Characterization of the Potential for Electricity Conservation in Portugal

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1. SYNOPSIS

The paper describes the DSM analysis of the Least-Cost Planning Pilot-Project carried out in Portugal, with the support of the SAVE programme of the European Union.

2. ABSTRACT

The Portuguese utility, EDP-Electricidade de Portugal, together with the University of Coimbra is carrying out a Least-Cost Planning pilot project, sponsored by the SAVE Programme of the European Union.

One of the main tasks of this project was the development of the conservation supply curves for the Residential, Services and Industrial Sectors, which are presented in the paper.

In the Residential sector 34% of the electricity consumption can be saved in a cost-effective way, that is with prices below supply costs. White appliances (refrigerator, freezer, washing machines) and lighting provide the most interesting saving opportunities. Space conditioning, although with modest importance in the present, is expected to grow significantly in the near future bringing dramatic changes to the load diagram.

In the Services Sector, which is the fastest growing sector, the cost-effective savings potential reaches an impressive 40%. Lighting contains more than half of the savings potential, followed in relative importance by space cooling technologies. Energy-efficient office technologies can also produce a significant impact in the load growth.

In the Industrial Sector the savings potential reaches 27%, without considering modifications to manufacturing processes. Energy-efficient motor-driven technologies provide the vast majority of potential savings. Energy-efficient lighting and power factor improvement are also attractive options.

The paper also discusses possible strategies and programmes to promote the penetration of the most attractive technologies in the different sectors.

3. INTRODUCTION

The electricity supply system in Portugal is almost totally controlled by a public company, EDP-Electricidade de Portugal whose sales in 1992 were 27.000 GWh. The growth in consumption has been fairly strong, being around 7% in the period 1982/92. To meet this growing demand the utility has been forced to make large financial investments, placing a heavy financial burden on the revenue requirements. To mitigate this burden the utility has recently sold a large coal power plant.

The SAVE programme of the European Union promoted in 1991 a call for proposals for Least-Cost Planning pilot projects. The studies described in this paper are based on the work carried out during that pilot project. Least-Cost Planning can be an attractive option for the Portuguese utility and for the consumers by providing substantial benefits, namely the following ones:

-- Decrease of the investment effort in generation, transmission and distribution of electric power;
-- Improve the load factor;
-- Minimize losses;
-- Provide cheaper electricity services to the consumers;
-- Improve the relations between utility and consumers;
-- Reduce the environmental impacts;
-- Decrease the dependency on imported fossil fuels (gas, fuel and coal).

4. METHODOLOGY

EDP has considerable experience in conventional supply-side power planning, namely in the area of hydro-thermal power systems. However, the effort of EDP in the area of demand-side management has been very limited. A joint team of EDP and the University of Coimbra was formed to carry out the project, taking into account the USA experience (such as Pacific Northwest, New England Electric System and Potomac Electric Company), as well as two pilot studies carried in Europe (Iberduero in Spain and Schleswig-Holstein in Germany).

EDP produced demand forecasts based on an optimistic economic growth scenario and a more moderate growth alternative. A considerable effort was dedicated to build present and future disaggregated consumption taking into account the most important end-uses in the different sectors. The end-use data was scant and dispersed showing a clear need for significant effort in end-use load research in the future.

To reach one of the main goals of this project, the construction of the conservation supply curves, some specific data was needed, such as the extra cost of implementation of the energy-efficient technologies and the annual savings potential of each of the end-uses, provided by the implementation of these technologies, in order to obtain de cost of saved energy (CSE).

5. RESIDENTIAL SECTOR

In the base year of 1992 the Residential Sector in Portugal represented 25% of the total electricity consumption, corresponding to 6.470 GWh for a total number of 3.635.000 consumers.

This section will present the estimated distribution of electricity consumption in the Residential Sector by the different appliances, for the base year of 1992 and for two different scenarios of evolution to the year 2000: "business as usual" and with the implementation of energy-efficient technologies already available.

5.1. Characterization of the electricity consumption in 1992 and the "business as usual" evolution to 2000

Table 1. Disaggregated characterization of Residential Sector electricity consumption in 1992 and in 2000

Electric Appliances	Annual Unit Consumption (kWh)		Saturation (%)		Annual Total Consumption (%)		Annual Total Consumption (GWh)	
	1992	2000	1992	2000	1992	2000	1992	2000
Refrigerator	460	409	93	110	24,0	18,9	1555	1754
Freezer	657	591	40	55	14,6	13,6	943	1268
Dish washer	377	333	10	35	2,1	4,9	133	454
Clothes washer	343	317	62	75	11,9	10,0	768	927
Oven/Microwave	112	192	10	25	0,6	2,0	41	188
Cooking range	455	380	8	7	2,0	1,1	127	107
Water heater	1220	1435	13	10	8,9	6,0	577	560
TV/Audio	110	110	88	115	5,4	5,3	350	491
Vacuum cleaner	78	78	56	75	2,4	2,5	158	228
Iron	96	96	93	100	5,0	4,0	323	374
Computer	36	55	10	24	0,2	0,6	13	51
Lighting	255	319	100	100	14,4	13,4	929	1247
Air conditioning	450	548	4	18	1,0	4,1	65	384
Space heater	206	300	47	90	5,4	11,3	352	1053
Other appliances	50	55	75	100	2,1	2,3	136	214
TOTAL					100,0	100,0	6470	9300

Table 1 shows a 44% increase of the Residential electricity consumption between 1992 and 2000 "business as usual". This estimated evolution for the year 2000 has specific explanations that are beyond the purpose of this paper but they are mainly due to the increase of the comfort level of people in general, that rises the specific hours of utilization and saturation of certain appliances, and consequently its annual consumption, and due to the natural

evolution of the efficiency of the appliances that decreases its annual consumption. Further explanations can be found in Almeida, Júlio, Cabral and Costa 1994.

5.2. Evolution of the consumption to 2000 with the implementation of energy-efficient technologies

This scenario of evolution assumes the implementation of several already available energy-efficient technologies in the following electric appliances, responsible for 75% of the consumption in the year 2000:

Refrigerator: Average unit savings potential of 186,5 kWh/year.

Freezer: Average unit savings potential of 332,7 kWh/year.

Dish washer: Average unit savings potential of 168,0 kWh/year.

Clothes washer: Average unit savings potential of 201,8 kWh/year.

Oven/Microwave: Average unit savings potential of 77 kWh/year.

Cooking range: Average unit savings potential of 41,8 kWh/year.

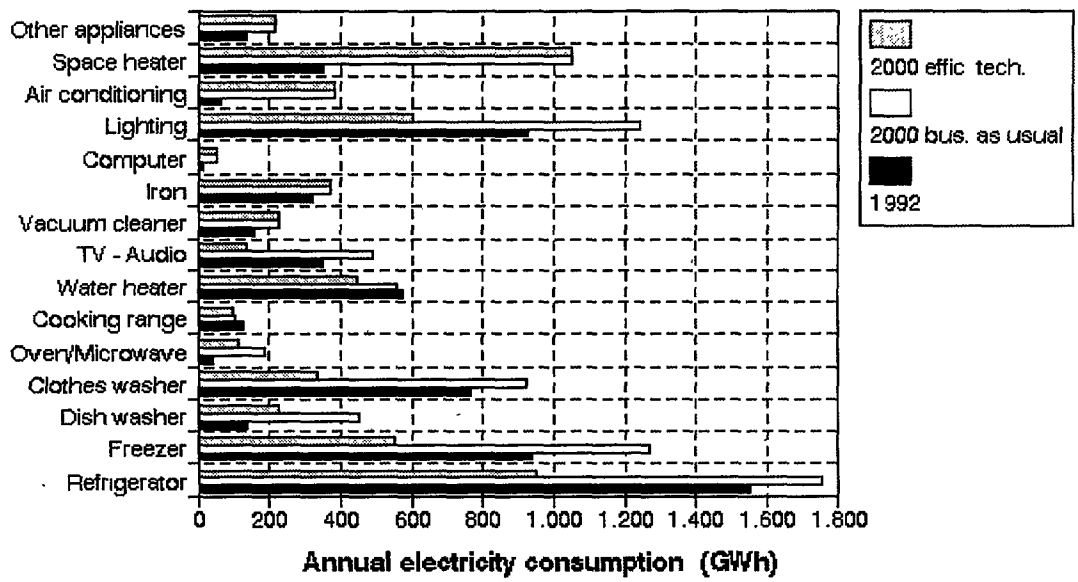
Water heater: Average unit savings potential of 287 kWh/year.

Television: Average unit savings potential of 81,9 kWh/year.

Lighting: The replacement of the 4 incandescent lamps with higher utilization (representing 80% of the incandescent consumption) with 4 fluorescent compact lamps (consuming 4 times less) can save (3/4) x 80% x 150W x 5 hours/day x 365 days = 164,3 kWh/year.

The other electric appliances (Vacuum cleaner, Iron, Computer, Air conditioning, Space heater) presented in the characterization of Table 1 were not studied because there was not enough data available.

Figure 1. Electricity consumption comparison between 1992, 2000 "business as usual" and 2000 with energy-efficient technologies



The implementation of the above mentioned energy-efficient technologies produces a savings potential of 38%. Refrigerators represent the largest conservation potential, followed by the Freezers, Lighting and Clothes washers. The annual potential of savings and the respective extra cost of implementation for each appliance are described in Table 2.

5.3. Economical analysis of the potential savings

Table 2. Annual savings potential, extra costs of implementation and cost of saved energyfor each appliance studied

Electric appliances	Annual savings potential		Extra cost	Cost of saved energy
	GWh	%	ECU	ECU/kWh
Refrigerator	800	22,7	112,1	0,071
Freezer	714	20,2	100,6	0,036
Dish washer	229	6,5	23,1	0,018
Clothes washer	590	16,7	37,0	0,024
Oven/Microwave	75	2,1	31,8	0,054
Cooking range	12	0,3	3,1	0,009
Water heater	112	3,2	25,0	0,011
Television	352	10,0	201,0	0,34
Lighting	641	18,2	44,0	0,035
Total	3525	100,0		

Figure 2. Conservation supply curves for the Portuguese Residential Sector in 2000

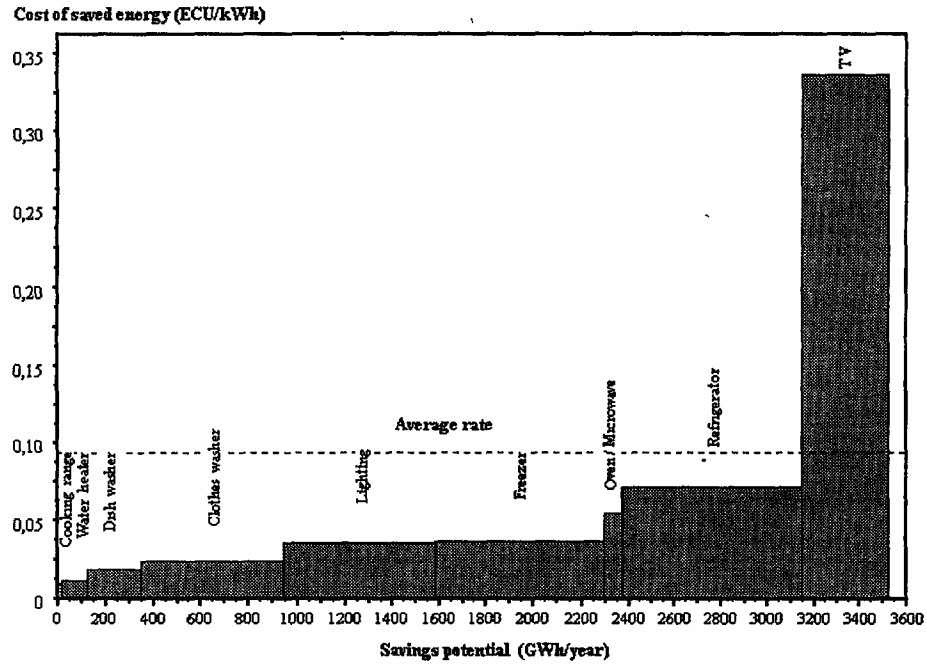


Figure 2 illustrates the relative importance of implementation of each of the energy-efficient technologies studied, that have a total estimated conservation potential of 3525 GWh/year. Every energy-efficient technology applied to the residential electric appliances, except the LCD for the Television that has a very expensive extra cost of implementation, are cost-effective because they have Costs of Saved Energy below the average residential electricity rate, which is 0,0093 ECU/kWh.

6. SERVICES SECTOR

The Services Sector represents 27% of the total electricity consumption in Portugal, corresponding in the base year of 1992 to 6790 GWh.

This section presents the estimated distribution of electricity consumption on the Services Sector, by the different end-uses, in the year 1992; in the year 2000 "business as usual"; and in the year 2000 using energy-efficient technologies already available.
To evaluate the electricity savings potential in this sector, the following end-uses were considered: Air Heating, Air Cooling, Lighting, Refrigeration Equipment, Ventilation and Pumps, Cooking Equipment and Water Heating. The Office Equipment was analyzed in a different way, because there is no available data of costs and savings potential of the efficient technologies. Other Equipment includes building pumps, lifts and escalators, cleaning equipment, laundry equipment, school equipment, radars and telecommunications equipment.

6.1. Evolution of the electricity consumption from 1992 to 2000

6.1.1. Characterization of the electricity consumption in 1992

Table 3. Disaggregated characterization of Services Sector electricity consumption in 1992

Subsectors	Air Heating (GWh)	Air Cooling (GWh)	Ventil. (GWh)	Lighting (GWh)	Water Heating (GWh)	Office Equip. (GWh)	Cooking (GWh)	Refrig. (GWh)	Other Equip. (GWh)	Water Pump. (GWh)	Total (GWh)
Trade	47,2 2,7%	139,2 7,8%	70,1 3,9%	1021,0 57,5	0,0 0,0%	2,56 0,1%	23,72 1,3%	296,3 16,7 %	175,1 9,9%	0,0 0,0%	1775,1 26,1 %
Hotels & Restaurants	30,1 4,9%	93,3 15,2 %	21,5 3,5%	124,2 20,2 %	16,4 2,7%	0,0 0,0%	122,6 19,9 %	112,2 18,2 %	95,8 15,5 %	0,0 0,0%	616,1 9,1%
Banks & Insurance Co.	9,1 2,9%	65,7 21,2 %	17,0 5,5%	93,0 30,0 %	0,6 0,2%	79,2 25,5 %	1,0 0,3%	0,0 0,0%	44,6 14,4 %	0,0 0,0%	310,2 4,6%
Administr. & Public Serv.	34,5 2,3%	23,8 1,6%	4,2 0,3%	885,3 58,1 %	1,6 0,1%	49,1 3,2%	0,0 0,0%	1,8 0,1%	83,3 5,5	440,0 28,8 %	1523,7 22,4 %
Education	4,1 2,2%	4,7 2,5%	0,0 0,0%	105,3 57,2 %	8,46 4,6%	8,14 4,4%	10,0 5,4%	8,2 4,5%	35,4 19,2	0,0 0,0%	184,1 2,7%
Health	11,3 7,8%	13,5 9,3%	0,0 0,0%	35,2 24,2 %	34,2 23,6 %	0,0 0,0%	5,1 3,5%	2,7 1,8%	43,2 29,8 %	0,0 0,0%	145,0 2,1%
Offices	57,6 4,8%	193,3 16,1 %	27,6 2,3%	433,4 36,1 %	6,0 0,5%	354,2 29,5 %	0,0 0,0%	0,0 0,0%	128,5 10,7 %	0,0 0,0%	1200,6 17,7 %
Sports	2,0 11,1 %	0,0 0,0%	0,0 0,0%	6,1 33,8 %	3,9 21,7 %	0,1 0,2%	1,6 8,7%	0,1 0,2%	4,4 24,2 %	0,0 0,0%	18,1 0,3%
Show Business	16,6 5,1%	55,4 17,0 %	23,2 7,1%	117,2 35,9	0,7 0,2%	0,0 0,0%	32,0 9,8%	32,0 9,8%	49,3 15,1 %	0,0 0,0%	326,4 4,8%

Army	5,4 0,8%	0,0 0,0%	0,0 0,0%	86,6 12,5 %	45,9 6,6%	0,0 0,0%	132,9 19,2 %	7,9 1,1%	411,9 59,6 %	0,0 0,0%	690,6 10,2 %
Total	217,9 3,2%	588,7 8,7%	163,5 2,4%	2907, 3 42,8 %	117,8 1,7%	493,2 7,3%	328,9 4,8%	461,2 6,8%	1071, 3 15,8 %	440,0 6,5%	6790 100%

Table 3 shows that the subsectors with the highest consumption are Trade (26,1%) and Administration & Public Services (22,4%). The end-uses with the highest consumption are Lighting (42,8%) and Other Equipment (15,8%).

6.1.2. Comparison between electricity consumption in 1992 and in 2000

Table 4. Disaggregated characterization of Services Sector electricity consumption in 1992, in 2000 "business as usual" and in 2000 with energy-efficient technologies

	Air Heating (GWh)	Air Cooling (GWh)	Ventil. (GWh)	Lighting (GWh)	Water Heating (GWh)	Office Equip. (GWh)	Cooking (GWh)	Refrig. (GWh)	Other Equip. (GWh)	Water Pump. (GWh)	Total (GWh)
1992	217,9 3,2%	588,7 8,7%	163,5 2,4%	2907, 3 42,8 %	117,8 1,7%	493,2 7,3%	328,9 4,8%	461,2 6,8%	1071, 3 15,8 %	440,0 6,5%	6790 100%
2000 business as usual	220,2 2,0%	1761, 6 16,0 %	275,3 2,5%	4514, 1 41,1 %	110,1 1,0%	1311, 1 11,9 %	495,5 4,5%	660,6 6,0%	1101, 5 10,0	550,0 5,0%	11.00 0 100%
2000 energy--effic. tech.	144,6 2,2%	610,9 9,4%	159,7 2,5%	2095, 3 32,3 %	69,4 1,1%	1311, 1 20,2 %	377,5 5,8%	389,4 6,0%	1009, 0 15,5 %	324,5 5,0%	6491, 4 100%

Table 4 shows a 62% increase of the Services Sector electricity consumption between 1992 and 2000 "business as usual". Although, in 2000, a savings potential of 41% is obtained if energy-efficient technologies are implemented, corresponding to a decrease of about 4500 GWh of the Services Sector electricity consumption.

Figure 3 illustrates a complete comparison among these cases, disaggregating the electricity consumption by the loads already considered.

Figure 3. Electricity consumption comparison between 1992, 2000 "business as usual" and 2000 with energy-efficient technologies

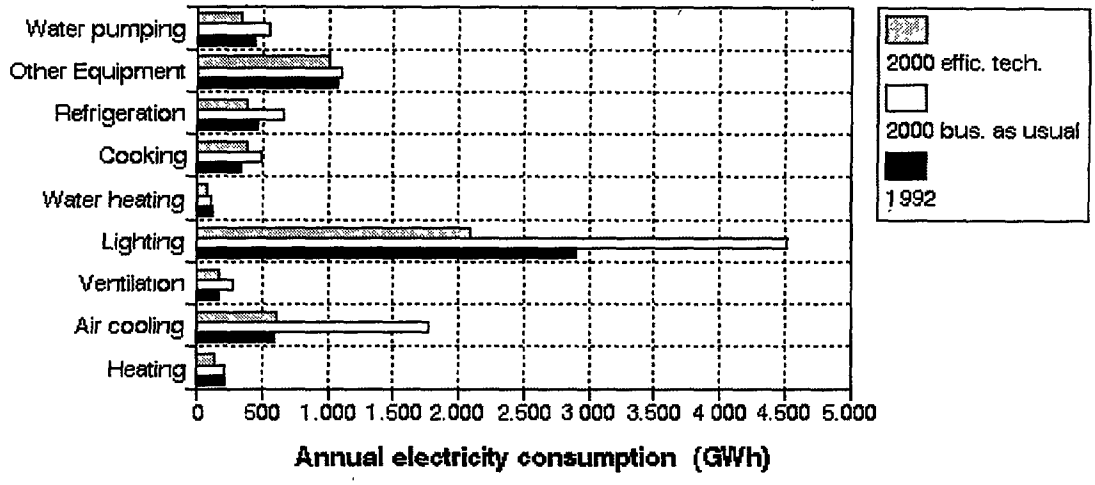


Figure 3 shows that some end-uses electricity consumption present significant evolutions from 1992 to 2000 "business as usual". The impressive increase of Air Cooling consumption (200%), ventilation (70%) and lighting (60%) is justified by the expansion of the sector and due to the increasing comfort levels. The decrease of the water heating consumption (10%) is due to the introduction in Portugal of the natural gas distribution network.

6.1.3. Brief description of the energy-efficient technologies considered

Heating and air cooling: High efficiency air conditioning; Outside air economizer; Heat recovery from exhaust air; Isolant double windows; Evaporative cooling.

Lighting: Replace fluorescent lamps with high-pressure sodium lamps; Application of reflectors on fluorescent lamps fixtures; Replace 38mm ⌀ fluorescent lamps with 26 mm ⌀ fluorescent lamps; Replacement of standard ballasts with electronic ballasts.

Refrigeration Equipment: High-efficiency compressors system; Floating head pressure control; Refrigerated case covers; High-efficiency motor.

Motors (Ventilation, pumps, lifts and escalators): Variable-speed drives; High-efficiency motors; Maintenance practices.

Cooking equipment: Energy-efficient fryers; Two-sided griddle; Convection oven.

Water Heating: Heat Pump; Reduce hot water recirculation; Heat recovery from chillers.

6.2. Economical analysis of the savings potential

Table 5. Annual savings potential and cost of saved energy of energy-efficient technologies

	Annual savings potential (GWh/year)	(%)	Cost of saved energy (ECU/kWh)
Air Cooling	1150,7	25,5	0,028
Air Heating	75,6	1,7	0,037
Cooking	118,0	2,6	0,039
Lighting	2418,8	53,6	0,041
Refrigeration	271,2	6,0	0,054
Water Pumping	225,5	5,0	0,055
Water Heating	40,7	0,9	0,056
Ventilation	115,6	2,6	0,064
Other Equipment	92,5	2,1	0,064
Total	4508,6	100	

Figure 4. Conservation supply curves for the Portuguese Services Sector in 2000

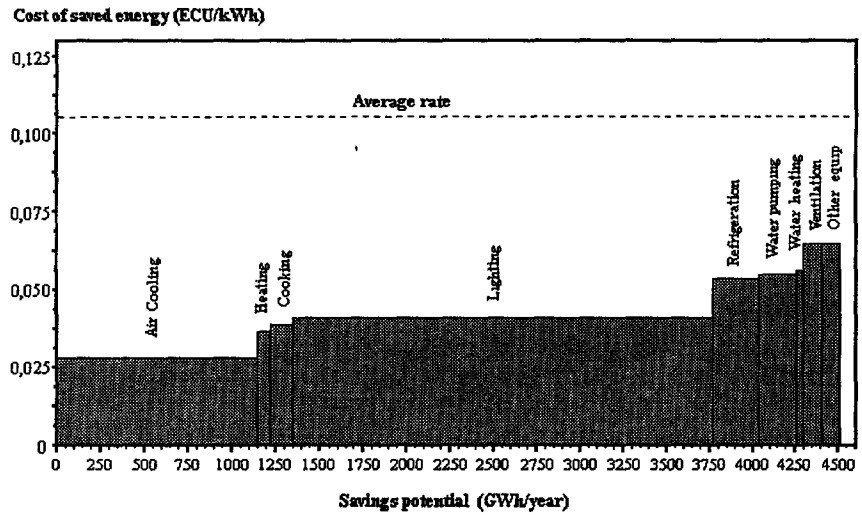


Figure 4 illustrates the relative importance of the implementation of each of the energy-efficient technologies considered. The total estimated savings potential is 4508,6 GWh/year and the Costs of Saved Energy vary between 0,028 ECU/kWh and 0,064 ECU/kWh, for a Services Sector average rate of 0,105 ECU/kWh.

7. INDUSTRIAL SECTOR

The Industrial Sector represents 45% of the total electricity consumption in Portugal, corresponding in the base year of 1992 to 11.600 GWh.

This section presents the estimated distribution of electricity consumption on the Industrial Sector, by the different loads, in the year 1992; in the year 2000 "business as usual", and in the year 2000 using energy-efficient technologies already available.

7.1. Evolution of the electricity consumption from 1992 to 2000

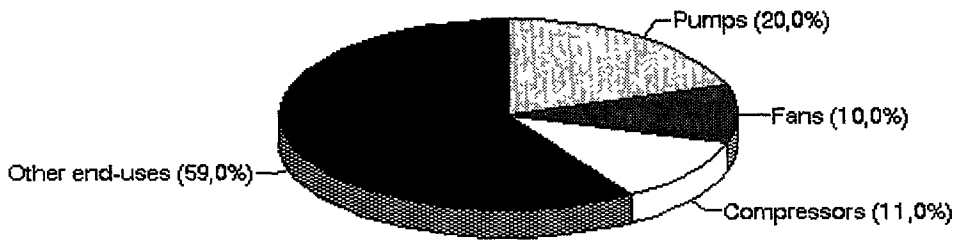
7.1.1. Characterization of the electricity consumption in 1992

Table 6. Disaggregated characterization of Industrial Sector electricity consumption in 1992

CAE	Economic Activity Subsectors	Motors (GWh)	(%)	Lighting (GWh)	(%)	Other loads (GWh)	(%)	Total (GWh)	(%)
20	Mining	319,2	90,9	22,2	6,3	9,6	2,7	351,0	3,0
31	Food, Drinks and Tobacco	901,8	85,7	135,2	12,8	15,5	1,5	1052,5	9,1
32	Textile, Clothes and Leather	1658,7	75,9	453,7	20,8	72,2	3,3	2184,5	18,8
33	Wood and Cork products	494,3	86,8	57,3	10,1	18,0	3,2	569,7	4,9
34	Paper, Printing and Publishing	1410,0	87,9	165,5	10,3	28,1	1,7	1603,5	13,8
35	Chemicals; Petrol & Coal; Rubber & Plastic	1441,7	72,3	182,0	9,1	371,2	18,6	1994,9	17,2
36	Stone, Clay and Glass	1370,0	82,5	91,3	5,5	199,3	12,0	1660,6	14,3
37	Primary Metals	247,6	35,0	38,9	5,5	421,0	59,5	707,5	6,1
38	Metal products & Machinery; Transp. Equipment; Instruments	606,3	62,5	94,6	9,8	269,1	27,7	970,0	8,4
39	Miscelaneous Manufactoring; Construction	450,0	89,0	55,6	11,0	0,0	0,0	505,6	4,4
	Total	8899,7	76,7	1296,5	11,2	1403,9	12,1	11.600	100,0

The main load of the 1992 Industrial electricity consumption was Motors with 76,7% of the total consumption, as it is illustrated on Table 6. Figure 5 shows the disaggregation of this consumption by the major motor-driven end-uses.

Figure 5. Disaggregation of Motors' electricity consumption by the major motor-driven end-uses.



7.1.2. Comparison between electricity consumption in 1992 and in 2000

Table 7. Disaggregated characterization of Industrial Sector electricity consumption in 1992, in 2000 "business as usual" and in 2000 with energy-efficient technologies

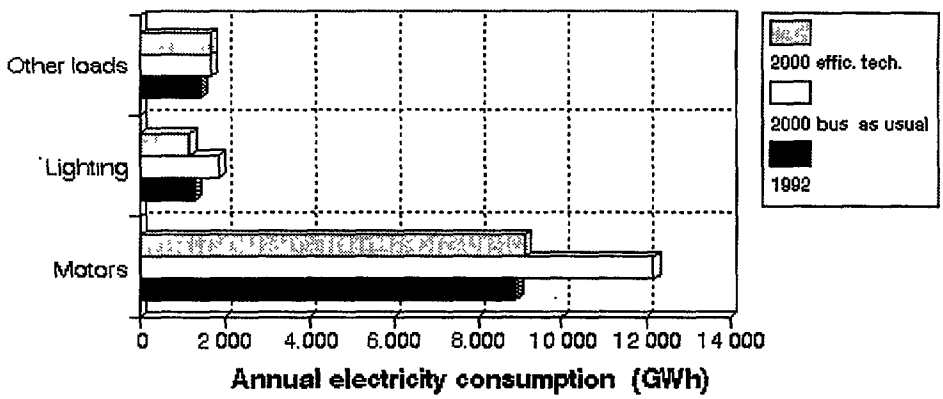
	Motors (GWh)	(%)	Lighting (GWh)	(%)	Other loads (GWh)	(%)	Total (GWh)	(%)
1992	8899,7	76,7	1296,5	11,2	1403,9	12,1	11.600	100,0
2000 business as usual	12.183,2	77,6	1868,3	11,9	1648,5	10,5	15.700	100,0
2000 with energy--efficient technologies	9106,3	76,3	1172,7	9,8	1648,5	13,8	11.928	100,0

Table 7 shows a 35% increase of the Industrial electricity consumption between 1992 and 2000 "business as usual". The relative importance of Motors' consumption also grows, from 76,7% in 1992 to 77,6% in 2000 "business as usual".

In the year 2000, a savings potential of 24% is obtained if energy-efficient technologies are implemented, corresponding to a decrease of 3772 GWh of the industrial electricity consumption. If power factor correction is considered, with savings of 464 GWh/year, the savings potential will rise to 27%.

Figure 6 illustrates a complete comparison among these cases, disaggregating the electricity consumption by the loads already considered.

Figure 6. Electricity consumption comparison between 1992, 2000 "business as usual" and 2000 with energy-efficient technologies



7.1.3. Brief description of the energy-efficient technologies considered

Motors: Use of adjustable speed drives (ASD); Replacement of standard motors with high-efficiency motors; Use of efficient transmission belts; High efficiency compressed air systems.

Lighting: Replace fluorescent lamps with high-pressure sodium lamps; Application of reflectors on fluorescent lamps fixtures; Replace 38mm ⇗ fluorescent lamps with 26 mm ⇗ fluorescent lamps; Replacement of standard ballasts with electronic ballasts.

Power Factor Correction: The estimated Portuguese average power factor in the year of 1992 was 0,82. Its correction to the lowest non-penalized value of 0,93 represents a savings potential of 464 GWh/year.

7.2. Economical analysis of the savings potential

Table 8. Annual savings potential and cost of saved energy of energy-efficient technologies

	Annual savings potential (GWh/year)	(%)	Cost of saved energy (ECU/kWh)
Power Factor Correction	463,8	11,0	0,015
Motors	3076,9	72,6	0,027
Lighting	695,6	16,4	0,029
Total	4236,3	100,0	

Figure 7. Conservation supply curves for the Portuguese Industrial Sector in 2000

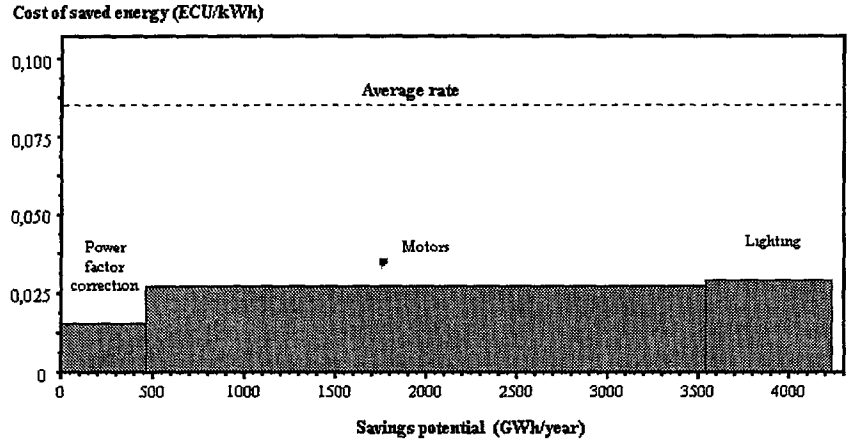


Figure 7 illustrates the relative importance of the implementation of each of the energy-efficient technologies considered. The total estimated savings potential is 4236,3 GWh/year and the Costs of Saved Energy vary between 0,015 ECU/kWh and 0,029 ECU/kWh, for an industrial average rate of 0,085 ECU/kWh.

8. STRATEGIES AND PROGRAMMES

8.1. General Information Programmes

8.1.1. Residential Sector

Information programmes are the most popular type of programme. In the Residential Sector, the proposed measures stretch from public relation work in mass media to brochures and utility-owned "conservation centers" as well as to individual efficiency calculation of energy saving measures ("home energy audits").

As the highest electricity savings potential in the Residential Sector belong to the Refrigerator, Lighting, Freezer and Washing Machine, the efficient technologies of these end-uses will have to be analyzed with more detail. Some actions that can be implemented are :

Information Campaign for Private Households
-- Customers information in a customers newspaper or as a supplement of the electricity bill;
-- Advertisement campaigns in local newspapers, TV interviews and continuous press information;
-- Flanking information in mass media of environmental impacts of the energy-efficient technology;
-- Exhibiting of demonstration appliances/prototypes in information centers.

Information Campaign for the Dealers
-- Write to dealers/wholesalers, presentation of the action considering the respective energy-efficiency appliances before starting programme;
-- Laying out of appliances lists, offer of special presentation racks;
-- Product information, creation of a special label for the Refrigerators, Freezers, Lighting and Washing Machines;
-- Invitation of all respective regional sales representatives for a presentation of the action;
-- Inquiry for support of the marketing.

Flanking Measures
-- Rental of measurement equipment to consumers for monitoring energy consumption;
-- Accompanying evaluation of the results of the programme;
-- Disposal of old appliances, to be replaced by the utility.

8.1.2. Services and Industrial Sectors

Although mass media provide sufficient communication with the Residential Sector, Services and Industrial Sectors are contacted directly. Normally, information programmes are dedicated to specific consumption sectors, i.e., information programmes have to be specially developed for restaurants, shopping centers, hospitals, etc. One of the main tasks of these programmes is to improve energy efficiency consciousness of the consumer.
In the Services Sector, the Air Cooling and Lighting have the highest potential electricity savings. In the Industrial Sector, Motors, Lighting and Power Factor Correction have also an important electricity savings potential and because of that the programmes have to be oriented to these end-uses.

8.2 Incentives Programmes

In the framework of LCP a lot of incentives programmes have been developed. Financial incentives from the utility should motivate consumers to perceive possibilities for reducing costs of energy usage. Whereas the utility provide funds, consumers financial contribution to the programme is partial or zero.

8.2.1. Energy Efficiency Rebate programmes

Energy efficiency rebate programmes are very popular among the utilities. They should motivate consumers to invest in energy-efficient appliances. In this case, the utility pays grants to the user of the respective installation or its dealer for purchasing/selling of energy-efficient energy transformation equipment. The concrete amount of the rebate is calculated from different standards. The rebate can either be a direct grant from the utility or a reduction of the electricity bill.
The concrete rebate depends on the kind of installation, its size and efficiency. Sometimes, the amount also depends on the fact, if the installation is being newly installed or if it is a replacement investment. From the point of view of the utility, the following aspects justify the rebate programmes: reducing peak load, reducing base load, smoother the load curve, increasing of electricity market share, supporting energy efficiency, improving utility-consumers relation and supporting economy locally.

8.3. Tariff-Oriented Measures

Also tariff-oriented measures can be appropriate for saving energy and shifting load by transmitting clear energy price signals and giving hereby incentives to the consumers for the efficient use of energy. For the Residential Sector, the divulgation of the bi-hourly tariff would be an important action.

For the others Sectors:
-- Demand rates: high share of load-dependent energy costs at total energy costs;
-- Time-of-use rates: time-dependent tariffs (high tariffs in peak hours);
-- Seasonal rates: Season-dependent tariffs (high tariffs in winter).

8.4. Other incentives

-- Special support of renewables;
-- Model/Demonstration reconstruction of buildings;
-- Cogeneration promotion;
-- Energy saving studies;
-- Free installations;
-- Low interest loans.

8.5. Energy Services

The aim of energy services is to make profitable savings potentials which are not used during the production of light, heat and power. Energy consultants of the utility itself, of an affiliated utility or of completely independent companies should assist consumers with their knowledge and/or their financial funds to open up these potentials. The utilization of the services of a Energy Service Company (ESCO) can be advantageous for the customer in several aspects:
-- No restriction of customers liquidity;
-- Take-Over of risks by the Energy Service Company;
-- Savings in personnel expenditures, if overtaking operation of new appliances the Energy Service Company;
-- Possibility of cost savings through favorite contract conditions;
-- Guarantee of a qualified appliances maintenance through the Energy Service Company.

Barriers for using the services of a Energy Service Company:
-- Linkage with the contractor over a long period;
-- Connection of the refinancing to the realized savings (exact fixing of energy saving potential);
-- If necessary, the height of a bonus to be paid for overtaking of risks.

Consequently, the energy-saving programmes are financed by the consumers which also take advantage of the cost savings. Besides this means of financing, a combination with incentive programmes is also possible. In this case, the energy consultant or the Energy Service Company is financed through consumers' payment, if necessary, in addition through incentive programmes of the utility.

8.6 Other Relevant Strategies for Portugal

8.6.1. Laws, Decrees, Regulations and Standards

A wide variety of policy instruments can also be used to complement the above mentioned measures:
-- Labels;
-- State energy laws;
-- Influence of the state policy;
-- Investigation into state laws and decrees;
-- Contracts on concessions;
-- Energy planning in public building plans;

-- Planning or building management;
-- Connection and use restraints for district heating;
-- Special contracts for electricity customers.

Other Implementation instruments:
-- Direct investments in public buildings and plants;
-- Energy economic co-operation.

9. CONCLUSIONS

The first Least-Cost Planning study carried out in Portugal showed a very substantial cost effective savings potential. However, to use this savings potential, a comprehensive set of policies, programmes together with a progressive

regulatory framework, is essential to achieve that purpose. The soon to be privatized electric utility will not by itself, and at the expense of future shareholders, invest in large demand-side programmes, which besides costing money, will also decrease sales.

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