the figures for year 2000 (US$61) is used. These figures are conservative in light of studies carried out in Norway which have estimated (in 1990 prices) the cost to stabilize the Norwegian CO_2 emissions at their 1989 level in the year 2000 at approximately US$184 per ton. That the benefits are conservative is also demonstrated by calculations prepared for the OECD countries which show that to stabilize the CO_2 emissions of the OECD countries as a whole will about US$60 per ton.

6. Another measure of the value of the reduction of the GHGs can be obtained by using the carbon taxes applied in some countries as a proxy to value the benefit of the reduction. There are nominal and effective CO_2 tax rates in effect in 1993 for the Nordic countries; the effective tax rate is defined as an average tax paid on all emissions, and is lower than the nominal tax rate due to exemptions for some sectors and fuels. The applicable taxes in US$ per ton of CO_2 are[2]:

COUNTRY	1993 NOMINAL RATE	1993 EFFECTIVE RATE
Denmark	15	7
Finland	4	4
Norway	56	20
Sweden	55	33
EC Proposal	25	

If the average of the nominal rates (US$26) is used, the annual savings would be valued at US$3 million; if the average of the effective rates is used (US$16), the figure is US$1.9 million. Regardless of the figure used, the benefits resulting from the reduction of CO_2 are significant and as a minimum can be estimated at US$1.9 million annually.

7. There are additional benefits attributable to the project, particularly those related to the reduction of the local environmental degradation. However, no figures are available to assign a monetary value to these benefits, although they are clearly important. It is expected that as Mexico in general, and CFE in particular, continue with their efforts to reduce SO_2 and NO_x emissions, relevant cost figures will become available. The benefits of reducing these emissions can then be calculated as part of the evaluation to be carried out as the Project is completed.

2. OECD Environment Monograph 78/1993: "A Comparison of Carbon Taxes in Selected OECD Countries".

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HIGH EFFICIENCY LIGHTING PILOT PROJECT

Project Monitoring and Evaluation

1. As explained in Annex 1, Project Organization, Project monitoring and evaluation will mostly be under the responsibility of the Project managers of the Implementing Units at both cities. The Project Coordination Unit, PCU, at CFE's Headquarters will supervise these activities and propose the adjustments as needed. Given the specialized nature of these activities, the Project managers and the PCU will be assisted by qualified consultants in the areas of marketing, canvassing and interviewing, as well as in Project evaluation. The terms of reference of these consultants can be found in Annex 7.

2. Project evaluation will gauge the achievement of the stated goals of the Project, including energy savings and the so-called "free driver" effect, which measures the sales by commercial retailers induced by the Project. It is envisioned as a continuous process, which will also provide information to make adjustments in Project implementation, particularly with regards to marketing strategies, to ensure Project success.

3. Base Line Survey. Project monitoring and control will start with a sales survey three months before the sale of FLs begins[1], and this will constitute the "base line" for Project monitoring and evaluation. This survey will determine prices and monthly sales of incandescent bulbs and FLs, including their type and characteristics. It will also determine the number of units available in warehouses and in the stores of bulk and retail suppliers, as well as the number of suppliers and their sales volume. A similar survey will be carried out at the end of the Project and this will provide the information required to estimate the "free driver" effect.

4. Sales and Participants Satisfaction Survey. As part of the Project monitoring and control, the following activities will take place three months after Project start, and again a year after that:

(a) an evaluation will be carried out of the FL sales made in CFE's agencies in Guadalajara and Monterrey. Its purpose will be to determine any shortcomings in the sales process, the need for additional training for the sales force, storage and inventory controls for the FLs, information systems and coordination with PAESE and FIDE, if needed. A similar evaluation would be undertaken three months after the start of the door-to-door sales process. In both cases, the

1. It is assumed June of 1994 as the date to start sales of CFLs and Project implementation.

evaluation will be based on interviews and conversations with the Project staff in both cities.

(b) a survey will be made among Project participants. The survey will be used to obtain the following information: (i) number and types of FLs installed, place where they were installed, the characteristics of the incandescent bulbs that they replaced and number of hours of use of the FLs; (ii) lighting level and quality, start-up time of the FL, prices, financing terms and how useful the participant found the information provided by the sales personnel; (iii) reasons for selecting the type of FL chosen; (iv) customers' perception of the savings realized, reasons for purchasing FLs, familiarity with FLs before Project start and knowledge gained since, purchases of FLs made prior to Project start, independent of the Project and probable future purchases; quality of the customer service provided by the Project, and (v) socio-economic characteristics of the participants (type and area of the home, number of family members, income, age, etc).

(c) a survey will also be carried out among non-participants in the Project. The aim of this survey will be to determine the reasons why they have not participated, together with the socio-economic information of the non-participants.

5. Survey on Hours of Use of FLs. Six months and eighteen months after Project start, a survey will be carried out to determine the number of hours per day that participants use the FLs. To this end, metering equipment will be installed in a selected sample of participants to record the hours during which the FLs are used every day. This will allow the Project to determine the savings accruing to those participants, as well as the peak coincidence factors. On the basis of this information, as well as studies carried out to determine the consumption in kWh before and after the installation of the FLs of a random sample of participants, it will be possible to calculate the benefits to the participants, CFE, Mexico and the environment.

6. Mid-term Project Implementation Review. On the basis of the above mentioned surveys, a comprehensive mid-term Project implementation review will be carried out with the participation of the Bank, not later than June 30, 1995. The results of the surveys will be discussed and appropriate measures will be taken as a result. In particular, if the target sale levels mentioned in the Operating Guidelines have not been reached, the Bank and CFE will discuss and agree on whether the ILUMEX project should de discontinued or modified. If the targets have not been reached, but it is decided that the Project should continue, then remedial measures to improve sales will be adopted. These measures might include, among others, expanding and/or training the sales force, improving the advertising campaign, resorting to setting up temporary and portable sales stands in selected neighborhoods and, as a last resort, proceed with a door-to-door sales effort.

7. End of Project Review. Upon Project completion, expected for the end of 1997, an end-of-Project review will be undertaken with the participation of the Bank. During this review, Project results will be critically evaluated and the lessons learned in ILUMEX will be incorporated in any new project that may be carried out by CFE. Furthermore, during the review meeting, agreement will be reached on the format, content, participants and date of a seminar to disseminate the results of the ILUMEX project. It is expected that the lessons learned will be disseminated among a sizeable international audience.

8. Final Project Evaluation. Six months after Project completion, a final evaluation report will be prepared and submitted to the Bank. This report will include the results of a survey to be carried out among the participants to determine how satisfied they were with the FLs, how many FLs failed and had to be replaced, whether they remained where they were originally installed, whether more FLs were purchased through commercial retailers and other similar data.

9. Monitoring and Evaluation Indicators: The attached table shows the goals and dates agreed with the Bank to monitor and evaluate the Project.

Project Monitoring and Evaluation Indicators and Events

	June 94	Dec 94	June 95	Dec 95	June 96	Dec 96	June 97	Dec 97	1998
Accumulated Sales of CFLs									
Guadalajara		91,000	318,000	546,000	773,000	876,000			
Monterrey		86,000	300,000	514,000	728,000	824,000			
Total Project		177,000	618,000	1,060,000	1,501,000	1,700,000			
Consultants									
Marketing Survey	Hired	AAAA		AAAA				AAAA	
Promotion and Advertising	Hired	AAAA	AAAA						
Monitoring and Evaluation	Hired		AAAA		AAAA		AAAA		AAAA
Laboratory Testing	Hired	AAAA	AAAA	AAAA	AAAA				
Reports									
Base Line Survey		XXXX							XXXX
Sales and Participants Satisfaction Survey			XXXX		XXXX				
Hours of Use Survey			XXXX						
Mid-Term Project Implementation Review 1/			XXXX						
End of Project Report							XXXX		
Final Project Evaluation								XXXX	XXXX
Semi-Annual Progress Reports		XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	
Auditing Reports				XXXX		XXXX		XXXX	XXXX

Notes: AAAA: Consultants' Activities XXXX: Report due this semester 1/ Meeting in August 1995

MEXICO

HIGH EFFICIENCY LIGHTING PILOT PROJECT

Project Operating Guidelines[1]

A. Project Objectives

1. The ILUMEX project will replace approximately 1.7 million incandescent bulbs with high efficiency fluorescent lamps (FLs) in the homes of CFE's residential consumers in the cities of Monterrey and Guadalajara. For the purpose of the Project, "FLs" includes compact fluorescent light bulbs and circular fluorescent bulbs. The Project will help CFE postpone the installation of additional generating capacity and save fuel that would otherwise be necessary to produce the energy that will be saved by the FLs. To the participants, the Project will produce savings in their electricity bills, as well as savings in incandescent bulbs that they would otherwise have to purchase. The Project will also have important benefits for the environment, as it will reduce the contamination that would otherwise be produced in order to generate the energy that the FLs will save.

B. Project Financing

2. The Project will be financed with an equivalent of US$10 million to be contributed by CFE, a grant of SDR 7.3 million from the GET, and a grant of NKr 20.25 million from the Kingdom of Norway. In addition, the participants of the Project will also contribute through the purchase of FLs.

C. Objective of the Operating Guidelines

3. The objective of these Operating Guidelines (OG), is to provide guidance to the staff that will be responsible for Project implementation. It is expected that these OG will contribute significantly to meeting the Project goals and targets. Nevertheless, it is also understood that unanticipated circumstances might appear during Project implementation; therefore, the OG must be understood a dynamic document that will evolve through feedback received from the Implementing Units (IUs). However, any major changes would have to be satisfactory to the Bank.

4. Initially, the ILUMEX project will cover only the cities of Monterrey and Guadalajara, but at a later stage may be extended to the entire states of Nuevo Leon and Jalisco if the demand for FLs in the two cities does not develop as predicted. To implement the Project, Implementing Units will be created in Monterrey and Guadalajara. These IUs will be financed with funds deposited in two trust accounts ("Fideicomisos") that will be opened in BANOBRAS. The operation of these trust accounts will follow the rules that legally apply to the "Fideicom-

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1. This Annex is an abstract of the document "Operating Guidelines" ("Guías de Operación del Proyecto") agreed with CFE during negotiations of the grant.

isos"; in particular, the funds will only be used for the implementation of the ILUMEX project and will be subject to strict auditing procedures.

D. Organization for the Implementation of ILUMEX

5. As may be seen in the chart on page 4 and 5 of Annex 1, Project organization involves staff in CFE's Headquarters as well as in the cities of Guadalajara and Monterrey. To set policy and supervise compliance with Project objectives, a Project Coordination Unit, PCU, has been set up in CFE's Headquarters in Mexico City. The Head of the Project Coordination Unit, or Project Coordinator, is the Subgerente de Evaluación (Deputy Manager for Project Evaluation) of the Subdirección de Distribución (Vice Directorate for Distribution). Other members of the Unit include other key staff of that Subdirección, a representative of PAESE, a representative of the engineering staff of CFE (responsible for the preparation of the technical specifications of the FLs) and a consultant specialized in economic analysis of projects.

6 The main functions of the PCU are the following: (a) to support the Distribution Divisions in Jalisco and Golfo Norte (which serve Guadalajara and Monterrey, respectively) as well as the Managers of the corresponding IUs; (b) supervise Project implementation; (c) propose the strategy and studies (marketing, technical and economic) to monitor and evaluate Project results; (d) based on the reports submitted by the Managers of the IUs, prepare the progress reports needed during Project implementation; (e) procure the goods and services that will be required by the ILUMEX project; (f) review and update the Operating Guidelines for the Project (major amendments have to be satisfactory to the World Bank); (g) inform the authorities of CFE (through the Central Advisory Committee mentioned in the next paragraph) of the advances in Project implementation; and (h) recommend shifting of funds among the two FILUMEX if the Project in any of the two cities is seriously lagging.

7. CFE will supervise the Project through a high level Central Advisory Committee whose members will be the Deputy Director for Distribution, the Director General of FIDE, the Distribution Manager of CFE and the Commercial Manager of CFE. The President of the Committee will be the Deputy Director for Distribution. The functions of the Committee will include the following: (a) appoint the members of the PCU; (b) approve the strategy for Project implementation developed by the PCU; (c) approve the details of the operating rules of two trust accounts to be opened in BANOBRAS to finance the two IUs; (d) appoint the presidents of the Technical Committees of each of the two Implementing Units, and (e) meet periodically to review the progress reports prepared by the PCU and recommend those measures that it deems necessary to reach the goals of the Project.

8. CFE will also provide technical support to the Project. The specifications for the procurement of the FLs have been prepared by CFE's Engineering Department in consultation with CFE's Procurement Office. CFE will also be responsible for the bidding process and the procurement of the FLs, which will then be handed over to the two IUs in Guadalajara and Monterrey. Finally, for deferred terms sales, CFE's Service Centers at Guadalajara and Monterrey will also be responsible for including in the customer's electricity bill the amount financed to purchase the FLs.

9. In order to implement the Project, two decentralized IUs will be established, one in Guadalajara and one in Monterrey. To ensure the administrative and financial independence needed for the expeditious implementation of the ILUMEX project, these units will be financed through two trust accounts ("Fideicomisos") opened in BANOBRAS. All funds required for the operation of the IUs, as well as the payments made by the participants who purchase the FLs on credit, will be deposited in these trust accounts. The funds shall only be used for the purposes of the ILUMEX project, in the two Distribution Divisions that serve Guadalajara and Monterrey (Jalisco and Golfo Norte, respectively); the initial efforts will be concentrated in the two cities.

10. The administration of each IU will be the responsibility of a Technical Committee whose members will be: (a) the General Manager of the Regional Distribution Division (Jalisco or Golfo Norte); (b) the Deputy Distribution Manager of the same Division; (c) the Deputy Manager of the Commercial Division of the same Region; (d) the Head of PAESE of the same Division, and (e) a representative of BANOBRAS who would be a non-voting member of the Committee. The President of the Committee will be the General Manager of the Regional Distribution Division.

11. The functions of the Technical Committee will include the following: (a) approve: (i) the annual program and budget; (ii) the agreement to be signed between BANOBRAS and CFE authorizing the latter to collect the amounts owed by the customers for the credit sale of the FLs, (b) supervise Project implementation, and (c) monitor the flow of funds for the Project, including CFE's contributions. The Committee will meet at least once a month.

12. To benefit from the local expertise that is available, the Technical Committee might decide to establish a local Advisory Committee, whose members would include representatives of : (a) the State (Monterrey or Guadalajara) Energy Conservation Commission; (b) the National Chamber of Contractors; (c) the National Chamber of Commerce; (d) the National Chamber of Electrical Equipment Manufacturers; (e) the local University or Technical Institute, and (f) FIDE. This Committee would meet when convened by the Technical Committee and will act strictly as an advisory group.

13. The day-to-day administration of each Implementing Unit fund will be the responsibility of a Project Manager. The Project Manager will be appointed by the Technical Committee, and he will then proceed to select the staff needed for Project implementation. The staff will include at least the following: (a) an administrative manager; (b) a commercial manager; (c) a warehouse manager; (d) sales supervisors (to supervise sales at CFE's service centers as well as door-to-door sales); (e) sales agents and (f) secretaries. The administrative and commercial managers and the remaining staff will be appointed directly by the Project Manager.

14. The main functions of the Project Manager will include the following: (a) propose for approval by the Technical Committee: (i) the annual program and budget for the Implementing Units, and (ii) the agreement to be signed between BANOBRAS and CFE authorizing the latter to collect the amounts owed by the customers for the financing of the FLs; (b) monitor Project implementation progress and propose, and when necessary take appropriate measures to ensure

Project success; (c) prepare all reports specified in the Operating Guidelines to keep all interested parties informed of the progress in Project implementation; (d) prepare procedures for the storage, distribution, sale and installation of FLs; (e) answer customer's queries and, based on the Operating Guidelines, settle complaints related to the performance of the FLs; (f) authorize payments to contractors that provide marketing, evaluation and installation services for the Project, and (g) appoint the administrative and commercial managers, as well as the rest of the required staff.

E. Facilities and Equipment

15. Both IUs will rent suitable office space in Guadalajara and Monterrey and will purchase sales stands and office equipment to furnish the offices. CFE will purchase vehicles, computers and metering equipment for the Project. For accounting purposes, these purchases will be charged to the account of each IU. The sales stands will be mounted in CFE's Service Centers in both cities and work space will be provided for a sales agent also. Thus, the prospective participants will find information and service in all Service Centers, as well as in the offices of the IUs.

16. Additional facilities and equipment might be needed if the ILUMEX project is to be extended to the rest of the Jalisco and Golfo Norte Regions. In this case, the PCU will authorize the IUs to procure locally the items that might be needed.

17. Goods and services will be procured by CFE and put at the disposal of the IUs as needed. This will allow ILUMEX to profit from better prices that result from bulk purchases. The funds needed for the operation of the IUs will be channeled to the Units through the trust accounts ("Fideicomisos") opened in BANOBRAS.

18. Procurement of goods financed by the GET or Norway, i.e. FLs, will be carried out in accordance with the Guidelines for Procurement of the World Bank. These Guidelines specify international competitive bidding (ICB) for the procurement of goods.

19. The IUs will be responsible for keeping and maintaining their own accounting, using CFE's standard chart of accounts. The PCU and/or BANOBRAS will appoint independent auditors to audit yearly the IU's accounts, including participants' accounting. After a contract is signed with a participant, the IU will provide the pertinent information to the corresponding CFE Distribution Division so that the amounts to be paid bimonthly by the participant can be included in the electricity bill to be prepared by CFE. CFE will also collect from the participants and deposit the corresponding amounts paid by the participants in the trust accounts opened in BANOBRAS.

20. CFE will provide space in their warehouses in Guadalajara and Monterrey to store the FLs prior to their sale to the participants. The storage and control of the FLs while they are in the warehouses will follow CFE's rules and procedures.

F. Characteristics of the FLs

21. The main characteristics of the FLs specified by CFE will be the following[2]:

(a) Operating voltage: 120 volts plus/minus ten percent for Monterrey, and 127 volts plus/minus ten percent for Guadalajara.

(b) Efficiency: minimum 47 lumens per watt.

(c) Luminous flux (at 25 degrees Celsius): (ii) Type 1: From 750 to 900 lumens; (iii) Type 2: From 1,000 to 1,200 lumens, and (iv) Type 3: From 1,400 to 1,700 lumens. The luminous flux must be equal or greater than 90% of the nominal value during 1,000 hours of operation.

(d) Color temperature (degrees Kelvin): (v) Type A: 4,000 to 4,200, and (vi) Type B: 2,600 to 2,800.

(e) Color Rendering Index: Greater than 80.

(f) Operating life: 10,000 hours.

(g) Power factor: Equal to or greater than 90%.

(h) Harmonic distortion: Not greater than: (vii) third harmonic: 30%; (viii) fifth harmonic: 10%; (ix) seventh harmonic: 7%; (x) ninth harmonic: 5%; (xi) eleventh through forty ninth harmonic: 3%, and (xii) total harmonic distortion: 33%.

(i) Total length: Not more than 8 inches for all Types.

22. Each FL will be provided with a thermal overload protection device that will automatically turn it off in case it overheats and that will automatically turn it back on when it cools off. The specifications will accept both electronic and electromagnetic ballasts, as well as a single piece (ballast and lamp integrated in a single unit) or two piece FLs (ballast and lamp manufactured as two independent units that can be separated and reconnected at will). In case a two piece FL is quoted, the bidder will guarantee that the complete unit will operate as required in the specifications.

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2. This information will be updated by the PCU when the contracts for the supply of the FLs have been awarded.

23. The FLs will be purchased through no more than three ICBs, each of approximately 1/3 of the total Project needs. In awarding the contract, both the efficiency of the FLs (measured in lumens per watt) and the power factor will be evaluated, and a bonus or a penalty will be applied depending on whether the proposed FLs exceed the specifications or fail to meet them. The experience gained with the FLs provided in the first ICB will be used to fine tune the specifications for the procurement of the second lot. For this purpose, the feedback received from the IUs will be critical.

G. Sales Procedures

24. Sales will be in cash or on credit, for a maximum of six FLs per customer. However, the PCU might raise this ceiling if it deems that this is necessary to reach the goals of the Project. If a customer opts to buy on credit, in order to keep operating costs under control, he must buy at least three FLs and make a down payment of five Nuevos Pesos per lamp. The balance will be paid in twelve bimonthly payments, so that the whole cost will be paid in 24 months. The minimum number of FLs to be bought on credit might be lowered if the PCU deems that this is necessary to meet Project goals.

25. CFE will give the participants in the Project a rebate for each FL purchased. This rebate will be calculated so that for a customer in category U3 (51 to 75 kWh), the savings in the electricity bill equal the bimonthly payments that he must make for the purchase of the FL. Furthermore, the rebate must be such that customers in categories U1 and U2 must be able to recover the investment they have made in the FLs in a maximum of 24 months. It is estimated that this results in an average rebate of 63% of the total cost of a FL (the direct cost plus all the other costs necessary to implement the ILUMEX project). The following rebates (lamp type in lumens and rebate in Nuevos Pesos) will apply initially but might be changed from time to time by the PCU:

Type of Lamp	FL 750	FL 1000	FL 1400	Circular
Rebate (N$)	21.90	19.30	29.80	11.00

26. The FLs will be sold at the sales stands installed in CFE's Service Centers, as well as in the offices of the IUs. The PCU may also require that portable sales stands be used in selected neighborhoods and shopping centers. Furthermore, if conditions so warrant, the PCU will require that the IUs undertake a door-to-door sales campaign. In all cases, except for the door-to-door campaign, the participants will be responsible for the installation of the FLs in their home. The participant will be provided, at the moment of purchase, with information that will allow to select the best place to install the FL (that is to say, the installation place that will produce the largest savings). During the door-to-door campaigns, the FLs will be installed for the customer by the IUs.

27. A contract will be signed with each participant in the Project. A draft contract will be prepared by the PCU and sent to each IU prior to the start of sales. A requisite for participation in the program will be that the person be a consumer in good standing with CFE and that presents the pertinent personal identification and information at the moment of contract signature. The bimonthly payments will be calculated on the balance using an interest rate to be fixed quarterly by the PCU, equal to the rate for the Government CETES prevailing in the last day of the previous quarter. The interest rate for the participant will remain fixed during the duration of the contract. The contracts will also specify that the program will replace, free of charge to the participant, any FL that fails within two years of contract signature. In order to receive a replacement unit, the participant will be required to return the failed FL.

28. Since CFE will not be able to disconnect service to a customer that pays his electricity bill but does not make his bimonthly payment for the FL, CFE will promptly notify the IU so that they can investigate the situation and take appropriate measures. If a participant wishes to abandon the Project because he feels that he is not receiving the expected benefits, the IU will investigate the situation and attempt to convince the participant to continue in the Project. If this turns out to be impossible, the IU will retrieve the FL and return it to its stock of FLs.

29. The bimonthly payments received for the sale of the FLs will be deposited in the pertinent account opened in BANOBRAS. These funds might be used to start a new project after ILUMEX is completed. The details of a possible subsequent project will be communicated by the PCU to the IUs.

H. Advertisement

30. The PCU will retain the services of a specialized firm to prepare an advertisement campaign prior to the start of sales. Although the ILUMEX project will be restricted to residential consumers, the advertisement campaign will also be directed to commercial and other consumers, who will be directed to purchase their FLs in normal retail outlets. The IUs must be prepared to provide additional information to these consumers and to direct them to several retail outlets. The PCU will also hire a firm to manage the advertisement campaign, and provision will be made to fine tune the campaign on the basis of the feedback received from the IUs.

I. Project Goals and Supervision

31. The monthly goals for sales for the first semester of Project implementation (second semester of 1994) per category of consumer and type of FL are listed in the table below. The semi-annual overall goals are also shown.

Jalisco (Guadalajara):

Category	FL 750	FL 1000	FL 1400	Circular
U1 (0-25 kWh)	6,400	2,500	1,900	3,700
U2 (26-50 kWh)	4,500	1,900	1,300	2,500
U3 (51-75 kWh)	5,800	2,400	1,700	3,300
U4 (76-100 kWh)	7,100	3,000	2,100	4,100
U5 (101-200 kWh)	13,900	5,800	4,100	8,000
U6 (≥ 201 kWh)	2,200	900	600	1,300
Total	39,900	16,500	11,700	22,900

Nuevo Leon (Monterrey):

Category	FL 750	FL 1000	FL 1400	Circular
U1 (0-25 kWh)	4,100	2,700	1,300	2,700
U2 (26-50 kWh)	2,900	1,900	900	1,900
U3 (51-75 kWh)	4,600	3,100	1,500	3,100
U4 (76-100 kWh)	5,900	3,900	1,900	3,900
U5 (101-200 kWh)	12,900	8,500	4,100	8,600
U6 (≥ 201 kWh)	2,000	1,400	700	1,400
Total	32,400	21,500	10,400	21,600

Overall Project Goals

Semester Ending	Monthly Sales	Accumulated Sales
December 94	29,500	177,000
June 95	73,500	618,000
December 95	73,700	1,060,000
June 96	73,500	1,501,000
December 96	33,000	1,700,000

32. By the time of the Mid-term Project Implementation Review (June of 1995), a total of 618,000 FLs should have been sold in the two cities; if the sales are below 70% of this goal, the World Bank may decide to cancel the balance of the two grants.

33. The IUs will monitor sales monthly and shall inform the PCU of their monthly sales level. Remedial measures, if needed, will be taken quarterly. If in either city, overall (i.e., for all customer classes and for all types of lamps) bimonthly sales fall 20% or more with respect to Project targets, one or a combination of the following measures will be taken:

(a) Improve advertisement campaign;

(b) Expand sales force or improve its training;

(c) Resort to sales using portable stands in selected neighborhoods and shopping centers;

(d) Resort to door-to-door sales;

(e) Resort to door-to-door sales and increase rebate.

If after taking a particular measure, it is found in a subsequent review that the situation did not improve, then complementary measures from this set shall be implemented.

J. Project Monitoring and Evaluation

34. The Project Coordination Unit, PCU, at CFE's Headquarters will supervise these activities and propose the adjustments as needed. Given the specialized nature of these activities, the Project managers and the PCU will be assisted by qualified consultants in the areas of marketing, canvassing and interviewing, as well as in Project evaluation.

35. Project evaluation will gauge the achievement of the stated goals of the Project, including energy savings and the so-called "free driver" effect, which measures the sales by commercial retailers induced by the Project. It is envisioned as a continuous process, which will also provide information to make adjustments in Project implementation, particularly with regards to marketing strategies, to ensure Project success.

36. Project monitoring and control will therefore start with a sales survey three months before the sale of FLs begins. This survey will determine local prices and monthly sales of incandescent bulbs and FLs, including their type and characteristics. It will also determine the number of units available in warehouses and in the stores of bulk and retail suppliers, as well as the number of suppliers and their sales volume. A similar survey will be carried out at the end of the Project and this will provide the information required to estimate the "free driver" effect. The PCU will request manufacturers and importers of FLs and incandescent light bulbs to provide information concerning the sales of these products in the Mexican market, as well as in the regions of interest.

37. Both the IUs and the PCU will monitor Project implementation and will continuously, and in close coordination, take appropriate measures to ensure compliance with Project goals.

The remedial measures will result from the supervision of Project implementation, but will also draw on the information provided by periodic reviews of Project implementation.

38. As part of the Project monitoring and control, the following activities will take place three months after Project start, and again a year after that:

(a) an evaluation will be carried out of the FL sales made in CFE's service centers in Guadalajara and Monterrey. Its purpose will be to determine shortcomings in the sales process, the need for additional training for the sales force, storage and inventory controls for the FLs, information systems and coordination with PAESE and FIDE, if needed. A similar evaluation would be undertaken three months after the start of the door-to-door sales process. In both cases, the evaluation will be based in interviews and conversations with the Project staff in both cities.

(b) a survey will be made among Project participants. The survey will be used to obtain the following information: (xiii) number and types of FLs installed, where they were installed, the characteristics of the incandescent bulbs that they replaced and number of hours of use of the FLs; (xiv) lighting level and quality, start-up time of the FL, prices, financing terms and how useful the participant found the information provided by the sales personnel; (xv) reasons for selecting the type of FL chosen; (xvi) customer's perception of the savings realized, reasons for purchasing FLs, familiarity with FLs before Project start and knowledge gained since, purchases of FLs made prior to Project start, independent of the Project and probable future purchases; quality of the customer service provided by the Project, and (xvii) socio-economic characteristics of the participants (type and area of the home, number of family members, income, age, etc).

(c) a survey will also be carried out among non-participants in the Project. The aim of this survey will be to determine the reasons why they have not participated, together with the socio-economic information of the non-participants.

39. Six months after Project start, and a year later, a survey will be carried out to determine the number of hours per day that participants use the FLs. To this end, metering equipment will be installed in a selected sample of participants to record the hours during which the FLs are used every day. This will allow the Project to determine the savings accruing to those participants, as well as the peak coincidence factors. On the basis of this information, as well as studies carried out to determine the consumption in kWh before and after the installation of the FLs of a random sample of participants, it will be possible to calculate the benefits to the participants, CFE, Mexico and the environment.

40. On the basis of the above mentioned surveys, a comprehensive mid-term Project implementation review will be carried out with the participation of the World Bank approximately one year after Project start. The results of the surveys and the remedial measures that might have already been implemented will be discussed. In particular, if the target sale levels have not been reached, the Bank and CFE will discuss and agree on whether

the ILUMEX project should continue. If the targets have not been reached, but it is decided that the Project should continue, then remedial measures to improve sales will be adopted. These measures might include, among others, expanding and/or training the sales force, improving the advertising campaign, resorting to setting up temporary and portable sales stands in selected neighborhoods and, as a last resort, proceed with a door-to-door sales effort. A flow chart has been prepared to illustrate the closed-loop system that will be put in place and is shown in page 12.

41. Upon Project completion, an end-of-Project review will be undertaken by the PCU with the participation of the World Bank. During this review, Project results will be critically evaluated and the lessons learned in ILUMEX will be incorporated in any new project undertaken by CFE. Furthermore, during the meeting agreement will be reached on the format, content, participants and date of a seminar to disseminate to a Mexican and international audience the results of the ILUMEX project.

42. Six months after Project completion, a final evaluation report will be prepared by the PCU and submitted to the financing agencies participating in the Project. Finally, one year after Project completion, another survey will be carried out among the participants in ILUMEX to determine how satisfied they are with the FLs, how many FLs failed and had to be replaced, whether they remain where they were originally installed, whether more FLs were purchased through commercial retailers and other similar data. Results of this survey will be made available to CFE and the World Bank.

43. To carry out the evaluation of the results of the Project, CFE will retain specialized consultants who will certify the evaluation of the results performed by the IUs and the PCU.

K. Project Reporting

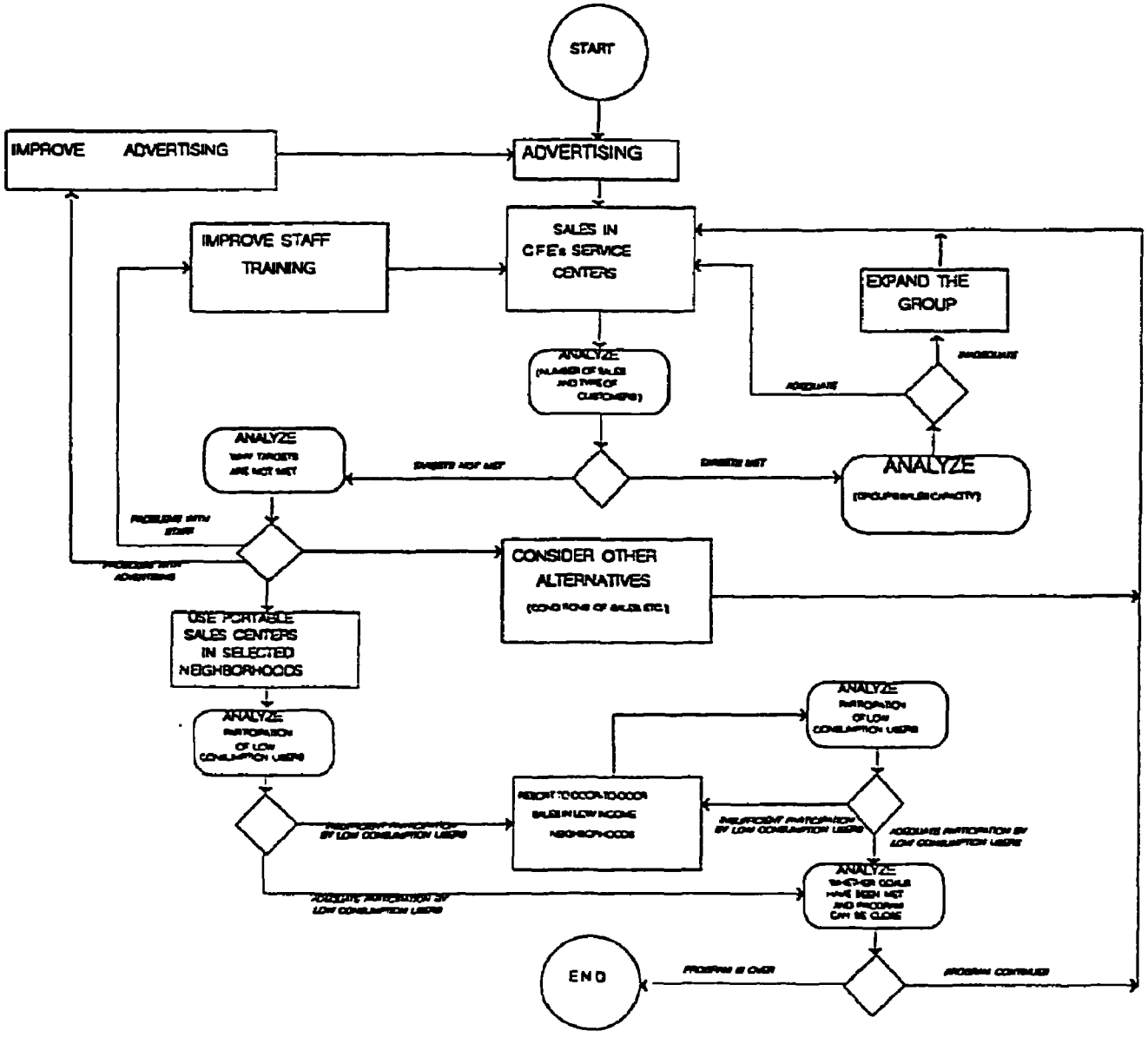
44. The IUs will prepare daily, monthly, quarterly and annual sales reports. They will also prepare quarterly progress implementation reports using a format specified by the PCU. The PCU will prepare the half-yearly implementation reports required by the World Bank. The IUs will also prepare annual reports of their activities, as well as a Project completion report. On the basis of this information, the PCU will prepare the Project completion report requested by the World Bank.

L. Project Monitoring and Evaluation Indicators

45. The table shown in Annex 5, page 4, includes the goals and dates agreed with the World Bank to monitor and evaluate the Project.

HIGH EFFICIENCY LIGHTING PILOT PROJECT

FLOW CHART OF THE SALES PROCESS



MEXICO

HIGH EFFICIENCY LIGHTING PILOT PROJECT

Terms of Reference for Consultants

1. Consultants will be retained to assist in: (a) Marketing Surveys; (b) Promotion and Advertising; (c) Monitoring and Evaluation, and (d) Laboratory Testing. This Annex provides a summary of the Terms of Reference to be used for hiring the different consultants. The timetable of consultants activities is the following:

Consultant for:	Latest date to Hire	Consultants Activities	
		Begin	Finish
Marketing Survey	June 94	July 94	April 98
Promotion and Advertising	June 94	July 94	May 95
Monitoring and Evaluation	June 94	July 94	July 98
Laboratory Testing	June 94	July 94	June 96

A. Marketing Surveys.

2. In this area, consultants will be hired to assist the PCU and the IUs in preparing and then undertaking the different market surveys required by the project. The market surveys required by the project are described in detail in Annex 5 and they include at least the following: (a) a "base line survey" to be carried out three months prior to project start and which will focus on sales of FLs and incandescent bulbs prior to project start in the Jalisco and Golfo Norte Regions in general, with emphasis on Guadalajara and Monterrey; (b) three months after project start and a year later, a survey will be carried out among project participants to determine how many FLs they purchased, where they were installed, daily usage, etc; (c) three months after project start and a year later, a survey will also be done among non-participants in the project to determine the reasons why they have chosen not to participate; (d) six months after project start and a year later, another survey will be undertaken to measure (by installing appropriate measuring equipment) the number of hours and the time of the day that the FLs are used, and (e) a year after project completion a final survey will be carried out to determine how satisfied the participants are with the FLs, their

pattern of usage and also to gauge the impact of the project in overall sales in FLs in both Regions.

3. The purpose of the surveys is threefold: (a) to measure the "free driver effect" (the induced sales of FLs produced by the project); (b) to identify measures to be taken during project implementation to ensure compliance with project goals, and (c) to calculate project benefits essentially in terms of energy and capacity savings and emission reductions. Each survey might contribute to more than just one of these purposes; however, it might be said that surveys (a) and (e) will be the basis for calculating the "free driver effect", while surveys (b), (c) and (d) will aid in determining how well project goals are being attained, and surveys (d) and (e) will serve as the basis for measuring project benefits.

4. For each survey, the Consultant shall work closely with the PCU and the IUs, training their staff as required. It is expected that the Consultant will act in an advisory position such that at the end of the project both the PCU and the IUs will have developed their own capacity to undertake by themselves this type of work in the future. The consultants' responsibilities will include at least the following: (a) establish the basis for selecting a representative sample for the survey; discuss it and agree it with the PCU; (b) proceed to identify the representative sample with the assistance of the PCU and the IUs; (c) design the methodology and the questionnaire to survey the sample; discuss it and agree it with the PCU; (d) train, or identify suitable training facilities, for the staff of the IUs who will be in charge of conducting the interviews; (e) train the staff of the PCU and the IUs to correctly interpret the results of the surveys, and (f) review and certify the accuracy of the results included in the reports prepared by the IUs and the PCU for each survey.

B. Promotion and Advertisement.

5. Two distinct tasks are involved here. The first one will consist of assisting CFE in designing a promotion and advertisement campaign to promote the use of FLs, while the second one will consist of implementing the campaign. It is expected that two different companies will participate in the two different tasks, and the terms of reference for both services are described in the following paragraphs.

6. The scope of service of the consultants who will design the promotion and advertisement campaign will include at least the following: (a) analyze the different types of participants that ILUMEX wishes to attract, keeping in mind that the campaign must cover not only the residential users, but also the commercial and other users although the non-residential consumers interested in purchasing FLs will be directed to the normal retail outlets; (b) on the basis of the analysis, propose the best mix of media to reach them effectively, while keeping the cost of the program within the budgeted amount. The media to be used will include written information to be delivered together with the electricity bills, demonstration

stands at CFE's Service Centers and at other selected places, newspapers, radio and TV; (c) propose also the best schedule for the campaign, which will have to be distributed over the 30 months that the project will last, but which will probably have different emphasis during different stages of the project (more concentrated at the beginning and less so afterwards); (d) propose also the best days of the week, the best time of the day, and the best programs to be used as channels for the advertisement campaign; (e) design the messages to be used to instruct and convince the public of the benefits of the FLs and consequently of their participation in the program; (f) prepare a budget estimate for the program, including its monthly disbursements; (g) draft invitations to submit proposals in order to select the firm to implement the campaign and prepare a list of no less than three and no more than six companies, preferably no more than two from any given country, who are qualified to successfully implement the campaign; (h) prepare terms of reference and a detailed evaluation methodology to select the company to implement the campaign; (i) assist the PCU in evaluating the proposals received, and (j) participate in periodic reviews, as requested by the PCU, to evaluate the success of the advertisement campaign and, if necessary, propose modifications to improve its efficiency.

7. The scope of service of the consultants who will implement the advertisement campaign will be defined by the PCU on the basis of the work of the consultants who will design the advertisement campaign. In general, their work will consist of implementing the campaign, submitting the reports that their contract will specify, keeping the cost of the campaign within the contractual budget and suggest the modifications that they might deem necessary to render the campaign more effective.

C. Monitoring and Evaluation.

8. Monitoring and evaluation will serve three purposes: (a) to measure the "free driver effect" (the induced sales of FLs produced by the project); (b) to identify measures to be taken during project implementation to ensure compliance with project goals, and (c) to calculate project benefits essentially in terms of energy and capacity savings and emission reductions. The consultants retained for this activities will assist the PCU and the IUs and will in fact certify the accuracy of the results and conclusions produced by the PCU and the IUs. It is expected that at the end of the project the PCU and the IUs staff shall be thoroughly trained in these activities.

9. The consultants' scope of service shall include at least the following: (a) prepare a manual for evaluating the results of the surveys mentioned in paragraph 2 above; (b) train, or propose suitable training, for the staff that will participate in project monitoring and evaluation; (c) propose a methodology for evaluating the "free driver effect", the energy savings and the environmental benefits associated with the project; (d) assist the PCU and the IUs in designing the reporting system, as well as the format of the reports, required for proper project monitoring and

evaluation; (e) review the review the supervision and evaluation reports prepared by the PCU and the IUs and certify their soundness and accuracy, and (f) assist the PCU and the IUs in preparing the end of project report, as well as the report to be prepared one year after the project is completed. These reports shall be submitted to the donors that participated in the project, as well as to the international community in seminars to be held for that purpose. The reports shall concentrate on the benefits of the project (both in energy savings and emission reductions), the "free driver effect" and on the lessons learned that might be valuable in implementing similar projects in other parts of the world.

D. Laboratory Testing.

10. The consultants in charge of the Lab Tests shall be responsible for testing the FLs that are first submitted as samples by all the bidders, and subsequently a random selection of FLs from the first delivery made by the selected contractor. The tests will be carried out in Mexico City's Lighting Lab; the PCU will make the appropriate arrangements so that the consultants can use the lab at no cost to them. After completing the tests, the consultants shall submit the required reports to the PCU.

11. In the first test the consultants will certify the characteristics of the samples supplied by the bidders. Each bidder will supply three samples for each type of FL proposed and they shall be tested for: (a) operating voltage; (b) efficiency (lumens per watt); (c) luminous flux; (d) color temperature and color rendering index; (e) power factor and (f) harmonic distortion.

12. In the second test the consultants will certify the performance of a random sample of 20 FLs taken from the first batch delivered by the contractor. These lamps will be subjected to the same tests mentioned in the preceding paragraph, but they will also be tested to confirm that they will maintain the luminous flux as required by the specifications. Additionally, the lamps will be subjected to a standard test to determine the useful life of the FLs. At the end of each test, the consultants shall submit a report to the PCU with their conclusions and recommendations.

MEXICO

HIGH EFFICIENCY LIGHTING PILOT PROJECT

Lessons Learned in the Implementation of Bank Financed Power Projects and CFE's Pilot Lighting Projects

Lessons Learned in the Implementation of Bank Financed Power Projects.

1. The Bank participated actively in the financing of the Mexican power sector from 1949 to 1972. A total of US$715 million was lent during that period. A long absence from the sector followed, as no agreements could be reached with the Government on important issues such as pricing, financing, sector organization, management and procurement. Beginning in 1986, new macroeconomic policies helped to reopen the dialogue with the sector; furthermore, important actions were taken to address the concerns of the Bank, making possible the processing of new operations.

2. OED's audit reports and LAC's PCRs have concluded that in general the Bank has made extraordinary financial contributions to the physical development of the sector. However, some issues and problems have affected its performance, and these include the need to: (a) improve sector organization and management, as well as management information systems; (b) base electricity pricing on economic and financial grounds, rather than on political expediency; (c) avoid unrealistic optimism on demand growth, project costs and project construction schedules, and (d) improve procurement methods.

3. Power sector organization, management, as well as management information systems have improved as a result of studies carried out by specialized consultants funded by Bank loans. In particular, CFE has decentralized its operations, with the corresponding gains in accountability, efficiency and prompt attention to customers. More importantly, the revision of the General Law of Electricity Services that took place in December of 1992, created an Energy Regulatory Commission, which will begin to operate in January of 1994, and authorized the operation of cogenerators, independent power producers, as well as the import/export of power from/to neighboring countries.

4. Tariffs have been raised in real terms so that the average revenue is approximately 83% of long run marginal cost (LRMC). There is however a significant distortion in the residential consumer category, where those that consume less than 200 kWh per month pay only approximately 63% of LRMC, whereas those that consume in excess of 200 kWh pay between 147% and 183% of LRMC. CFE is committed to correct this distortion and it is expected that the newly created Regulatory Commission will support CFE's efforts to more adequately reflect the economic cost of providing service to residential consumers.

5. Although electricity losses are relatively low by developing country standards (14%), they can and should be brought down in line with those registered in industrialized countries. A new Bank operation is being discussed with the Mexican authorities to help reduce losses, and it is anticipated that it will be appraised in FY95.

6. Improvement in procurement practices can best be effected by reaching agreement during project preparation on the tender documents to be used for the project; this will also expedite project implementation. The tender documents for the procurement of the FLs have been extensively discussed and agreement has been reached with CFE. No difficulties are therefore expected in this matter.

7. A new lesson recently learned stems from the financial constraints imposed on the sector for macroeconomic reasons by the Ministry of Finance and Public Credit during the past three years. These constraints have forced CFE to reduce its investment program. It is therefore crucial to determine whether any new project will fit under the investment limit set by the Ministry, as otherwise the project will suffer delays in its implementation. Given the nature and magnitude of the proposed project, the Ministry has authorized CFE to include it in its investment program. Therefore, no delays should be experienced in project implementation.

Lessons Learned from CFE's Pilot Lighting Projects.

8. CFE has implemented seven small pilot lighting projects. In three of them (Hermosillo I, Puebla and Querétaro) CFE donated the lamps to the participants. In another three (Chetumal, Valladolid and Hermosillo II) it sold the FLs at a discount, and in one (sales to CFE's employees in Mexico City) it sold the lamps at full price but financed them over five months.

9. In all projects, the number of FLs and participants involved was very small as may be seen from the following table:

Project	Number FLs	Participants
Hermosillo I	400	139
Puebla	400	136
Querétaro	500	100
Valladolid	9,054	3,638
Chetumal	20,729	5,436
Hermosillo II	50,000	16,670
CFE employees/Mexico City	9,337	1,670

10. CFE's experience demonstrates that: (a) of all the FLs offered (typically four or five types were made available) two thirds of the participants preferred the 22 watt circular lamp (which in strict sense is not a FL but rather an efficient fluorescent lamp); (b) energy (and electricity bill) savings ranged from a low of 3% to a high of 12% for the very small projects in which CFE donated the lamps. In Valladolid, savings reached 27%; however, in this community lighting accounts for nearly all residential consumption. Consequently, savings as a percent of normal electricity consumption were extraordinarily high; (c) in those projects were FLs were sold at a discount, door-to-door sales proved to be a far more effective marketing strategy. In Valladolid, during four months lamps were sold at selected stores at a discount but sales stagnated at 1,771; 7,322 more were sold over the next two months through a door-to-door campaign; (d) all surveys indicated that the main reasons why customers were reluctant to participate in the program was the high cost of the FLs. Therefore a rebate was instituted as a means to attract participation; the rebates normally ranged from 30 to 50% of the cost of the FLs, except for the case of CFE's employees in Mexico City who were not given a rebate and for the very small projects in which the FLs were given away at no cost to the participants, and (e) the evaluation process was deemed instrumental to improve project implementation. However, financial constraints forced CFE to restrict financing for this purpose and consequently the information available is only partial.

11. In spite of the shortcomings of the evaluation process, important lessons have been learned from CFE's small pilot projects, and these have been reflected in the design of the proposed project. The main lessons incorporated in project design are those related to the type of lamps to be offered, the need to resort to door-to-door marketing and to offer an attractive rebate and the requirement for a comprehensive evaluation process which must be carried out in parallel with the project.

MEXICO

HIGH EFFICIENCY LIGHTING PILOT PROJECT

Project File

List of project related documents filed in the LAC Information Center:

1. Feasibility Study of the ILUMEX project. Prepared by the International Institute for Energy Conservation in December of 1992 and financed by USAID.

2. Executive Summary of the ILUMEX Project (Resumen del Proyecto ILUMEX) and Technical Annex (Anexo Técnico), prepared by CFE in August of 1993 as a result of the pre-appraisal mission.

3. Estimate of the Emissions from CFE's thermal power stations prepared by the consulting firm UITESA.

4. Review of the Technical Annex (Anexo Técnico) prepared by CFE in October of 1993 as a result of the Appraisal mission.

5. Economic Analysis of the Ilumex Project prepared by CFE and Luis Cosenza (consultant) in October of 1993.

6. Project Implementation Plan, prepared by the Appraisal Mission.

7. Minutes of Negotiations, including the agreed texts for the Project Operating Guidelines and for the establishment of the Implementing Units.

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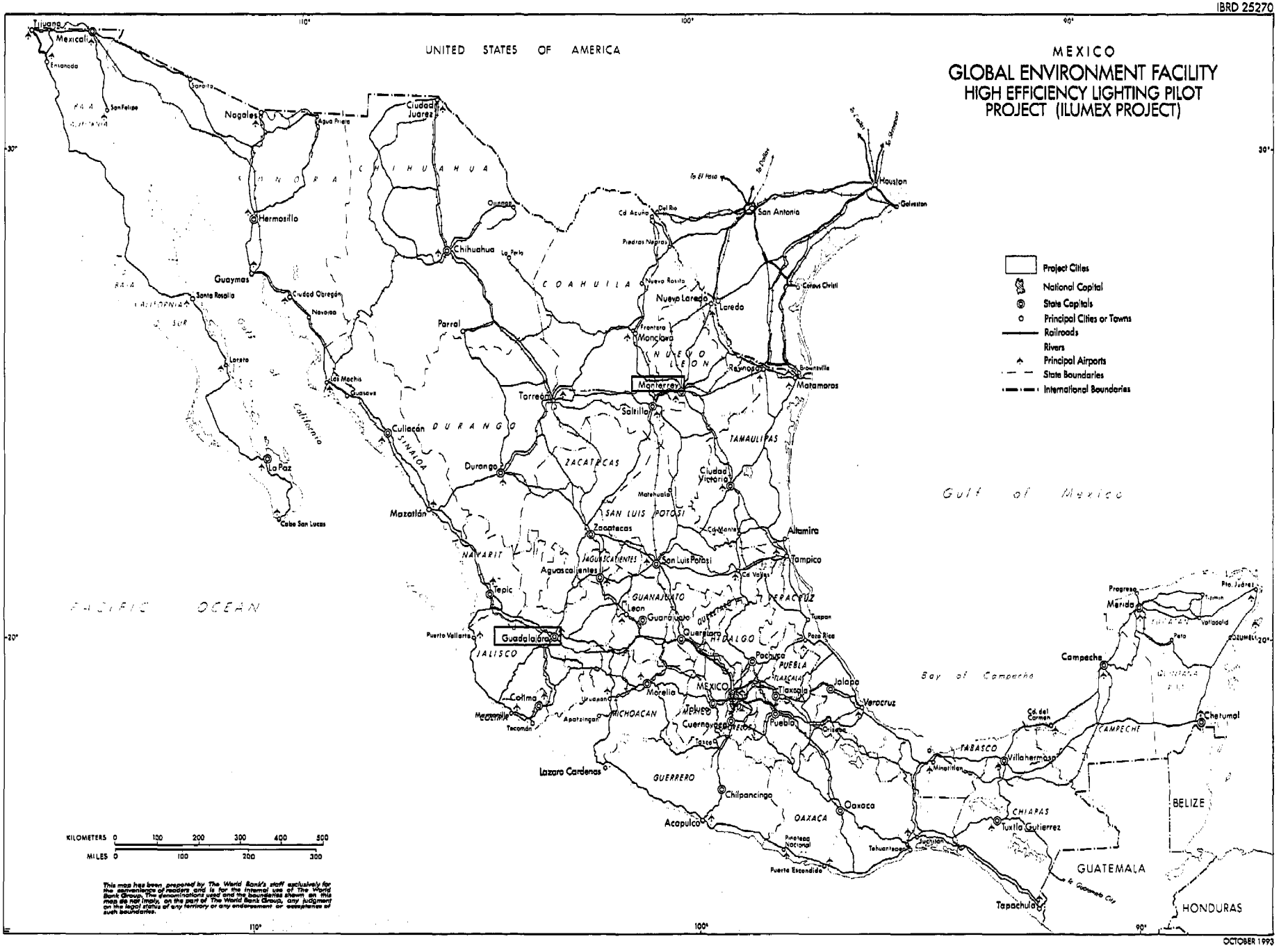

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