Republic of Poland
Poland Efficient Lighting Project

Project Document
September 1996

Environment Division
Technical and Environment Department
International Finance Corporation

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PART II: PROJECT DESCRIPTION AND TECHNICAL ANNEXES

CURRENCIES AND EQUIVALENT UNITS

(Exchange Rate as of March 1996)
US$1.00 = PLN 2.50

UNITS AND MEASURES

1 Metric Ton (mt or tonne) = 1000 kg
1 MW (Megawatt) = 1 X 10^3 kW (kilowatts)
1 MWh (Megawatt hour) = 1 X 10^3 kWh (kilowatt hours)
1 GWh (Gigawatt hour) = 1 X 10^6 kWh
1 TWh (Terawatt hour) = 1 X 10^9 kWh
1 PJ (Petajoule) = 1 X 10^{15} joules
1 TJ (Terajoule) = 1 X 10^{12} joules
1 GJ (Gigajoule) = 1 X 10^9 joules
1 MJ (Megajoule) = 1 X 10^6 joules

ACRONYMS and ABBREVIATIONS

CFL	Compact Fluorescent Lamp (a fluorescent lamp and ballast combination designed to be used in a standard light bulb socket)
CO_2	Carbon Dioxide
EU	European Union
DSM	Demand-side Management
FEWE	Polish Foundation for Energy Efficiency
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GLS	General Lighting Service
IIEC	International Institute for Energy Conservation
IFC	International Finance Corporation
KAPE	National Energy Conservation Agency
kWh	Kilowatt hours
LRMC	Long-run Marginal Cost
NECEL	Netherlands Energy Efficient Lighting B.V.
NECO	Netherlands Energy Company B.V.
NGO	Non-governmental organizations

PELP	Poland Efficient Lighting Project
PKE	Polish Ecological Club
PLN	New Polish Zloty
PLP	Philips Lighting Poland S.A.
PSE	Polish Power Grid Company
SRC	Synergic Resources Corporation
VAT	Value Added Tax
ZEs	Polish Electric Utilities

This report is based on several pre-appraisal and appraisal missions, which visited Poland between 1994 and 1996, and ongoing work on project implementation by IFC staff and consultants. Participating individuals were Messrs./Mmes. Dana R. Younger (Task Manager), Astra Michels (Investment Officer), Carol Mates (Lawyer), Hugo Waszink (Chief Counsel), Mohan Pherwani (Engineer), Russell Sturm (IIEC), Catherine Strickland (IIEC), Marc Ledbetter (Battelle), Slawomir Pasierb (FEWE), Adam Gula (FEWE), Ewaryst Hille (FEWE), and Malgorzata Jedrzejowska-Popiolelek (FEWE). Mr. Christopher A. Granda (Consultant) is responsible for IFC's ongoing project supervision responsibilities and he assisted with the writing and editing of this report. Mr. Andreas Raczynski is the Director of the IFC Technical and Environment Department, Mr. Martyn J. Riddle is the Manager of the Environment Division, and Mr. Hany Assaad is the Chief of the Special Projects Unit. NETENCO/NECEL personnel include Albert Kloezen (Managing Director); Joep Rijntjes (Project Manager); and Andrzej Jarosz (Project Leader).

REPUBLIC OF POLAND
POLAND EFFICIENT LIGHTING PROJECT

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PART I: PROJECT SUMMARY

PART I: Project Summary

REPUBLIC OF POLAND
IFC/GEF Poland Efficient Lighting Project

GRANT AND PROJECT SUMMARY

Recipients:	Polish Consumers
Beneficiaries:	Polish Consumers, Lighting Manufacturers, Electric Utilities, Municipalities
Amount:	US$ 5 million
Terms:	Grant (Administered by the International Finance Corporation)
Financing:	GEF with Contributions from Private Sector Participants and Potential Cofinancing from other Governmental and Non-governmental Organizations
Economic Rate of Return:	Not Applicable (See Appendix D for cost-effectiveness analysis)

Republic of Poland
IFC/GEF Poland Efficient Lighting Project

1. Country Background: Poland began a transition from a centrally planned to a market based economy in 1989. This transition is not yet complete and the legacy of the former system can be seen in the country's energy consumption. The Polish economy is still characterized by generally inefficient energy use in most sectors, a high energy intensity of Gross Domestic Product (GDP), and extensive environmental damage caused by energy production, transformation and application. Poland's primary energy supplies are dominated by domestically produced coal, which (including lignite) accounts for more than 70 percent of the country's primary energy supply. Poland's reliance on coal and the inefficiency of its energy sector has resulted in the country being a major contributor to annual global greenhouse gas (GHG) emissions. These emissions are primarily in the form of carbon dioxide (CO_2) as a byproduct of coal combustion. Poland had a population of 38 million and GHG emissions in excess of 400 million tonnes CO_2 in 1995 and is generally acknowledged to be the twelfth largest CO_2 emitting nation in the world.

2. The electricity generation, transmission and distribution industries remain owned by the State and are over 90 percent dependent upon coal-fired generating plants. Price reforms are being instituted, but retail electricity prices are still not completely reflective of long-run marginal costs. Substantial excess generating capacity exists at present, but additional investments by the Polish Power Grid Company (PSE) in new generating capacity are currently forecast by the World Bank for the period beyond the year 2000 as the economy continues to grow.

3. Major opportunities for energy conservation exist in Poland. However, the ability to implement these options is limited by available technology and capital as well as by institutional issues, some of which are related to economic restructuring. However, Poland does have one plentiful and untapped indigenous resource that can lower the cost of providing energy services, reduce pollution, and defer the need for new generation, transmission, and distribution capacity: domestically-produced energy-efficient compact fluorescent lamps (CFLs). CFLs replace ordinary incandescent light bulbs and provide a similar quality of lighting while only consuming 25 percent as much electricity and lasting 8 to 10 times longer.

4. Project Background: A joint venture between Polam Pila, the government-owned and largest Polish lighting manufacturer, and Philips Lighting B.V. of the Netherlands was launched in 1992 with debt financing from the International Finance Corporation (IFC), the private sector affiliate of the World Bank Group. Following modernization, the resulting Polish joint venture, renamed Philips Lighting Poland (PLP), began manufacturing several lighting products, including two lines of CFLs.

Current production capacity for CFLs at PLP is in excess of 14 million annually. Because the domestic market for these lamps was undeveloped, the majority of PLP's CFL production was historically exported to Western countries.

5. In late 1992, IFC 's Environment Division undertook a review of the Corporation's investment portfolio with support from the International Institute for Energy Conservation (IIEC), an international NGO, to identify suitable environmentally beneficial energy efficiency opportunities with unrealized global environmental benefits that could be secured with support from GEF's pilot phase. The PLP joint venture was identified as having created a capital-conserving, environmentally beneficial energy resource which had remained largely untapped for use in the Polish economy. The full potential of the domestic efficient lighting industry had gone unexploited as a tool to cost-effectively reduce GHG emissions. IIEC proposed preparation of a project using GEF pilot phase funds to stimulate the domestic market for CFLs, thereby allowing Poland to realize some of the environmental benefits from CFLs which were being exported. IIEC recommended development of a utility-style demand-side management (DSM) CFL promotion program aimed at residential consumers in Poland. Participation in such a project, by Polish electric utilities, NGOs and government organizations would help develop an indigenous capacity to implement further DSM efforts in the future.

6. As models for this project, IFC and IIEC reviewed numerous initiatives, undertaken primarily by North American and western European utilities, to promote CFLs. These initiatives had often been developed by electric utilities as part of DSM campaigns to conserve energy, manage demand, and produce environmental benefits. Although CFLs are a cost-effective investment for consumers in most parts of the world, the retail price of a CFL is typically 35 or more times that of an incandescent light bulb. This price difference poses a significant "first cost" barrier to consumers, therefore most of the CFL promotional campaigns have involved some type of product subsidy to lower the retail price.

7. Project Design: A program template developed at Southern California Edison (SCE), a large electric utility in the US, was chosen by IFC and IIEC as the basis for a CFL-based Polish DSM initiative because it promised the largest increase in CFL sales at the lowest cost. SCE's program relied on private sector involvement and competitive market principles to encourage manufacturers, wholesalers and retailers to increase the availability and decrease the price of CFLs to consumers. SCE's program provided subsidies directly to CFL manufacturers via a competitive bidding process. Successful bidders agreed to pass on at least the full value of the subsidies to the product distribution chain in the form of lower wholesale prices. Because the SCE program required relatively few transactions at the manufacturer level, administration expenses

were lower than other utility DSM programs which delivered subsidies directly to consumers via rebate coupons or other approaches.

8. IFC and IIEC worked closely with the Polish Foundation for Energy Efficiency (FEWE) to research the Polish lighting market and survey the level of consumer awareness of energy efficient lighting options. IFC and IIEC staff conducted project preparation missions to Poland in 1993 and 1994 to meet with Polish government agencies, NGOs and private firms; gather data; and prepare analyses that would allow international experience with DSM CFL dissemination programs to be adapted to Poland. This research and a series of consultation meetings with interested groups in Poland culminated in the preparation of a "Pre-Appraisal Report to the Global Environment Facility for the IFC/GEF Poland Efficient Lighting Project (PELP)."

9. Project Implementation: PELP received approval from the Global Environment Facility (GEF) in December 1994 for use of $5 million in GEF pilot phase funds. IFC and its Environment Division were assigned responsibility by the GEF Secretariat for managing project implementation. As Polish electric utilities have had no direct experience with DSM programs, IFC's management approved competitive selection of a private sector utility partner with the necessary experience to administer a CFL-based DSM program in Poland along with Polish counterparts. Netherlands Energy Company (NECO), which is owned by several major Dutch gas and electric utilities, was chosen by IFC to administer PELP. Management of project activities resides principally with NECO's daughter company, Netherlands Energy Efficient Lighting B.V. (NECEL). NECEL works with the Polish Foundation for Energy Efficiency (FEWE), other respected Polish professional societies and environmental NGOs, selected Polish electric distribution companies (ZEs), and the Polish Power Grid Company (PSE) and Polish lighting manufacturers to realize the objectives of PELP.

10. Under PELP, participating manufacturers are required to perform a substantial portion of their CFL production in Poland. Since PLP began production of CFLs in Poland, several additional Polish lighting manufacturers have also entered the domestic market for CFLs. These manufacturers either assemble CFLs under license to international lighting producers or produce CFLs of their own design from components purchased on the global market. CFLs which are wholly manufactured outside of Poland are not eligible for participation in PELP, although import products have a significant presence in the Polish CFL market. The participation of multiple manufacturers in PELP allows competitive market mechanisms to be included in the project design for the award of CFL subsidies.

11. Project Objectives: PELP's main development objectives are: to reduce greenhouse gas (GHG) emissions from the Polish electricity sector; to maximize the benefits to the Polish economy from the indigenous domestic CFL manufacturing

resource; to develop the capacity of entities within Poland to deliver DSM resources; and to demonstrate the value of DSM programs to the Polish electric power sector, the Polish government and Polish NGOs. PELP is attempting to achieve these objectives by accelerating the penetration of CFLs into the Polish residential lighting market through improved availability and lower prices; leveraging private sector investments and private sector technology and management skills to realize GEF objectives; and thereby realizing Poland's potential to develop a sustainable domestic market for energy-efficient lighting products.

12. Project Description: PELP has been designed to use a combination of direct subsidies, other DSM approaches, and consumer and lighting professional education. Careful monitoring and evaluation will track and document the project's impact on the Polish lighting market, on Polish residential energy consumption, and on GHG emissions. The major components of PELP are:

- CFL Subsidy program;
- Luminaire Subsidy program:
- Pilot DSM program;
- Public Education program;
- Monitoring and Evaluation program; and
- PELP Administration

The program components are further described in Part II: Project Description and Technical Annexes. PELP will use these tools to achieve the direct replacement of at least 1.2 million incandescent light bulbs with CFLs over an eighteen month period, encompassing two "lighting seasons" in the Polish market (northern hemisphere countries typically experience increased sales of lighting products from September to March). The 1.2 million CFL projection is based on an average manufacturer subsidy of US$ 2.20/unit, based on accumulated project experience. In addition, PELP will subsidize the development and installation of energy efficient lighting fixtures, or luminaires and work with electric utilities and municipalities to establish additional distribution system related benefits of DSM. Thus, while the benefits of these CFL Subsidy lamp replacements alone are significant, PELP was conceived to have a deeper impact by stimulating the market for energy efficient lighting in Poland and advancing the growth of that market by five years.

13. PELP Administration: NECEL maintains a Warsaw office with local staff to administer activities under the various components of PELP. NECEL performs some of these activities itself, but issues contracts to Polish and international vendors for the provision of specific services. Contracts above a certain cost limit are submitted to IFC

for approval. IFC and NECEL have stressed the use of Polish vendors to perform project functions whenever possible. NECEL has successfully contracted for high quality advertising, market research, and lighting technical services with a number of Polish firms. As part of PELP's effort to increase indigenous Polish DSM capacity, a few international DSM contractors have been identified to provide services to PELP, and to transfer information on state-of-the-art DSM practice to Polish entities.

14. Project Sustainability: Project sustainability will be achieved by development of a strong domestic market in Poland for affordable, energy efficient, lighting technologies produced by a range of competitive manufacturers marketing high quality products. PELP will attempt to generate widespread public recognition of a project identity with the PELP logo serving to help identify products which are energy efficient, and of high quality. The logo may be eventually transferred to a Polish entity for use in future energy efficient product labeling and marketing activities. IFC and NECEL will also disseminate the results of PELP to increase the capacity of Polish electric utilities and municipalities to identify and exploit opportunities to increase lighting energy efficiency through private sector financing mechanisms.

15. Participatory Approach: Polish non-governmental and governmental organizations have played an integral role in the project both through consultations and through active participation in the project's design. An Advisory Committee made up of interested Polish organizations and government agencies, including leading environmental and energy NGOs, was formed by IFC to advise PELP generally. Other ad-hoc groups have been formed to focus on specific issues including: environmental issues involved in efficient lighting, and design of grass-roots public education efforts.

16. Lessons Learned from Previous Bank Involvement: The World Bank Group has not been previously involved in DSM initiatives in Poland. The U.S. Agency for International Development (USAID) funded design of a pilot industrial DSM project which is proposed to be implemented by the Gliwice ZE as part of the US$100 million IBRD Poland Power Distribution Project (PLPA-40184) loan operation. However, the large current surplus of generating capacity in the Polish power sector make ZEs reluctant to engage in activities that directly reduce power sales. The Polish utility sector has been proposed for privatization, but action has been delayed. Therefore, PELP was designed to be implemented by private sector intermediaries with support from IFC as an initial pilot utility DSM project. Related Bank Group GEF DSM pilot projects in other countries include the "Proyecto de Uso Racional de Iluminacion en Mexico" (ILUMEX, or the High Efficiency Lighting Pilot Project); the "Promotion of Energy Efficiency Project" in Thailand; and the "Jamaica Demand-Side Management Demonstration Project". While these projects offered helpful context to the IFC and IIEC in designing a lighting energy efficiency project for the Polish context, PELP

utilizes a primarily private sector approach to the promotion and dissemination of CFLs.

17. Rationale for GEF Funding: As the Polish economy continues to modernize, consumers will make choices which will have long term environmental consequences for Poland and the global environment. When CFLs replace incandescent lamps, they substantially reduce the CO_2 emissions associated with providing lighting service. At current Polish electricity prices, a CFL is a cost effective purchase for the typical consumer on the basis of the value of the avoided electricity and conventional lamp purchases, even though CFLs in Poland typically sell at retail prices equal to or greater than those generally found in western Europe. Despite this, CFLs remain a relative rarity in Polish homes. Poles currently purchase and install CFLs at a rate well below that of consumers in western European countries. Because income levels in Poland are significantly below those in western Europe, the initial cost of a CFL poses a significant barrier to the consumer. Polish consumers also face other market barriers such as a lack of information about product selection and installation and limited availability of different types of CFL products. GEF support for this project will focus on reducing the first cost and other market entry barriers for consumers to make initial purchases of CFLs. It will also provide consumer information on the benefits and applications of CFLs, and generally help to strengthen the Polish energy efficient lighting industry and sustain long term transformation of the lighting end-use sector in Poland to higher levels of energy efficiency.

18. **PELP's objectives are in line with the Bank's Country Assistance Strategy (CAS) for Poland (Report number 13617-POL) approved by the Board on November 17, 1994. The project integrates three important elements into its approach: private sector involvement, environmental protection, and popular participation to increase country energy efficiency.**

19. Agreed Actions: Based on discussions with the Polish Power Grid Company; the Ministry of Foreign Affairs; and the Ministry of Environmental Protection, Natural Resources and Forestry, it was agreed that IFC would directly administer the project through the private sector, as a pilot IFC/GEF private sector activity. PELP has also been specifically designed to address major issues involving program delivery strategy, monitoring and evaluation criteria and sustainability that were raised during the GEF technical review process and by interested Polish parties.

20. Environmental Aspects: Implementation of this project will increase the electrical end-use efficiency of residential lighting. Reduced electricity consumption also results in reduced transmission and distribution losses (estimated to be greater than 10% in Poland). Poland's electricity generation sector is overwhelming based on coal-fired generation and is a major contributor to national GHG inventories. When a

CFL replaces an incandescent lamp, the avoided electricity consumption, distribution, transmission and production can avoid more than 75% of the CO_2 emissions associated with that lighting service. The project also has substantial local environmental benefits, primarily in the form of avoided sulfur dioxide and other non-GHG air pollutants released by Polish power plants. Additional environmental benefits include avoided water and air pollution from coal mining, avoided thermal water pollution from power generation, avoided land use changes from transmission line siting, and direct and indirect economic benefits from reduced or avoided pollution.

21. Project Benefits: Many parties will realize substantial economic benefits through the execution of PELP including:

- participating consumers who will enjoy comparable lighting service to that provided by their former, incandescent lamps but who will need to purchase significantly less electricity to provide this service. The value of energy savings from PELP are projected to be worth US$40 million;
- participating CFL manufacturers who will experience an expanded domestic market for their products;
- Polish utility sector, municipalities, and private companies through the development of a capacity to deliver DSM resources;
- Polish society in general through increased awareness of the benefits of energy efficiency, CFLs, and energy efficient lighting among Polish NGOs and consumers; and
- the global environment through cost-effective emission reductions of GHGs and other pollutants. Energy savings from PELP are expected to avoid power plant emissions equal to 200,000 tonnes of carbon equivalent.

22. PELP has been designed to encourage investment by the private sector towards realizing the objectives of the project. Polish manufacturers have been asked to decrease the wholesale prices of their products to participate in PELP. The value of these price reductions over the two year period of the project is expected to approach US$ 1.6 million. The combined effect of typical Polish distribution mark-ups and VAT usually results in retail CFL prices which are 175% of wholesale prices. By reducing wholesale prices, PELP will effectively solicit an additional investment in the form of reduced distributor mark-up and VAT of approximately US$ 3.6 million. The US$ 2.7 million GEF subsidies will therefore result in total retail price reductions with a value of approximately US$ 7.9 million.

23. Risks: PELP has completed one season of the CFL subsidy program and is on schedule to implement the second season starting in September of 1996. The pilot DSM and luminaire subsidy components are only now nearing implementation. PELP is dependent on the effective application of competitive market concepts in a context where they are relatively unfamiliar. Participating manufacturers, wholesalers and retailers must be able to see the CFL subsidy as a tool for increasing the market and total sales in the long run, rather than as a way to increase their short-term profits. There is also the danger of "overselling" efficient lighting technologies to consumers. DSM programs which have promoted inappropriate products in other countries have engendered consumer distrust, rather than enthusiasm.

Schedule A: Project Estimated Costs and Financing Plan (US$ 000)

Project Components	Total
CFL Subsidy	2,755
Luminaire Subsidy	505
DSM Pilot	430
Public Education	570
Project Monitoring and Evaluation	280
Project Administration	460
Total	5,000

Note: IFC competitively selected NECO, subsidiary NECEL to be the program administrator. With final approval from IFC, NECEL competitively awards subsidies to qualifying Polish lighting manufacturers and has competitively selected sub-contractors to provide services to the project.

Schedule B: Summary of Disbursement Arrangements
GEF Trust Fund Disbursement Schedule (US$ 000)

IFC Fiscal Year	1996	1997
Annual	2,500	2,500
Cumulative	2,500	5,000

Schedule C: Timetable of Key Project Events

Time taken to prepare the project	18 months
IFC management approval granted	May 1995
Negotiations conducted	July 1995
Project became effective	August 1995
First Season CFL Subsidy began	December 1995
First Season CFL Subsidy concluded	May 1996

SCHEDULE D: Summary Statement of IFC Investments

Poland
STATEMENT OF IFC's
Committed and Disbursed Portfolio
As of August 31, 1996
(In US Dollar Millions)

FY Approval	Company	Committed IFC Loan	Committed IFC Equity	Committed IFC Quasi	Committed Partic	Disbursed IFC Loan	Disbursed IFC Equity	Disbursed IFC Quasi	Disbursed Partic
1990	Bristol Hotel	7.66	0.00	0.00	0.00	7.66	0.00	0.00	0.00
1990	EDB-AL	5.98	0.00	6.76	0.00	0.00	0.00	0.00	0.00
1990	EDB-ITAL-POL	.01	0.00	0.00	0.00	.01	0.00	0.00	0.00
1990	EDB-Malkiewicz	.01	0.00	0.00	0.00	.01	0.00	0.00	0.00
1990	EDB-Piotr Ostrow	.14	0.00	0.00	0.00	.14	0.00	0.00	0.00
1991	CHEMAGEV	1.52	.76	0.00	2.31	1.52	.76	0.00	2.31
1991	Intl Bank Poland	0.00	3.20	0.00	0.00	0.00	3.20	0.00	0.00
1992	Philips Poland	10.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00
1993	BONA	2.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00
1993	Huta Warszawa	38.60	0.00	4.80	0.00	13.51	0.00	2.29	0.00
1993	Poland Inv Fund	0.00	2.30	0.00	0.00	0.00	.75	0.00	0.00
1993	Sandoglass	32.22	0.00	8.27	18.81	32.22	0.00	8.27	18.81
1994	Amoco Poland	0.00	0.00	8.70	0.00	0.00	0.00	3.16	0.00
1994	Handlowy Heller	0.00	.60	0.00	0.00	0.00	.19	0.00	0.00
1994	Kwidzyn	24.00	0.00	0.00	18.75	19.37	0.00	0.00	15.13
1994	PPMs Opole	5.25	0.00	1.00	0.00	4.50	0.00	.88	0.00
1995	Globi Retailing	0.00	10.00	0.00	0.00	0.00	7.66	0.00	0.00
1995	Intercell	0.00	7.00	0.00	0.00	0.00	7.00	0.00	0.00
1995	Nesky	0.00	.50	1.55	0.00	0.00	.50	1.55	0.00
1996	Baltic Malt	6.90	1.96	0.00	0.00	0.00	0.00	0.00	0.00
1996	Gaspol	20.00	5.00	0.00	0.00	0.00	5.00	0.00	0.00
	Total Portfolio:	154.29	31.32	31.08	39.87	90.94	25.06	16.15	36.25

Approvals Pending Commitment

FY Approval	Company	Loan	Equity	Quasi	Partic
1996	GLOBE TRADE CNTR	7.50	0.00	3.80	16.70
1996	PAM BANK	15.00	0.00	0.00	0.00
	Total Pending Commitment:	22.50	0.00	3.80	16.70

PART II: Project Description and Technical Annexes

Project Description

IFC/GEF Poland Efficient Lighting Project

1. Introduction: Poland is a nation in east central Europe with an area of 312,683 sq. km and a population of 38,519,486 (1993 est.) that is growing at a rate of 0.35% annually. The population density is 123.2 persons per sq. km with a distribution which is 62% urban, 38% rural. About 61% of the total area of the land area of the country is used for agriculture. The capital and largest city is Warsaw (1992 est. pop., 1,653,000). In addition to Warsaw, the largest cities are Lodz, Krakow, Wroclaw, Poznan, Gdansk, Szczecin, Bydgoszcz, Katowice, Lublin, Sosnowiec, Bialystok, and Czestochowa.

2. The Polish landscape is quite flat, three quarters of the country is less than 200 meters above sea level. Climatically, Poland is in a transition zone between the coastal central European region and the continental extremes of the eastern European region. The most thickly settled areas are in the south and west while the north and east are devoted primarily to agriculture and are more thinly settled. One quarter of Poland is covered by forest and some of the last remaining primeval European forest exists on Poland's eastern border with Belarus.

3. Poland borders on the Baltic Sea and Russia in the north, Lithuania, Belarus, and Ukraine in the east, Germany in the west, and the Czech Republic and Slovakia in the south. Formerly much larger than it is today, Poland was the dominant power in eastern Europe from the 14th to the 17th centuries. In the 18th century it was divided up by its neighbors and ceased to exist until resurrected in 1918. Again partitioned by Germany and the USSR at the beginning of World War II, it was reestablished after the defeat of the Axis Powers as a communist "people's republic." In 1989, Poland began a transition from a centrally planned to a market based economy.

4. The Economy: In 1992, Poland's GDP in current dollars was US$167.6 billion, or about $4,400 per capita. Labor was distributed between industry and construction - 34.4%; agriculture - 27.3%; trade, transport, and communications - 16.1%; and government/other - 22.2%. Deep economic reforms instituted in 1990 resulted in declining real GDP until 1993. Since then, annual economic growth has been in excess of 3.0%.

5. After World War II, Poland underwent extensive industrialization. Coal, steel and chemical industries were all extensively developed. Electricity production increased by an order of magnitude. Primary emphasis was placed on the development

of industrial production capacity, often to the detriment of the environment. Poland's economy today is characterized by inefficient energy use, and a dependence on imported oil and natural gas. Coal dominates Poland's fuel mix, comprising roughly 75 percent of the primary energy consumed in 1994. The mining and burning of coal and lignite for electricity and steam generation results in extensive air and water pollution. In 1994 Poland was the world's twelfth largest national source of CO_2. Of the formerly communist economies, only Russia and Ukraine emit more. Other greenhouse gases include methane emissions from bituminous coal production (Poland accounts for 7% of world coal mine methane emissions). The use of low-energy, high sulfur lignite in particular also contributes to levels of sulfur-dioxide emissions which continue to be substantially higher than EU per capita averages.

6. Historically, heavy industry has been concentrated in the southwestern corner of the country, and the concentration of uncontrolled coal-fired industrial and electricity generation facilities in this area has lead to the recognition of the Silesia region as being amongst the most polluted on earth. The current Polish government must face the challenge of cleaning up the environmental legacy of the former era, while continuing the transition to a market-based economy and ensuring that strong economic growth does not create new environmental problems.

7. <u>Energy Resources</u>: The first few years after the institution of reforms also saw declines in primary energy consumption, but positive growth of this indicator began again in 1993. Primary energy per unit GDP has remained stable between 1990 and 1993, though at a level significantly higher than in western Europe. Poland's indigenous fossil energy resources are primarily large reserves of bituminous coal and lignite with a small production of natural gas. Poland currently exports coal to the rest of Europe (in excess of 25 million tonnes in 1994). There are currently about 32,000 MW of installed generating capacity in the electricity subsector. Thermal electricity generation fueled almost exclusively by coal accounts for 97% of gross electricity production. Poland's relatively flat terrain limits opportunities for the development of hydroelectric power. Due to the dependency on coal, electricity generation is a heavy producer of CO_2, accounting for 41% of annual emissions.

8. There is currently a surplus of generating capacity in the electricity sector, but economic growth is expected to create a need for investment in new generating capacity by the year 2005. Given Poland's desire to use domestic energy resources and reduce foreign exchange costs, this new generation capacity is also likely to be fueled by domestic coal resources, rather than by natural gas. Domestic supplies of natural gas are declining (or are being phased out in the case of coke oven gas) and two-thirds of current consumption is imported from Russia.

Table 4: Poland Economic and Energy Intensity Indicators

Indicator	1985	1990	1992	1993
Population (millions)	**37.3**	**38.2**	**38.4**	**38.5**
GDP million (1985 US$)	**71**	**69**	**65**	**68**
GDP per capita (1985 US$)	**1901**	**1807**	**1692**	**1766**
Primary Energy PJ	**5002**	**4144**	**4052**	**4096**
Primary Energy per capita GJ	**134**	**109**	**105**	**106**
Primary Energy per GDP (MJ/US$)	**70**	**60**	**62**	**60**

World Energy Council, National Energy Data Profile, Tokyo 1995

9. <u>Energy Consumption</u>: As shown in Tables 4 and 5., The Polish residential and commercial sectors together accounted for 50% of total energy demand in 1993, with the industrial sector accounting for 32% and the remaining share consumed primarily by transportation. Industrial users consumed 43% of total electricity sales in 1993, followed by residential users at 21% and commercial customers at around 10%. Electricity use in the residential sector in Poland in 1993 was estimated to be 66 PJ. Electricity supply per capita and per unit of GDP peaked in 1990 and have declined in the last few years. Estimated CO_2 emissions fell sharply during the 1980s, but have been holding relatively steady since 1990. Poland has been experiencing strong, steady economic growth and gross electricity consumption is projected to grow by 3-5% annually through the 1990s.

Table 5: Poland Final Energy Demand by Source and Sector 1993 (PJ)

Sector	Coal	Oil	NGas	Other	Elec	Heat	Total	%
Industry	**302**	**31**	**77**	**6**	**134**	**330**	**880**	**0.32**
Transport	**12**	**314**	**0**	**0**	**19**	**7**	**352**	**0.13**
Other: of which	**641**	**69**	**166**	**30**	**157**	**315**	**1378**	**0.50**
Residential	**NA**	**NA**	**142**	**NA**	**66**	**NA**	**NA**	
Commercial	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	
Non-Energy use	**5**	**77**	**53**	**3**	**0**	**0**	**138**	**0.05**
Totals	**960**	**491**	**296**	**39**	**310**	**652**	**2748**	**1.0**

World Energy Council, National Energy Data Profile, Tokyo 1995

10. Future growth in electricity consumption will depend upon continued economic growth, on ongoing energy price and macro-economic reforms, and on the priority given to energy efficiency investments. The proportion of total energy used by the consumer sector has been increasing since 1985 and is expected to continue to increase as the consumer sector grows and the industrial sector continues to restructure. As Poland's economy continues its transition, consumers will choose from the vast array of electricity-using technologies available on the world market. The energy efficiency of

the technologies they choose will have a continuing impact on the growth in electricity consumption, and on the CO_2 and other pollutants emitted by the Polish electricity industry.

11. A 1993 study of DSM potential in Poland identified significant energy consumption associated with lighting in the residential, commercial and industrial sectors (Hagler-Bailly, 1993). In the residential sector, lighting use accounted for 14,550 GWh of annual energy consumption or 55% of the total sector, representing a total installed end-use capacity of 13,250 MW. This is consistent with an almost exclusive reliance on inefficient incandescent lighting technology in Polish homes and the low incidence of other major electrically power end-uses, such as heating or air-conditioning equipment. The most common other major end use in addition to lighting is likely to be refrigeration. Thus, in the residential sector, improved lighting energy efficiency has an opportunity to significantly reduce overall sector electricity consumption.

12. The same is also true in the commercial sector where, excluding specialty lighting, annual energy consumption associated with lighting totaled 5,321 GWh, 54% of the total sector energy consumption, and represents 2,163 MW of total installed end-use capacity. This compares to the industrial sector where, excluding specialty lighting, annual energy consumption for lighting totaled 4,507 GWh, which is only 9% of the total sector, and represented 1,132 MW of total installed end-use capacity.

Residential Lighting Options: A Technology Overview

13. Background: The ubiquitous incandescent lamp was developed a century ago. It consists of an evacuated or gas filled glass bulb which contains a conductive filament. Electricity is passed through the filament which glows or "incandesces" white-hot, emitting a small amount of visible light and a large amount of infrared light or heat. In lighting industry parlance, an incandescent lamp produces about 14 lumens of visible light for every watt of input power. The filament in an incandescent lamp typically breaks after about 1000 hours of use, at which point the lamp must be replaced. Incandescent lamps are a commodity and are manufactured in most countries in the world. A 75 watt incandescent lamp can be purchased at retail in Poland for less than US$ 0.50 per unit.

14. In recent years, illumination technologies have been developed which are more than seven times as efficient as incandescent lamps. Not all of them are suitable for residential use because the color of the light generated is too far from normal sunlight, or because they can only be cost-effectively manufactured in packages which are too

bright for indoor applications. One lighting technology which is significantly more efficient and is also appropriate for residential applications is fluorescent lighting.

15. *Fluorescent Lighting Technology*: Fluorescent lamps have been available for over fifty years, but in the last decade the technology has made rapid advances, becoming substantially more efficient, and becoming available in smaller packages with better quality light. Fluorescent lamps operate on an entirely different principle than incandescent lamps. Electricity is passed through a gas held in a tube until the gas ionizes and emits ultraviolet light. The ultraviolet light strikes and is absorbed by chemicals called phosphors which coat the inside of the tube. This causes the phosphors to "fluoresce" and emit visible light which passes outside of the tube. The fluorescent process of converting electricity into visible light is much more efficient than incandescence. The best fluorescent lamps currently available approach 100 lumens per watt. They also last up to 10 times longer than incandescent lamps. Although fluorescent lamps cost significantly more than incandescents for packages which produce the same amount of light, they are usually cheaper in the long run because of the electricity savings.

16. *Compact Fluorescent Lamps (CFLs):* The recent advances in fluorescent technology have culminated in the CFL. The CFL is a fluorescent lamp that incorporates a compact, bent tube and miniaturized electronics into a package small enough to be screwed into a socket designed for an incandescent lamp. CFLs last 8,000-10,000 hours, compared to approximately 1,000 hours for incandescent lamps and produce up to 80 lumens/watt. CFLs normally cost 15-30 times more than incandescents of similar light output, but because they are much more energy-efficient and last ten times longer, they are a cost effective investment for consumers in most parts of the world. Over its life, one 15-watt CFL replacing ten 60 watt incandescent lamps can avoid the need to burn 350-400 pounds of coal or almost one barrel of oil in a power plant. This in turn avoids the release of 600-800 pounds of CO_2. CFLs commonly available on the market tend to be slightly bulkier and heavier that incandescent lamps, and therefore are not appropriate substitutes in all situations.

17. *Electronic and Magnetic Ballasts:* All fluorescent lamps require special electronics called a "ballast", to initiate and regulate the ionization of the gas in the tube. The important distinction between electronically and magnetically ballasted CFLs is that electronic ballasts allow CFLs to come very close to replicating the performance of incandescent lamps while magnetically ballasted CFLs typically flicker upon ignition and may produce audible noise. Electronically ballasted CFLs also tend to be more expensive and more energy efficient than magnetically ballasted ones. Electronically ballasted CFLs are usually recommended for residential applications.

18. *Integral and Modular CFLs:* CFLs come in two general types: integral and modular. Integral CFLs incorporate both the lamp and ballast in one piece. It is the lamp part of a CFL that typically limits life to 8,000- 10,000 hours of operation, because the available ballasts can last several times as long. When the lamp in an integral CFL burns out, the whole unit must be disposed of. Modular CFLs have separable lamps and ballasts. This allows the user to replace the lamp while retaining the ballast. Because the ballast may comprise more than 50% of the total cost of a CFL, modular CFLs can offer additional cost savings, though usually at some sacrifice in terms of size. Integral and modular CFLs can both have either magnetic or electronic ballasts.

19. *Screw-In CFLs and Hard-wired CFL Luminaires:* Screw-in CFLs are designed to replace an incandescent lamp in a traditional Edison socket and will fit into many luminaires designed for incandescent lamps. However, lighting manufacturers can also produce hard-wired luminaires which are optimized to the optics and electronics of a CFL. In these hard-wired CFL luminaires the ballast is incorporated into the housing and the socket will only accept standard an appropriate fluorescent tube, not an incandescent lamp. Hard-wired CFL luminaires are the optimal long-term option for consumers because they maximize the performance of the fluorescent technology, while allowing the tube to be replaced without discarding the ballast.

MAIN ISSUES IN THE POLISH RESIDENTIAL LIGHTING SECTOR

20. Market Penetration by CFLs: There are an estimated 209.5 million incandescent (or general lighting service - GLS) lamps in use in Poland. The residential sector uses the most GLS lamps, 191 million (91%); the commercial sector uses 18 million GLS lamps (9%), and the industrial sector uses 0.5 million GLS lamps. In 1993, Poland produced 213 million incandescent lamps. Annual sales of incandescent lamps are on the order of 200 million. The Polish CFL market was established in 1992, when Philips Lighting Poland (PLP) began selling CFLs domestically. Prior to PLP's appearance, sales of imported CFLs had been negligible. The average Polish home has 15 standard "Edison base" electric lamp sockets and while the market has been growing steadily since 1992, CFLs still represent only a tiny percentage of total lighting sales.

21. Awareness of CFLs has grown rapidly in Poland over the last two years. Surveying in 1993 showed little familiarity amongst consumers with CFLs. By December 1995, 83% of survey respondents indicated that they had heard of CFLs and 28% were able to accurately describe one. At this time, 71% of surveyed electronics shops carried CFLs, 11.5% of households surveyed owned at least one CFL. By May of 1996, surveying showed that while the percentage of consumers sampled who had heard of CFLs had not increased, 41% could now accurately describe one and 14.4% owned at least one. CFLs were also now available in 75% of electronics shops.

22. Most of the changes in the Polish CFL market prior to December 1995 may be attributed to broad marketing campaigns mounted by Philips Lighting Poland, and by Osram, a Germany-based lighting manufacturer which also imports substantial

Table 6: Growth in the Polish CFL Market (all sectors)

Year	Total Market	Market Growth	CFLs as % of GLS sales*
1992	181,000	NA	.09%
1993	360,000	100%	.2%
1994**	613,000	70%	.3%
1995**	1,000,000+	63%	.5%

*more than 200 million annually
**estimated sales

numbers of CFLs into the Polish market. Table 6 shows the estimated growth of the

CFL market. The potential size of the Polish market for CFLs has been estimated by the IIEC to be between 21 -26 million units, with annual sales at saturation of 4 million units.

23. Although they may be familiar with the technology, residential customers in Poland still face barriers to purchasing CFLs. CFLs have a high up-front cost (around PLN 35.00, compared to around PLN 1.00 for an incandescent lamp in 1995 prices. For this reason, the recent rapid growth in Polish CFL sales has been largely driven by the commercial/professional sector. These customers typically use lighting for many hours each day and are therefore able to realize the relative benefit of a CFL over a conventional incandescent lamp in a short period of time. Because CFLs only need to be replaced one tenth as often as an incandescent lamp they are an attractive option to commercial customers who have to pay someone to change burned out lamps. Anecdotal evidence also suggests that a major factor influencing commercial/professional sales of CFLs is the popular perception that CFLs convey, particularly in retail establishments, an image of modernity and technological sophistication.

24. Changes in Energy Tariffs: After a long period of subsidy by the central government, electricity tariffs in Poland have been allowed to rise to levels more reflective of generation costs. By way of comparison, tariffs in less developed countries are usually around US$0.07/kWh and in Poland the average residential consumer's rate is approximately US$0.06/kWh (as of March 1996). Also for the first time in 1996, retail electricity tariffs will be allowed to vary geographically (by a maximum of 15%) to reflect regional differences in generation, transmission and distribution costs. However, no additional significant net increases in retail tariffs are expected in the near term. The long run marginal cost (LRMC) of electricity generation on an asset valuation basis is in the US$0.05-0.06/kWh range; using fuel value alone LRMC levels are only US$0.027/kWh although when corrected for the cost of environmental controls they reach US$0.048/kWh according to a tariff study conducted for the PSE in 1993 with USAID support.

25. Institutional Framework: The PELP project is designed to operate almost exclusively in the private sector. However, several ongoing public sector activities and trends are likely to have an impact on project outcomes. Expanding government requirements for the testing and labeling of electronic products for safety reasons have meant that some of the testing which was originally seen as necessary to ensure product quality under PELP has now become redundant and can be eliminated. Recent regulations requiring retailers to respect manufacturers' recommended retail prices aids an important objective of the program in helping to insure that the manufacturer

subsidy survives as lower retail prices, rather than being captured by distributors and retailers. In the broader policy context, the Ministry of Industry has identified lighting as a key area for industrial development and co-funding may be available for applied research. The Ministry of Environmental Protection has also identified energy efficient lighting as a key pollution prevention strategy. Poland is progressive in the application of taxes on pollution, usually levied in the form of fees against industries which exceed emissions limits, and the funds accumulated are earmarked for pollution control activities, including improving energy efficiency. One of the quasi-public agencies responsible for the investment of these accumulated fees, the National Energy Conservation Agency or KAPE, is on the PELP Advisory Committee.

26. High First Costs: CFLs are an attractive investment at current prices for the typical Polish consumer. However, consumers tend to use different methods for evaluating potential purchases of energy saving equipment than they do for investing in financial instruments. Typically, a consumer considering buying a CFL will ask how long it takes for the incremental cost to be paid back through energy savings and is generally reluctant to purchase if the payback period is more than two years. This reflects the fact that consumers do not have the financial flexibility or orientation necessary to make medium or long term decisions designed to conserve energy. Although the internal rate of return on an investment in a CFL is quite good, the simple payback times for the most common type of CFL available for the Polish residential retrofit market are around three years depending upon the lamp use profile.

27. Macro-economic circumstances and electric utility billing practices for residential customers have also obscured the economic "signal" from energy conservation in the form of lower utility charges. Utility residential billing is typically done on a quarterly or semiannual basis, six months following the time of actual consumption. Since 1989, the rate of inflation in Poland and the frequency of increases in electricity tariffs have caused changes to customer bills of such magnitude as to overwhelm most conservation induced savings.

THE POLAND EFFICIENT LIGHTING PROJECT

28. Background: The IFC/GEF Poland Efficient Lighting Project (PELP) received approval from the Global Environment Facility (GEF) in December 1994 for use of US$ 5 million in GEF pilot phase funds. IFC and its Environment Division were assigned responsibility by the GEF Secretariat for managing project implementation. The Polish market for CFLs is currently far less developed than in western Europe, particularly for residential and small business consumers. PELP will use direct manufacturer subsidies, pilot demand side management (DSM) activities at selected electric distribution companies and municipalities, and consumer and lighting

professional education programs to increase Polish domestic demand for CFLs and luminaires. PELP includes a rigorous monitoring and evaluation component to support effective program implementation, to encourage high quality of CFL products, and to allow a robust assessment of the project's impact on greenhouse gases emissions from the Polish electricity sector.

29. The IFC/GEF project development process was launched in the spring of 1993. The IFC Environment Division conducted a mission to Poland to meet with PLP and FEWE to assess Polish interest in a market stimulation effort and to identify the barriers to market development and the benefits to the Polish economy and environment that such an initiative might create. IFC enlisted the assistance of the International Institute for Energy Conservation (IIEC) and Battelle Pacific Northwest Laboratories of the United States to help refine the project concept. In August of 1993 IFC's Environment Division convened a GEF technical review panel to assess the project concept and provide recommendations for further developing the project.

30. A pre-appraisal process completed during the Fall and Winter of 1993 included several missions to Poland to meet with manufacturers, retailers, distributors, design engineers, and financiers of the lighting industry, as well as a variety of utility sector executives. FEWE also provided data and analysis on the lighting market that drew from four focus groups and close to 100 CFL field tests conducted during the Fall of 1993. FEWE and the PSE participated in the analysis of the project impact on Polish power demand and the resulting local environmental benefits. A pre-appraisal report was prepared to respond to the input from and comments of the GEF technical review panel whose concerns and suggestions about the proposed project helped guide its development to date. Follow-up missions in the Spring and Fall of 1994 provided a basis for on-going collaboration between the IFC project development team and representatives of the Polish government, Polish electric distribution companies, environmental and energy NGOs and a variety of Polish lighting product manufacturers and lighting professionals in finalizing the project design.

31. The IFC/GEF pre-appraisal team chose to rely principally on consumer focus groups, product field tests, and interviews with professionals from the lighting industry, and on data about the market made available from manufacturers and distributors. The team's purpose was to gain insight into local market dynamics in order to determine how to stimulate most effectively the growth of a healthy market for domestically-produced CFLs. The market assessment draws on material from a CFL market survey, conducted by PLP in Warsaw and in the Katowice region; focus group research, conducted by FEWE and the project team; a field test of CFLs, conducted by FEWE in the Warsaw and Katowice regions, in which 35 participants were given a total

of 80 CFLs to use at home, and were asked to fill out a questionnaire which tracked lamp use and consumer response to the lamps; on-site retail market research, conducted by the project team; on-site manufacturer and distributor research, conducted by the project team in Pila, Katowice, Warsaw and Krakow; and a report to the World Bank on demand-side management in Poland, prepared for USAID. (Hagler 1993) This report includes a discussion of lighting use in Poland.

32. Project Organization: In May 1995, IFC selected the Netherlands Energy Company B.V. (NECO), a wholly owned private subsidiary of Dutch gas and electric utilities, to oversee project implementation. Administrative management of project activities resides principally with NECO's daughter company, Netherlands Energy Efficient Lighting B.V. (NECEL). NECEL works with FEWE and other respected Polish professional societies and environmental NGOs to implement PELP's various components. NECEL and FEWE will also work with selected Polish electric distribution companies (ZEs), municipalities, and PSE to develop their institutional capacities to develop pilot CFL distribution activities as utility DSM programs.

33. NECEL capacity includes a part-time project manager based in the Netherlands and an office in Warsaw staffed by a full-time project leader and a support person. Since the establishment of this office in August of 1995, NECEL has commissioned several studies to further characterize the Polish residential lighting market including a brief survey of retail prices for CFLs in different parts of Poland; a survey of consumer awareness and incidence of CFL ownership; telephone and onsite surveys of retail shops to determine the availability and pricing trends of CFLs; a consumer survey to evaluate the effectiveness of the initial PELP television campaign in creating awareness of the PELP program and recognition of the PELP program logo.

34. Day-to-day project coordination is the responsibility of Netherlands Energy Efficient Lighting (NECEL). NECEL has direct responsibility for completing many of the tasks contained under the CFL subsidy component of PELP, and a managerial responsibility for all other tasks. NECEL is supported by an array of contractors and is advised by an Advisory Committee made up of Polish organizations with an interest in PELP. Particular stress has been placed on identifying Polish contractors to perform tasks to assist NECEL. Table 7 presents the organizations which have been involved in PELP to date. The list will likely grow during the second season of the project. Annex 1 presents the organizational chart for PELP.

Table 7: Organizations Involved in PELP

Organization	Nationality	Function
International Institute for Energy Conservation (IIEC)	International	Planning
Netherlands Energy Company (NECO)	Netherlands	Implementation
Netherlands Energy Efficient Lighting (NECEL)	Netherlands	Implementation
Polish Foundation for Energy Efficiency (FEWE)	Poland	Implementation
Association of Polish Electric Utilities	Poland	PELP Advisory Committee
City of Elk (representing Energy Cite)	Poland	PELP Advisory Committee
Institute of Environmental Protection	Poland	PELP Advisory Committee
National Energy Conservation Agency (KAPE)	Poland	PELP Advisory Committee
Ministry of Environmental Protection	Poland	PELP Advisory Committee
Ministry of Foreign Affairs (GEF Focal Point)	Poland	PELP Advisory Committee
Polish Consumer Federation	Poland	PELP Advisory Committee
Polish Ecological Club (PKE)	Poland	PELP Advisory Committee
Polish Power Grid Company (PSE)		
Optimum Media	Poland	PELP Advisory Committee
Quendi	Poland	Contractor: Advertising
Studio P	Poland	Contractor: Advertising
Trans Media	Poland	Contractor: Advertising
Battelle PNL	Poland	Contractor: Advertising
Synergic Resources Corporation (SRC)	USA	Contractor: DSM pilot
EEI	Netherlands	Contractor: Legal
Detlam-Polam	Poland	Contractor: Taxes
GE Polska	Poland	CFL manufacturer
Kania	Poland	CFL manufacturer
Maya	Poland	CFL manufacturer
Philips Lighting Poland	Poland	CFL manufacturer
Polam-Investment	Poland	CFL manufacturer
Vox	Poland	CFL manufacturer

35. <u>Project Objectives</u>:

- Reduce greenhouse gas emissions in the Polish electricity sector.
- Realize the economic and environmental benefits for Poland from the energy efficiency resource represented by the domestic CFL manufacturing capacity.

- Accelerate the penetration of screw base CFLs and CFL based luminaires in the Polish residential lighting market, through improved availability, lower prices and public education.
- Leverage existing IFC loans with GEF grant funds to realize Poland's potential to develop a sustainable market for energy-efficient lighting products.
- Develop the capability of Poland's electric distribution companies, the Polish Power Grid Company (PSE), and the Polish Energy Efficiency Foundation (FEWE) to deliver demand-side resources and demonstrate the value of DSM programs to the electric power sector.
- Demonstrate that a direct manufacturer's subsidy can provide immediate retail cost reductions in excess of the subsidy amount, can be administered efficiently at a very low cost, can spur CFL demand growth, expand the variety of products available, increase domestic manufacturing capacity, and provide a sustained impact on market growth.

36. CFL Subsidy: The PELP CFL Subsidy program is the largest part of the PELP project. Approximately US$ 2.7 million of GEF funds will be available over a two year period through PELP to reduce the cost of screw base CFLs to consumers and stimulate demand. The first phase of these subsidies will use approximately US$ 909,455 to subsidize over 345,000 CFLs in Poland during the 1995-1996 winter lighting season. The balance of the subsidies will be made available during the 1996-1997 lighting season, and over 750,000 additional CFLs are expected to be distributed. PELP is also intended to demonstrate that a direct manufacturer's subsidy can:

- provide immediate retail cost reductions in excess of the subsidy amount;
- be administered efficiently at a very low cost;
- spur growth in demand for CFLs for efficient lighting products and expand the variety of products available in the market;
- increase domestic manufacturing capacity; and
- provide a sustained impact on market growth.

37. Under PELP, NECEL provides subsidies on a competitive basis to Polish CFL manufacturers, using a program design based on experience derived from U.S. electric utility DSM programs. The PELP approach is often called a "manufacturer subsidy", but the GEF funds are actually used to "buy down" the manufacturers wholesale price for eligible CFLs at the beginning of the product distribution chain, and the subsidies then flow through to consumers. Manufacturers do not benefit directly from the subsidy, but benefit indirectly from being able to sell their products at lower prices. In

fact, manufacturers essentially finance the subsidies by first reducing their wholesale prices and then applying to NECEL for reimbursement. The manufacturer wholesale price buy down results in lower retail prices for each unit of subsidy than, for example, providing rebates directly to consumers in the form of coupons. Retail shops in Poland and other countries typically calculate retail prices by multiplying the wholesale prices they pay by a set markup percentage. In addition, VAT (value added sales tax) in Poland is also based on a percentage of the wholesale price. A rebate given to the consumer decreases the price of the CFL after both the retail markup and VAT. When the rebate is given to the manufacturer to reduce the wholesale price of a CFL, both the retail mark up and the VAT paid are also reduced. Thus, a decrease in the wholesale price can yield a much larger decrease in retail price. For example, by the time a 15% wholesale markup, a 25% retail markup, and a 22% VAT are factored in (75% total increase over manufacturer's price), a US$1 subsidy in the Polish CFL market will reduce retail price by US$1.75. Furthermore, the direct manufacturer subsidy approach has many benefits over comparable retail-level programs, including greater control over product price and availability, and reduced program administration costs.

38. PELP subsidies are potentially available to any CFL manufacturer who can meet the technical requirements of the program and who substantially manufacturers their product in Poland. All PELP CFLs must meet minimum technical standards detailed in Annex B: "IFC/GEF Poland Efficient Lighting Project CFL Subsidy Minimum Specifications for Promotional CFLs". In addition, participating manufacturers must be able to assist in conducting adequate program monitoring and to control product distribution. Manufacturers must pass on the full value of the subsidies as lower wholesale prices, and are also encouraged to provide additional wholesale price reductions and advertising. Manufacturers are also required to help where they can to control excessive rent capture throughout the distribution chain. This last point is crucial to ensuring that consumers see substantially lower prices for PELP subsidized products.

39. Manufacturers participating in PELP compete with each other for the right to receive subsidies by submitting proposals for their use to NECEL. Preference is given to those manufacturers who are able to provide the greatest savings, in terms of projected avoided electricity use, for the smallest application of subsidies. After evaluating the proposals, NECEL signs contracts with manufacturers which entitle them to apply for a certain amount of subsidies by documenting that they have sold certain numbers of specific types of CFLs at the agreed upon prices to targeted customers. NECEL only pays out the subsidies following verification of "proof of performance" documentation supplied by the manufacturer showing that the appropriate products have been sold in the required way. If a manufacturer is unable

to sell sufficient CFLs quickly enough to use the subsidies awarded in its contract, the entitlement to the subsidies is reallocated by NECEL to more successful competitors. In this way, PELP preserves and strengthens competitive forces in the marketplace and uses them to help achieve project CFL penetration goals.

40. Manufacturers are encouraged to propose subsidies which vary by the type of CFL, applying only the minimum subsidy necessary to each model to achieve the desired sales. Manufacturers are also encouraged to spread the subsidies over as many CFLs as they believe they can sell within the time constraints imposed by PELP. The intent is to use the manufacturers' knowledge of the marketplace to maximize CFL sales, and thereby maximize energy savings per dollar of available subsidy. Manufacturer proposals are evaluated using common technical and marketing criteria to establish a "level playing field" between the manufacturers.

41. Four manufacturers qualified for PELP, signed agreements to participate, and sold subsidized products during the winter of 1995-1996. Additional manufacturers have submitted proposals for the winter of 1996-1997. The average subsidy applied per CFL by the participating manufacturers during PELP's first lighting season was US$2.64. During the first lighting season, two manufacturers entered the Polish CFL market for the first time, and therefore had no pricing history. The other two manufacturers who had been already selling in Poland contributed reductions in wholesale price of about 13%, which amounts to a retail price reduction of US$465,800 (PLN 1,164,840) leveraged with an investment from PELP of $909,455. Assuming that similar contributions can be solicited from manufacturers during the 1996-1997 lighting season, the value of the total retail price reductions, including the multiplier effect of the distribution chain markups will be on the order of US$ 5 million.

Luminaire Subsidy: For various reasons, CFLs are not able to substitute for incandescent light bulbs in all lighting applications. To realize the full potential of energy efficient lighting technology in Poland it is also necessary to consider luminaires; which integrate the light source and its fixture or housing. Each compact fluorescent luminaire installed will assure the future use of CFL technology for that lighting application over the expected 50,000-hour life of the luminaire. There are currently few energy efficient luminaire products currently available on the Polish market which are suitable for residential applications. PELP is working with IIEC and Polish luminaire manufacturers to develop a luminaire subsidy program to stimulate the Polish market for such products.

42. Because the market for CFL fixtures in Poland is less mature than the market for screw base CFLs, a study has been commissioned to determine the capacity of the

domestic Polish luminaire industry to produce CFL dedicated products suitable for residential applications. The results of this study will guide the development of this program. In addition to US$ 410,000 for subsidies, the PELP budget contains funding for a technology transfer and education component to introduce technically sound prototype compact fluorescent technologies to Polish luminaire manufacturers who are generally unfamiliar with them. There may also be opportunities to create markets for energy efficient luminaires by organizing bulk purchases.

43. Pilot DSM: The Pilot DSM project will provide an important opportunity to test the effectiveness of promoting CFLs through Polish municipalities and electric utilities. Current Polish government policies encouraging electricity sales have made it difficult for utilities to participate directly in DSM programs. Municipalities have a broad public purpose, have access to public resources, and can approach utilities on a different basis concerning reducing energy costs.

44. The two cities which have agreed to participate in the DSM Pilot are Chelmno, a city of about 22,000 in the northern part of the country, and Elk, a city of about 54,000 in the northeast region of Poland. A substantial part of the DSM Pilot program will target specific areas in Elk and Chelmno with distribution capacity problems. FEWE estimates lighting represents 50% of the residential peak in Poland, which implies a substantial opportunity to reduce residential peak load with CFLs. If successful in reducing peak load in the affected areas, and thereby avoiding the need for expensive transmission and distribution upgrades, the DSM Pilot should powerfully demonstrate the attractiveness of DSM to Polish city governments, policy makers, and electric distribution companies.

45. In addition to the targeted installation of CFLs, the Pilot DSM program will take advantage of the City of Chelmno's interest in a city-wide installation of CFLs. A city-wide campaign would allow promotional efforts and other Pilot DSM program mechanisms to be tested that would not be possible under a program limited to small geographic areas. In order for the Pilot DSM program to have the maximum impact on the Polish market, results must be well documented and widely disseminated. An excellent medium for dissemination of the results of the Pilot DSM program is Energy Cities, an organization of about 25 small to medium cities organized and staffed by FEWE, that is working to improve municipal energy use.

46. These activities will help to establish indigenous Polish expertise in DSM and help build the capability within the Polish electricity sector to successfully implement efforts such as the planned World Bank distribution system loan (which includes a DSM Pilot Project). PELP is exploring the use of GEF funds to leverage potential sources of indigenous co-financing such as environmental funds (e.g. EcoFundusz).

Similar pilot DSM activities will be encouraged with other interested organizations such as environmental NGOs, and housing cooperatives. While the current excess generating capacity situation in Poland has dampened utility enthusiasm for DSM, legislation currently pending before the Polish parliament may also increase the attractiveness of utility sponsored DSM activities to the Polish utility sector as it is privatized.

47. Public Education: Developing consumer awareness is essential if PELP is to have a sustained impact on the market for energy-efficient lighting products in Poland. The consumer education component of PELP promotes the CFL subsidy to the public by providing general information on the benefits of CFLs from an independent perspective. The Public Education component also covers the preparation of energy efficiency education materials and curricula and promotes the PELP logo as a way for consumers to identify, energy-efficient, high quality products. There has been extensive promotion of PELP in the Polish press including an article in a national newspaper and many smaller publications. NECEL contracted with FEWE to draft and publish articles about PELP and its progress in various publications. In January 1996, a press conference was held in Warsaw to provide information to the media and to sustain media interest in PELP as the first season of the program was completed.

48. The first season of the PELP CFL subsidy program relied heavily on paid television advertisement. For the second season, PELP will make more extensive use of print media, with additional public service announcements on television if available. NECEL staff are meeting with Polish NGOs to plan and coordinate a wide variety of grass roots public education activities to promote the economic and environmental benefits of energy efficient lighting. Recognizing that children are an effective information conduit, the project will target schools, providing teaching materials for use by Polish teachers. Professional societies will also be enlisted to help to inform their customers of the lamps' economic and environmental benefits. Finally, the project will increase lighting professionals' awareness and understanding of CFLs by organizing symposia on energy-efficient lighting and publishing technical background materials on the lamps. This initiative will also address directly an expanded role for efficient lighting in the new building construction market in Poland.

49. Monitoring and Evaluation: Monitoring and evaluation efforts will assess both the direct effects of the purchases of subsidized CFLs, and the "market transformation" effects of the broader market stimulus provided by the impact of the combined PELP components. Synergic Resources Corporation (SRC) was competitively chosen to work closely with Polish contractors to develop and implement a comprehensive evaluation plan. Environmental benefits will be evaluated using the World Bank's Greenhouse

Gas Abatement Investment Project Monitoring and Evaluation Guidelines for GEF Projects (June 1994). Evaluation activities for PELP are also designed to allow continual fine-tuning of PELP's functions, and to maintain the project's responsiveness to its objectives.

50. With the assistance of a Polish market survey form EEI, NECEL will monitor participating manufacturers' sales of subsidized CFL to ensure that lower retail prices are achieved. The participating manufacturers will assist in the monitoring process by properly labeling PELP products and including a customer response card in CFL product packaging. Limited telephone surveys will be used to supplement the packaging surveys. The ongoing monitoring of results will be used to modify the project's operation including activities within the marketing and information programs, determination of subsidy levels, distribution methods, and manufacturers' eligibility status for continuing project participation. Follow-up evaluations will measure long-term market impact including prices, sales, and availability. These data will be used to estimate PELP's electricity generation, peak capacity, and CO_2 savings, and attempt to measure the persistence of savings once the program subsidies are complete. The monitoring and evaluation efforts will ensure the program's demonstration value as a market development tool and DSM delivery mechanism, as well as providing a check and oversight for monitoring program participants' sales and price performance throughout the implementation process.

51. Project Costs: Costs for the project are distributed between the various components, with over 60% allocated directly for product subsidies. To the largest extent possible, PELP attempts to use Polish contractors to perform project functions so as to utilize indigenous capabilities, to help build DSM related skills which could be applied to future projects, and to take advantage of Poland's lower wage rates as a way to reduce administrative costs. A breakdown of expected costs is presented in Table 8. While core PELP funding comes from the GEF, there are several opportunities for linkage with other projects and co-financing which are in various stages of discussion or under development. The World Bank is in the very early stages of preparing a loan to parts of the Polish power industry to fund reorganization of the power distribution companies which we slated to be privatized. USAID has developed a pilot utility industrial DSM program with the Gliwice ZE, which will be implemented through the World Bank US$100 million Poland Power Distribution Project loan which is in preparation.

Table 8. PELP Costs

Program Component	Costs (USD)
Project Administration	
Staff	210,000
Legal and Administrative	60,000
Other	190,000
Product Subsidy (CFL and luminaire) Component	
Direct subsidies	3,165,000
Product testing and design	950,00
Utility DSM Pilot Component	
Consultants	280,000
Direct Cost Contribution	150,000
Public Education	
Direct CFL Promotion	400,000
Other education activities	170,000
Monitoring and Evaluation	
Evaluation Consultants	165,000
Monitoring Contractors	115,000
Total	5,000,000

BENEFITS, ENVIRONMENTAL IMPACTS AND RISKS

52. Benefits: Because the GEF subsidies and the manufacturer price reductions are applied at the wholesale level, they are multiplied as the CFLs are sold, bought and resold down through the product distribution chain. The distribution system for retail products in Poland is similar to other countries with market based economies, though possibly less organized and with a larger "gray" market segment. Each level of the distribution chain, adds its own percentage mark-up. Poland also applies a 22 percent sales, or value added tax (VAT) to CFLs. As a result, retail CFL prices are typically 175% of wholesale prices at the factory gate. Because these markups and taxes are usually calculated as percentage of the wholesale cost, lowering the wholesale cost effectively lowers the amount that the consumer must pay for markups and taxes. This multiplier effect is one of the advantages of a manufacturer subsidy program approach, over a direct consumer subsidy. As Table 9 shows, the multiplier effect can be substantial, with the value of the retail price reductions for promotional CFLs nearing three times the value of the GEF subsidies applied. Other private sector investments

towards the objectives of PELP are more difficult to quantify, but may also be large.

Table 9: Estimated Total Project Investment (US$ 1995)

GEF Subsidies	2,700,000
Manufacturer Allowances	1,584,432
Distribution Multiplier (mark up and taxes)	3,599,306
Total Leveraged Investment	5,183,737
Total Retail Price Reduction	7,883,737

For example, there is ample anecdotal evidence that PELP has accelerated more than one CFL manufacturers' plans for entering or expanding into the Polish market.

53. Compact fluorescent lamps are a cost-effective investment for Polish consumers, and for the GEF. Even without subsidies, at current electricity prices in Poland, a CFL offers an attractive rate of return compared to other investments which are available to Polish consumers. However, few consumers evaluate the purchase of lighting and appliances as they would financial investments. A common method which consumers use to assess purchases of energy conserving equipment is how long it will take to recoup the incremental cost through undiscounted energy savings, often referred to as "simple payback".

54. Table 10 compares the purchases of a CFL and an incandescent bulb of equivalent light output. All the values presented in this table are representative of actual PELP project experience in Poland, but because many different types of CFLs at different prices and subsidy levels are involved, the evaluation of any one specific CFL will differ. Table 10 shows that without subsidies, simple payback is about three years for a CFL at current retail and electricity price levels. A consumer survey performed prior to PELP indicated that Polish consumers were fairly accurate in their assessment of the length of payback. Table 10 also shows that a typical PELP subsidy of US$ 2.50 per CFL will cut the length of payback by a third. During the first season, this increased benefit (coupled with effective advertising) caused significant increases in consumer demand for CFLs.

Table 10: Example Cost Effectiveness Calculations: Incandescent vs. CFL

Price of 75 W Incandescent Lamp (PLN)	1.00
Lifespan of Incandescent Lamp (hours)	1000
Lifespan of Compact Fluorescent Lamp (hours)	9000
Cost per kilowatt hour (PLN/kWh)	0.17
Average length daily residential light service (hours)	3
Discount Rate	10%
Unsubsidized CFL	
Retail Price of 20 W CFL (PLN)	35.00
NPV of incandescent cost stream over 8.2 years (PLN)	85.95
NPV of CFL cost stream over 8.2 years	58.30
Consumer's IRR for CFL investment	29%
Simple Payback (months)	37
Subsidized CFL	
Retail price of 20 W CFL (PLN)	24.38
NPV of incandescent cost stream over 8.2 years (PLN)	85.95
NPV of CFL cost stream over 8.2 years	47.68
Consumer's IRR for CFL investment	45%
Simple Payback (months)	25

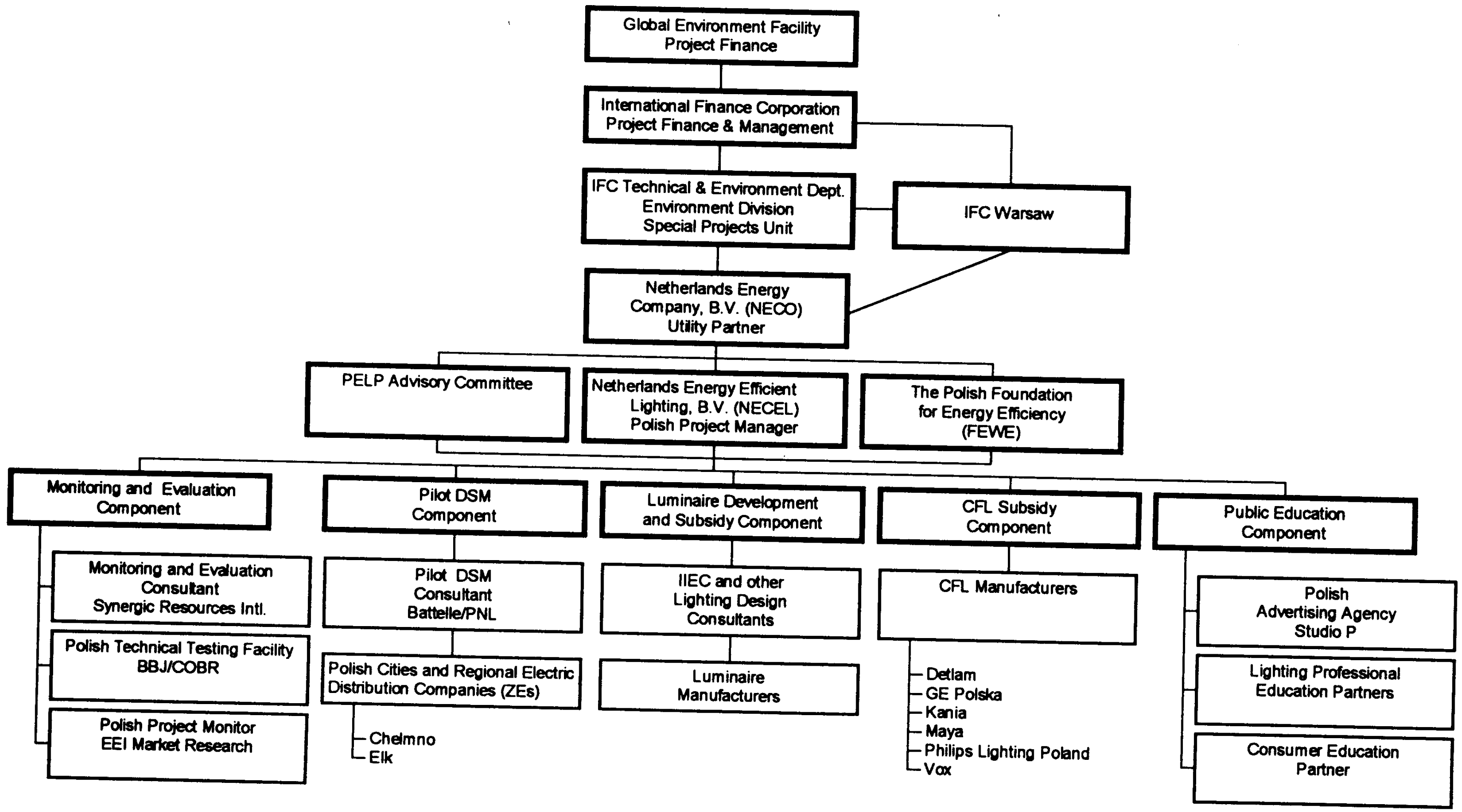
55. Risks: The assumptions in Table 10 are conservative, but extreme situations can degrade the benefits to be realized from CFLs. One inherent risk is that the benefits of a CFL depend upon it remaining in place long enough for it to replace many shorter-lived incandescent bulbs. The rated lifespan of a CFL can be shortened by mechanical failure, by being damaged by the user, or by being removed for other reasons. The success of PELP is also dependent on the effective utilization of market forces in a context where market economics are still relatively novel. Participating manufacturers must be able to see the provision of the subsidy not as a way to immediately increase their profits, but as a tool for increasing the market and thus their total sales. Manufacturers are required under their contracts with NECEL to pass on the full value of the subsidies to consumers, but it is impossible to completely control the pricing and distribution process. It is even more difficult to exert pressure on wholesale distributors or retailers to prevent them from retaining the subsidies for themselves. The Polish retail distribution system is complex and still largely informal. Wholesalers and retailers must also be persuaded to realize PELP's benefits through greater volume, as opposed to higher profit margins.

56. Consumers must be able to find and purchase energy efficient lighting that they learn about through the public education component or manufacturer advertising. The high quality of products included in PELP must be carefully maintained in order to ensure that consumers are satisfied with their investments in energy efficient lighting. The project's success may also stimulate more demand for subsidized CFLs than can be met through the program. Short term economic or political considerations may cause manufacturers to reconsider their participation in PELP. For example, the large current excess of generating capacity makes it difficult for electric utilities to engage in any activities which reduce sales. The success of PELP is dependent upon the carefully cultivated goodwill of consumers who trust the promise of benefits from CFLs enough that they are willing to spend their money to purchase energy efficient lighting products.

Annex 1: Organizational Chart

IFC/GEF Poland Efficient Lighting Project

PELP Project Management Structure



Annex 2: Minimum Specifications for Promotional CFLs

IFC/GEF Poland Efficient Lighting Project

Minimum Polish Content - CFLs must be substantially assembled in Poland. This may include the assembly of components manufactured in other countries into finished Promotional CFLs but shall exclude the simple assembly of components meant to be assembled or disassembled by consumers (such as lamps and ballasts in two-part CFLs). This shall also exclude the simple packaging of finished Promotional CFLs.

Safety - Promotional CFLs must meet all applicable Polish safety regulation for electronic and/or lighting products .

Light Output - There are no specific requirements for lumen output, however the light flux of all Promotional CFLs must be measured in accordance with IES LM-66-1991, Electrical and Photometric Measurements of Single-ended Compact Fluorescent Lamps, at an independent testing facility and the results supplied to NECEL.

Color Temperature - Correlated color temperature of Promotional CFLs must fall between 2,700 to 3,000 Kelvin, measured in accordance with IES LM-16-1984, Colorimetry of Light Source and the 1993 IES Lighting Handbook as measured at an independent testing facility and the results supplied to NECEL.

Color Rendering Index - Promotional CFLs must have a CRI higher than or equal to 70, measured in accordance with IES LM-16-1984, Colorimetry of Light Source and CIE Technical Committee TC-3.2 Method of Measuring and Specifying Color Rendering of Light Sources Publication No. 13.2 Paris, Commission International d'Eclairage, 1988 at an independent testing facility and the results supplied to NECEL.

Rated Average Life - Minimum rated average life of Promotional CFLs shall be no less than 8,000 hours at 3 hours of operation per start, measured in accordance with IES LM-65-1991, Life Testing of Single-ended Compact Fluorescent Lamps. Manufacturers must offer a minimum one year warranty covering product replacement.

Electromagnetic Interference - Promotional CFLs must meet all applicable Polish regulation for electromagnetic emissions.

Customer Survey Card - A customer response card with content defined by NECEL will be inserted in the packaging of all Promotional CFLs.

Power Quality - No minimum standards are required for either Power Factor or Total Harmonic Distortion(THD) during the first year of PELP. However, all Promotional CFLs will required to meet EU standards for Power Factor and THD in the second year of PELP.

Annex 3: Environmental Analysis

(excerpted from the PELP Pre-appraisal Report)

1. Introduction: In 1993, the prospective global environmental benefits of the PELP project were analyzed using a model called Greenhouse Gas Assessment Methodology (GGAM). GGAM was jointly developed by the University of Maryland's Center for Global Change and the Stockholm Environmental Institute, specifically for the analysis of the cost-effectiveness of GEF GWG emission reduction projects. The assumptions for CFL prices and subsidy levels used in this analysis are no longer current, but the trend of the changes (higher CFL prices, smaller subsidy per CFL, more CFLs sold) have generally worked to increase the estimated benefits to be realized from PELP. Therefore, this analysis should be considered particularly conservative.

OVERVIEW OF THE TWO SCENARIOS MODELED

2. Scenario A: Effect of Subsidized Lamps Only: Two GGAM analyses were conducted. The first, called Scenario A, accounts only for the carbon reductions obtained directly from the subsidized lamps that are distributed through the project. This analysis extends for seven years beyond the end of the program, for a total of nine years (lamp lifetime will be approximately seven years according to the usage levels assumed in the analysis).

3. Scenario B: Market Transformation Due to the Project: Scenario B accounts for the effect of the program on the Polish CFL market as a whole. Scenario B assumes that over the course of its two-year operation, the program moves the CFL market forward by five years. This analysis covers 18 years, starting from the beginning of the project (1995) to the year in which it is assumed the market would have reached saturation without the project (2013). Since a third of program resources are devoted to long-term market development, Scenario B more accurately captures the overall program impact.

4. For the purposes of this analysis, it was assumed that it would take the market 20 years from the emergence of the Polish CFL market in 1992 for this technology to reach saturation in the residential market, and that the saturation point would be a sales level of 3.7 million. Annual sales at saturation are equal to total number of CFLs in homes (estimated to be around 26 million) divided by CFL lifetime (seven years, assuming four hours of use per day). PELP was assumed, during the two years of its operation (1995-96), to advance the market by five years. Thus the with-project sales level in 1997 is equal to the without-project sales level for 2002, and the market reaches saturation five years earlier than if the project had not occurred. This analysis ignored exogenous changes that could also affect market development, such as changes in the

price of electricity, changes in CFL prices that are not due to the project, and enhancements in CFL technology that would increase customer acceptance.

5. It is important to note that the cost GGAM determines per tonne of carbon reduced is from the donor perspective only, and not from a societal perspective. If an analysis were done from a societal perspective, the cost per tonne of carbon reduction would be far lower, because it would include net benefits to the consumer (lower bills), to the utilities (avoided expenditures on generation, new capacity, and transmission and distribution upgrades), and to society as a whole (avoided environmental externalities).

GGAM Analysis for the Poland Lighting Project, Scenario A:
Effect of Subsidized Lamps Only

6. Overview: This project is designed to reduce GHG emissions by stimulating indigenous Polish manufacturing capability for CFLs, and increasing the penetration of CFLs in the Polish residential market. The project has three components: education, manufacturer subsidies, and utility promotion of CFLs. Scenario A accounts only for the GHG reductions due to the manufacturer subsidies.

7. The project will subsidize two kinds of lamps: integral CFLs, which include a ballast and which can screw into an existing incandescent socket, and modular CFLs, which do not include a ballast and which are sold with a lighting fixture that is hard-wired to accept only CFLs. The integral CFLs were assumed to be 18W units, which replace incandescent lamps with an average wattage of 75W. The modular units will draw 9W each, and on average, two lamps will be used to replace one 75W lamp. Both types of lamps have an average lifetime of 8,000 hours, compared to 1,000 for the incandescent lamps they will replace.

8. The analysis assumed that PELP will provide manufacturer subsidies of US$ 3.05 (PLN 8.75) per lamp for the integral CFLs, and subsidize a total of 895,082 lamps. This was expected to reduce their price from US$11.50 (PLN 28.75) to US$5.00 (PLN 12.50). The subsidy for the modular lamp was expected to be US$1.64 (PLN 4.10). When coupled with a special manufacturer's promotion run in conjunction with the project, the subsidy will make the lamp free to purchasers of hard-wired luminaires (the customer will still have to pay a premium for the luminaire itself, which, because of the ballast it contains, costs more than an equivalent incandescent fixture). The project will subsidize 250,000 modular lamps. (Note: this analysis was done before PELP was implemented, and the parameters have changed. However, actual

experience has shown PELP to be more cost-effective than projected due to lower subsidies per CFL, and more CFLs sold)

9. The analysis does not count effects due to lamps that would have been sold without benefit of the subsidies (free riders). The current size of the CFL market is about 360,000 lamps, and it was assumed that it will grow to 811,000 in the 1995-96 lighting year (September 1995 - September 1996), and 1,094,000 lamps in the 1996-97 lighting year. It was estimated that about one quarter of CFLs currently sold in Poland are manufactured domestically. Thus without the project, domestic production would be 203,000 lamps in 1995 and 273,000 in 1996, for a total domestic production of 476,000 in the course of the program. Of these, the majority would be sold to the commercial market. The project targets the residential market. We can conservatively assume that 70% of CFL sales would be to the commercial market, leaving 30%, or 143,000 lamps that would be sold to residential customers without the project. This amounts to a free rider rate of 12%. Inputs to GGAM are net of free riders.

10. The principal environmental effects of the project will be to reduce GHG and other emissions by lowering electricity demands in the residential sector. Electricity generation in Poland is exclusively derived from thermal power, most of which is produced by burning coal or lignite. Emission rates for CO_2, oxides of sulfur and nitrogen, and particulates are taken from figures provided to FEWE by PSE. Emission rates for all other pollutants are the model's default values, which are based on an Eastern U.S. coal plant. GGAM's model runs have been calibrated to reflect three different emission assumptions: baseload Polish coal plant emissions, peaking Polish coal plant emissions, and the model's default (Eastern U.S. coal plant emissions). Information on the dispatch order of Polish plants was unavailable, therefore the weighted average emissions base for peaking plant was used.

GEF contribution to Project Cost:	US$ 5 million
GEF cost of avoided carbon emissions: (at 0% discount rate for emissions)	US$ 21 /tonne

Note: GGAM does not account for costs or benefits to the consumer (cost of CFLs; avoided lamp expenditures, lower electricity bills), to the utility (cost of CFL program; avoided expenditures on generation, on new capacity, and transmission and distribution upgrades), or to society (avoided environmental externalities). If GGAM did account for consumer, utility, and societal net benefits, the cost per tonne of carbon reduced by the program would be lower according to the model.

11. Global warming benefits of the proposed project: This project will increase the penetration of energy-efficient lamps in the Polish residential sector. It will decrease

Polish electricity generation, thereby reducing GHG emissions from utility combustion of coal and lignite.

12. Unresolved Questions:

- Level of free riders;
- Upstream effects of manufacture of CFLs vs. incandescent lamps;
- Changes in electricity prices; and
- Actual manufacturer costs.

13. Technical Assumptions Used in this Analysis:

- Integral CFLs have an average lifetime of 8,000 hours, draw 18 W of electricity, and will replace a 75 W incandescent lamp that would have been in use for four hours per day.
- Modular CFLs sold with luminaires have an average lifetime of 8,000 hours, draw 9W of electricity, and two 9W units are used to replace a 75 W lamp that would have been in use for four hours per day.

14. Critical Factors in this Analysis:

- Consumer response to subsidized lamps (price elasticity of demand);
- Emission rates of Polish power plants; and
- Average usage of the CFLs and of the incandescent lamps they replace.

GGAM Analysis for the Poland Lighting Project, Scenario B: Market Transformation

15. Overview: This project is designed to reduce GHG emissions by stimulating indigenous Polish manufacturing capability for CFLs, and increasing the penetration of CFLs in the Polish residential market. The project has three components: education, manufacturer subsidies, and utility promotion of CFLs. Scenario B accounts for the GHG reductions due to the project's transformation of the CFL market. Specifically, the analysis assumes that the project hastens CFL market saturation by five years.

16. The project will subsidize two kinds of lamps: integral CFLs, which include a ballast and which can screw into an existing incandescent socket, and modular CFLs, which do not include a ballast and which are sold with a lighting fixture that is hard-wired to accept only CFLs. The integral CFLs were assumed to be 18W units, and would replace incandescent lamps with an average wattage of 75W. The modular units will draw 9W each, and on average, two lamps will be used to replace one 75W lamp.

Both types of lamps have an average lifetime of 8,000 hours, compared to 1,000 for the incandescent lamps they will replace.

17. The analysis assumes that PELP will provide manufacturer subsidies of US$3.05 (PLN 8.75) per lamp for the integral CFLs, and subsidize a total of 895,082 lamps. This will reduce their price from US$11.50 (PLN 28.75) to US$5.00 (PLN 12.50). The subsidy for the modular lamp will be US$1.64 (PLN 4.10). When coupled with a special manufacturer's promotion run in conjunction with project, the subsidy will make the lamp free to purchasers of hard-wired luminaires (the customer will still have to pay a premium for the luminaire itself, which, because of the ballast it contains, costs more than an equivalent incandescent fixture). The project will subsidize 250,000 modular lamps. In order to stimulate the development of an indigenous CFL manufacturing industry, one of the prerequisites for manufacturer participation is that the lamps be made in Poland.

18. The analysis for Scenario B models assumes that in the course of its two-year operation, the project will have the effect of advancing the penetration of CFLs by five years. This effect will be due to several factors operating in concert:

- extensive consumer education will increase customer awareness of the product and its benefits;
- product promotions will increase the availability of CFLs;
- subsidies to start-up manufacturers will strengthen these fledgling new CFL producers; and
- the project will jump-start a competitive dynamic, fueled by customer demand, that will have the effect of keeping prices low, encouraging the development of new CFL product lines.

19. The principal environmental effects of the project will be to reduce GHG and other emissions by lowering electricity demands in the residential sector. Electricity generation in Poland is exclusively derived from thermal power, most of which is produced by burning coal or lignite. Emission rates for CO_2, oxides of sulfur and nitrogen, and particulates are taken from figures provided to FEWE by PSE. Emission rates for all other pollutants are the model's default values, which are based on an Eastern US coal plant. GGAM's model runs have been calibrated to reflect three different emission assumptions: baseload Polish coal plant emissions, peaking Polish coal plant emissions, and the model's default (Eastern U.S. coal plant emissions). Information on the dispatch order of Polish plants was unavailable, therefore the weighted average emissions base for peaking plant was used.

GEF contribution to Project Cost: US$ 5 million
GEF cost of avoided carbon emissions: US$ 2/tonne
(at 0% discount rate for emissions)
Note: GGAM does not account for costs or benefits to the consumer (cost of CFLs; avoided lamp expenditures, lower electricity bills), to the utility (cost of CFL program; avoided expenditures on generation, on new capacity, and transmission and distribution upgrades), or to society (avoided environmental externalities). If GGAM did account for consumer, utility, and societal net benefits, the cost per tonne of carbon reduced the model finds would be lower.

20. Global warming abatement benefits of the proposed project. This project will increase the penetration of energy-efficient lamps in the Polish residential sector. It will decrease Polish electricity generation, thereby reducing GHG emissions from utility combustion of coal and lignite.

21. Unresolved Questions:
- Upstream environmental effects of manufacture of CFLs vs. incandescent lamps;
- Possible changes in electricity prices;
- Survival of small manufacturers and entry of new manufacturers into market;
- Technological improvements in CFLs; and
- Future manufacturer pricing levels.

22. Technical Assumptions Used in this Analysis:
- Integral CFLs have an average lifetime of 8,000 hours, draw 18 W of electricity, and will replace a 75 W incandescent lamp that would have been on four hours per day;
- Modular CFLs sold with luminaires have an average lifetime of 8,000 hours, draw 9W of electricity, and two 9W units are used to replace a 75 W lamp that would have been on four hours per day;
- At market saturation, annual sales of CFLs will be about 4 million lamps per year (this is the economic potential for CFLs calculated earlier in the PELP pre-appraisal report); and
- It will take the market 20 years from its emergence to reach saturation.

23. Critical Factors in this Analysis:
- Consumer response to subsidized lamps (price elasticity of demand);
- Emission rates of Polish power plants;
- Average use of the CFLs and of the incandescent lamps they replace; and
- Rate of market transformation.

Annex 4: Cost-Effectiveness Analysis

(excerpted from the PELP Pre-appraisal Report)

1. Introduction: This Appendix contains cost-effectiveness analyses for the proposed project. The project has been analyzed from three perspectives: the participant's perspective, the societal perspective, and the total resource cost perspective. The cost of saved energy (CSE) was also calculated. Table 9-1 summarizes each of the analyses.

Table 9-1: Summary of Benefit-Cost Analyses

Benefits Tests	Without project	With project	Donor perspective
Cost of saved energy			
18W integral units	-	$ 0.01	$ 0.01
9W modular units	-	$ 0.01	$ 0.02
Participant's Test:18W integral			
Benefit/Cost Ratio	2.06	4.74	-
Net Benefits	$ 12.20	$ 18.70	-
Participant's Test: 9W modular			
Benefit/Cost Ratio	1.05	3.01	-
Net Benefits	0.66	8.46	-
Societal Test			
Benefit/Cost Ratio	-	5.17	9.80
Net Benefits	-	$ 39,539,244	$44,015,244
Total Resource Cost Test			
Benefit/Cost Ratio	-	4.28	8.11
Net Benefits	-	$ 31,071,836	$ 35,547,836

Notes: The Total Resource Cost Test is the Societal Test without environmental externalities. From the Donor's perspective, the only costs included are those covered by the Donor, i.e. the CFL subsidies and (for the Societal and Total Resource Cost Tests) the project administration costs.

2. The analysis applies only to Scenario A presented in Appendix C. As described in the PELP economic and environmental analysis (see Chapter 8 of the PELP Pre-appraisal Report), Scenario A accounts only for the benefits accruing directly from subsidized lamps. Scenario B, on the other hand, assumes that the project moves the CFL market forward by five years, and accelerates the penetration of CFLs into the

Polish economy. In other words, Scenario B assumes that the project has a large "free driver" effect: due to market forces, the project would increase CFL sales by more than the number of subsidized units. Scenario B is the actual objective of the project, and the program is designed to achieve this outcome. Thus, the calculations presented in this Appendix represent a floor, a minimum value for the benefits of the project. Because of substantial "free driver" effects accruing from the project's designation as a market-driver, the project's actual benefits will likely be much higher.

3. <u>Cost of Saved Energy</u>: The cost of saved energy (CSE), sometimes referred to as "cost of conserved energy" (CCE) in ZL/kWh is given as annualized net cost of the CFL divided by the annualized energy savings. The project team has calculated the cost of conserved energy (CSE) in two ways: from the Polish consumer's perspective, and from the Donor's perspective.

4. To calculate the CSE from the consumer's perspective, the cost of the CFL is taken to be the cost of a CFL to a Polish consumer, net of the cost of incandescent lamps the consumer no longer needs to buy. Calculated in this way, the CSE is a measure of the gross cost per kWh, to society as a whole, of the project's energy savings. The calculation assumes that the cost of an 18W CFL is the project target price of PLN 10, and that the cost of a 9W modular CFL is the incremental cost of a CFL luminaire after the subsidy compared with a similar non-ballasted, Edison-base luminaire, PLN 8.40. The 1993 cost of an ordinary one-lamp incandescent luminaire is PLN 10.00. The cost in 1993 of a one-lamp luminaire hard-wired for CFLs is PLN 24.00, including the lamp. The project would bring this cost down to PLN 10.00.

5. The CSE from the Donor's perspective has been recalculated. From this perspective, the cost of the CFL is only the subsidy paid per CFL, plus administrative costs. The Donor's CSE calculation provides a measure of the gross cost per kWh, to the donor, of the project's energy savings.

6. <u>Findings</u>: The cost of saved energy from 18W integral CFLs is PLN 0.0156/kWh (less than US$0.01/kWh). The cost of saved energy from a Donor-only perspective, for 18W integral CFLs, is PLN 0.026/kWh (less than US$0.01/kWh). The cost of saved energy from 9W modular CFLs is PLN 0.0223/kWh (less than US$.01/kWh). The cost of saved energy from a donor-only perspective, for 9W modular CFLs, is PLN .0363/kWh (less than US$.02/kWh). This does not include the long-term benefit of the hard-wired CFL luminaires, which includes long-term savings generated by replacement modular lamps after the initial lamp reaches the end of its useful life.

7. Participant's Test: This test measures the project's cost-effectiveness from the participant's perspective only. It helps answer the question: "is it worth it for a (rational) customer to participate in this program?" In the participant's test, the benefits are:

- bill savings; and
- savings on CFL expenditures.

The costs are:

- the marginal cost of the CFL.

8. The participant's test has been calculated both for CFLs given current prices (in which case it should more appropriately be called a "purchaser's test", because there is not yet a program in which to participate), and at the lower price made possible by the project. Taken together, these two calculations show the difference the project will make, from a consumer's perspective, in the economics of purchasing a CFL.

9. Findings: Without the project, from the purchaser's perspective, 18W integral CFLs have a benefit/cost ratio of 2.1, and yield net benefits of PLN 24.40 (US$12.20). With the project, from the participant's perspective, 18W CFLs have a benefit/cost ratio of 4.7 and yield net benefits of PLN 37.40 (US$18.70). Thus the project has increased the cost-effectiveness of an 18W integral CFL and the CFL's net benefits to the consumer by about 50 percent. This is in addition to the non-measured benefits of improved product availability and variety associated with the more advanced, mature market. Without the project, from the purchaser's perspective, 9W modular CFLs are not cost-effective: They have a benefit/cost ratio of 0.7. With the project, from the participant's perspective, 9W modular CFLs have a benefit/cost ratio of 3 and yield net benefits of PLN 17.00 (US$8.50).

10. Societal Test: This test assesses the project's cost-effectiveness from a societal point of view. From the societal perspective, the benefits are:

- avoided utility expenditure on energy and on meeting peak demand (known as "avoided costs");
- avoided environmental externalities; and
- avoided consumer expenditure on incandescent lamps.

The costs are:

- cost of the measure; and
- program administrative costs.

11. The societal test does not count customer bill reductions as benefits, nor does it count utility lost revenues as costs. From the societal perspective, these items are viewed as transfer payments. When this test is used to evaluate utility programs, any incentive paid to customers is also viewed as a transfer payment, and thus does not figure in the test. For the current analysis, however, we seek a measure of the entire GEF grant's cost-effectiveness. Thus we have included customer incentives in the "program costs" category. The environmental externality value used ($0.021/kWh) was taken from the Hagler, Bailly, Inc. draft report, "Demand-Side Management in Poland: Assessment and Pilot Program" (U.S. Agency for International Development, June 1993).

12. The analysis also includes a societal test calculated from the Donor's perspective. In this case, the only costs counted are those of the grant itself. The consumer's expenditures are not included. This Donor-societal perspective indicates the grant's leverage (accounting for the monetized value of the grant's environmental benefits).

13. Findings: Under the societal test, the benefit/cost ratio of the project is 5.17, and the net benefits are PLN 79 million (US$ 39.5 million). From a Donor perspective only, the project has a benefit/cost ratio of 9.8, and net benefits of PLN 88 million (US$ 44 million).

14. Total Resource Cost Test: This test is identical to the societal test except that it does not account for environmental externalities. The analysis also includes a calculation of the total resource cost test from the donor's perspective only. As with the Donor-societal test, the only costs counted are those of the grant itself. The consumer's expenditures are not included. The Donor-total resource cost test indicates the grant's leverage, though it does not account for the monetized value of the grant's environmental benefits.

15. Findings: Under the total resource cost test, the benefit/cost ratio of the project is 4.28, and net benefits of PLN 62.1 million (US$31 million). From a Donor perspective only, the project has a benefit/cost ratio of 8.11, and net benefits of PLN 71 million (US$ 35.5 million).

LIMITS OF THE ANALYSIS

16. The analysis in this Chapter does not present a complete picture of the project's costs and benefits. Several important factors have been omitted: employment effects, multiplier effects, effects on export revenues, economic value of the education initiative (including lighting professionals programs and seminars), and the benefits associated with the utility pilot DSM activities that result in avoided capital costs of distribution

system expansion and improved system efficiency through load management. The project will likely increase employment in smaller (non-PLP) assemblers of CFLs, such as VOX and MAYA. These effects can be expected to be small relative to the Polish economy as a whole. Multiplier effects will come about from participants' savings on their electricity bills. As shown in the analysis above, each 18W CFL will have net benefits to the participant of PLN 37.4 ($18.70), and each 9W CFL will have net benefits of PLN 16.9 ($8.50). The overall project will lead to an increase of PLN 37.7 million ($18 million) in disposable income.

17. The project will lead to approximately one million units of domestic production being sold in Poland instead of being exported. The report does not contain an analysis of the project's impact on the Polish balance of trade. Domestic CFL production capacity should expand as a result of the project and the market at equilibrium would not be expected to show reduced exports as domestic sales increase. The strengthened domestic market would provide the foundation upon which the fledgling Polish manufacturers can enhance their competitiveness in regional and international markets. The project's education program will provide societal benefits associated with the curricula developed for school children. In addition, the lighting professionals education initiative will enhance competitiveness in the Polish lighting industry and generate expanded capability in the Polish economy. Finally, the pilot utility DSM programs associated with the project will generate net economic benefits for the participating utilities, their customers, and the society. Specifically, the targeted DSM activities will enable deferral of new electric distribution plant investment, enhancing the reliability of electric services on the grid while saving capital resources. The proposed utility pilot projects will also provide a variety of benefits that will generally improve utility company stability, including: building new energy services and DSM capability in the utility sector, reducing revenue losses from non-payment, establishing a new revenue source, and shifting demand to more profitable customer groups.

Annex 5: List of Reference Documents

IFC/GEF Poland Efficient Lighting Project

Pre-appraisal Report to the Global Environment Facility: IFC/GEF Poland Efficient Lighting Project (IIEC, Washington, D.C., 1994)

Poland Lighting Project (FEWE, Warsaw, Poland, 1994)

IFC/GEF Poland Efficient Lighting Project (PELP): Work Plan (IFC, Washington, D.C., 1994)

RCG/Hagler, Bailly, Inc. draft report, "Demand-Side Management in Poland: Assessment and Pilot Program" (US Agency for International Development, Washington, D.C., June 1993)

SCORE: Supporting the Cooperative Organisation of Rational Energy-use: Poland (Novem, Utrecht, the Netherlands, 1996)

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