

Methodology for the Implementation of the Energy Efficiency Program for the Industrial Sector in Brazil

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ABSTRACT

The Energy Efficiency Program for the Industrial Sector in Brazil was created by Eletrobrás - Centrais Elétricas Brasileiras S.A., through PROCEL (Program to Combat the Waste of Electricity) with the objective to promote actions related to the efficient use of energy in the Industrial Sector.

Due to the importance of the Industrial Sector, which consumes 45% of the electricity produced in Brazil, the implementation of the Industrial Program expects to obtain significant results in terms of saved MWh, with benefits to consumers, utilities and electrical system, and society.

For the implementation of this program a methodology was developed suitable to the Brazilian market but considering international successful experiences in programs of energy savings.

This paper presents the main proposed actions, the method of implementation and the targets expected for the Industrial Program developed by PROCEL. It highlights the following points: development of pilot projects, identification of industrial sectors that will be focused on, execution of the energy diagnosis in industrial units selected to implement the demonstration projects, elaboration of studies of financing engineering, and implementation of pilot projects and evaluation of results.

Also, the paper presents the results that are expected and the resources to the Industrial Program, considering the short-term targets (1998/1999), the medium-term targets (2000/2004) and the long-term targets (2005/2009).

Introduction

In 1997, the amount of electricity used by the Brazilian industrial sector was 125.0 TWh, which is equivalent to around 45% of the total electricity use of the country, as can be seen in Table 1. The average annual growth rate of the industrial sector for the period 1990 to 1995 was 2.6%. In 1997, this rate was 5.0%.

Table 1. Consumption of Electricity by Sector - 1997

SECTOR	ELECTRICITY USE (TWh)	SECTOR AS % of TOTAL
Industrial	125.0	45.4
Residential	74.1	26.8
Commercial	38.2	13.9
Rural	9.3	3.4
Government	28.8	10.5
TOTAL	275.4	100.0

Source: ELETROBRÁS - Ten years of expansion - 1997 -
Self producers and consumption of interruptible energy not included.

The electricity used by the industrial sector is concentrated in the aluminum, steel, iron alloy, cement, soda-chlorine, paper, cellulose and petrochemical segments, which correspond to approximately 50% of the total consumption of the industrial sector.

The level of growth from 1990 to 1997 was substantially smaller than that of commercial and residential sectors, which can be attributed to the reduction of economic activity in this period. While consumption in the commercial and residential sectors grew by about 32%, growth in the industrial sector for the same period was only 13%.

The participation profile of the diverse end uses of electricity consumption in the industrial sector makes it evident that prioritized action in this sector is needed, taking into account the current operating conditions of the equipment, and the applicability of techniques and technologies that promote the increase of global efficiency of the systems.

The waste of electricity in Brazil in 1997 stood in order of 36 TWh, 16 TWh of which was in the end use of energy. The waste in end use counts for 8% of the total consumption in the country, which represents an annual cost to society of approximately US\$2.4 billion. The industrial sector was responsible for 60% of end use waste, as can be seen below in Table 2.

Table 2. Energy Waste in 1995 - End Use

END USE	VALUES (TWh)	%
Industrial Sector	12	60
Commercial Sector	4.2	21
Residential Sector	3	15
Public Sector	0.8	4

Source: ELETROBRÁS - Ten years of expansion - 1997 -

Without the implementation of an energy conservation program, forecast consumption in the industrial sector in 2010 is 260 TWh. Because of the industrial sector's potential for energy efficiency, the energy efficiency program for the industrial sector in Brazil was created by Eletrobrás - Centrais Elétricas Brasileiras S.A., through PROCEL - Program to Combat the Waste of Electricity.

Due to the importance of the Industrial Sector, the implementation of the Industrial Program expects to obtain significant results in terms of saved energy, with benefits to consumers, utilities and electrical system, and society.

For the implementation of this program a methodology was developed, suitable to the Brazilian market, considering international successful experiences in programs of energy savings, and based principally on the Best Practice program from the United Kingdom.

This paper presents the main proposed actions, the methodology of implementation and the targets expected for the Industrial Program. It also describes aspects of the following issues: development of pilot projects, identification of industrial sectors that will be focused on, execution of the energy diagnosis in the industrial units selected to implement the demonstration projects, studies of financing engineering, and implementation of pilot projects and evaluation of results.

The main objectives of the pilot projects will be to identify the best opportunities to apply different technologies in each industrial sector, allowing further dissemination of the results.

The identification of the industrial sectors that will be focused on will be done in each selected state (at the first stage the selected states are: São Paulo, Rio de Janeiro, Minas Gerais, Rio Grande do Sul, Santa Catarina, Paraná and Bahia), with the participation of the Industrial Federation of each state.

The strategies to reach the multiplication of the obtained results with demonstration projects include: try to find ways to obtain financing to implement the projects; implement the Monitoring & Targeting Program; train the agents involved with implementation of the Industrial Program to use the techniques and methods related to the energy efficiency projects; disseminate the successful projects through workshops and seminars, based on the Best Practice method.

Methodology

The methodology established to implement the Brazilian industrial program concerns three stages: short-term targets, medium-term targets and long-term targets.

The short-term targets for the projects in the industrial sector, from 1998 to 1999, include the implementation of energy efficiency projects. These projects will serve as a demonstration of the successful use of efficient technology in industry, the results will be disseminated, and PROCEL will take on the key role of coordinating the actions necessary to guarantee the success of the projects. This phase is considered the pilot program.

The medium-term targets, after the results of the demonstration projects of energy efficiency are disseminated, are that the market, supported by PROCEL, will create the necessary conditions for the self-sufficiency of the program. The market will be a key player in overcoming the main barriers, principally when it comes to identify projects with a cost-effective energy efficiency potential, and also when dealing with financial support mechanisms.

The long-term targets consider the same strategies as the medium-term targets, but expand the actions to the national level.

The overall purpose of the first phase of the program, the pilot program, is:

- To test different approaches that could be applied in a long-term program;
- To identify priority sectors and techniques where energy savings may be achieved quickly and cost effectively;
- To design a long term strategy for energy efficiency in Brazilian industry;

- To secure funding for a full-term program through successful performance to targets.

This first phase will involve the states: Rio de Janeiro, São Paulo, Rio Grande do Sul, Paraná, Santa Catarina, Minas Gerais and Bahia, where there are the principal concentration of the industrial production in Brazil.

The multiplicity of projects to be implemented and the diversity of states involved makes the strengthening of existing state partnerships (utility companies, energy secretary, energy agencies, universities, etc.) highly recommended, with a view to their taking on responsibility for the respective regional coordination, thus maximizing the efforts of the general management of PROCEL.

The implementation of the projects should include:

- The identification of the industrial sectors to be prioritized in each of the selected states;
- The carrying out of energy diagnoses in the industrial units selected for the demonstration projects;
- Financial engineering studies, to be prepared for the projects with real opportunities for implementation, identified together with the top management in the industries;
- Monitoring the obtaining of resources from financing bodies;
- Monitoring the implementation of projects and evaluation of results;
- Implementation of Monitoring and Targeting program;
- Dissemination of successful cases, utilizing the Best Practice methodology.

Figure 1 shows the main stages of the methodology established for implementation of the energy efficiency program for the industrial sector in Brazil.

Pilot Projects that now are underway include car industries in São Paulo (General Motors, Volkswagen, Mercedes Benz, Ford Motors and Scania) and Companhia Vale do Rio Doce (mining facilities and pelletizing plant), both in the diagnosis phase.

The diagnosis of Coca-Cola Company is completed and the implementation of the recommended actions is underway.

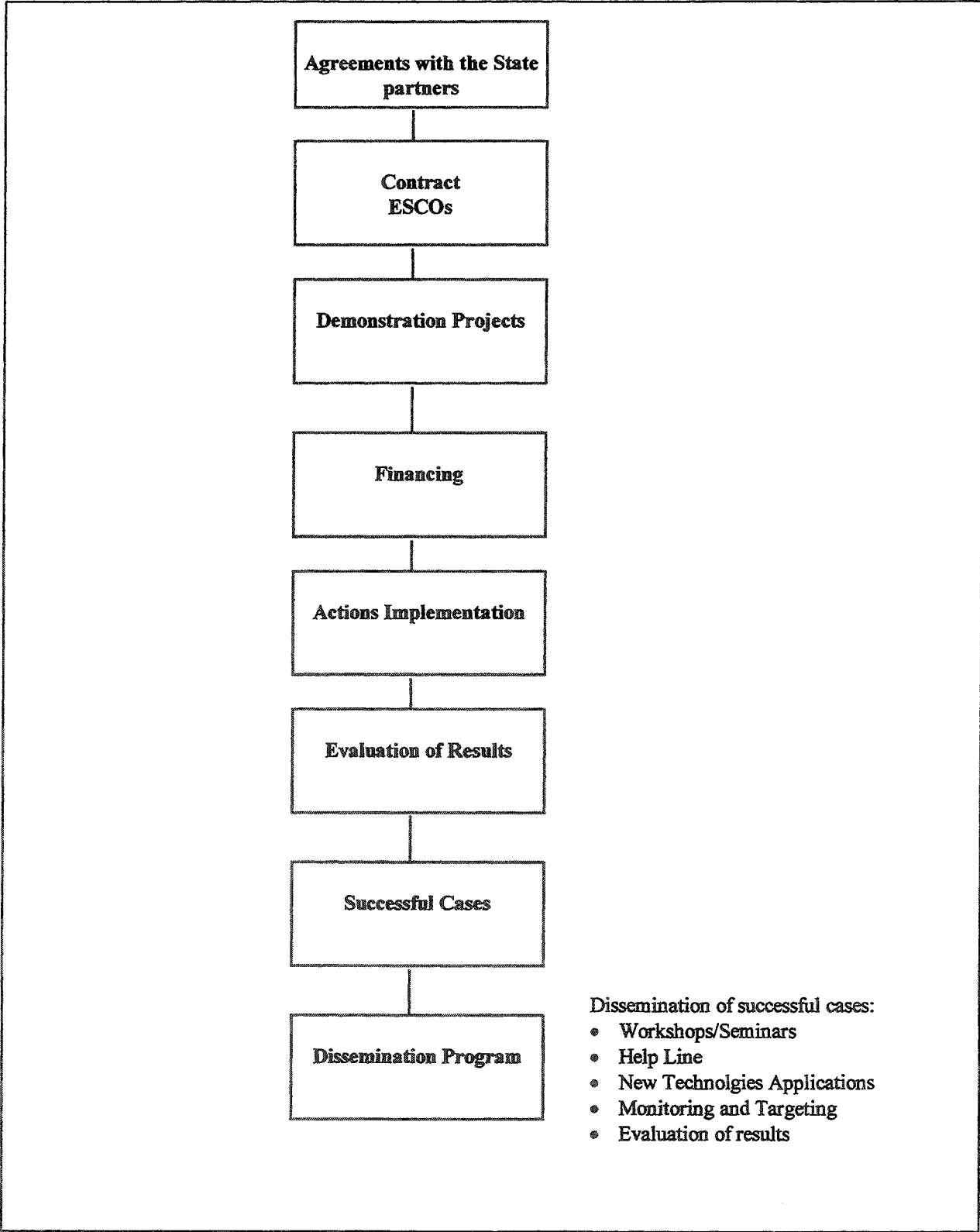


Figure 1. Main Stages of the Methodology Established for Implementation of the Energy Efficiency Program for the Industrial Sector in Brazil

Identification of the Industrial Sectors to be Prioritized

The selection of the industrial sectors to be prioritized for the demonstration projects should consider the industrial production profile in each of the states being considered, as well as the factor of dissemination of the projects to be carried out.

The agreements made by PROCEL/State Partners might consider the main industrial sectors and implement pilot projects in 15 industries from 5 different industrial segments in each state.

The selection of the industries that will participate in the program will be done by the bodies that represent these industries (federations, associations, etc.).

The bodies representing the industries participating in the project are involved mainly in order to validate the selection of the companies in each segment, while also facilitating the access to their management.

The Execution of the Energy Diagnosis

In Brazil, the main barriers to execute energy diagnoses with the required quality levels are: the small number of professionals with the technical skills necessary to develop the projects; and the financial inability of these companies to participate in performance contracts involving risks.

In most cases, the current diagnosis reports have consisted of excessively technical documents, without indicating clearly the costs and benefits (direct and indirect) of the projects. The reports also limit themselves to identifying possible ways to reduce electricity bills (alteration of electricity rates and correction of power factor), and to changing electric circuits, with limited results in terms of saved energy.

Practically no attention has been paid to: losses in the utilities systems (raw water, compressed air, steam, heating and refrigeration); analysis of process flowcharts (with evaluation of handling and transport systems); mass balance; energy management of buildings; or possibilities for modernization of production processes, where it is possible to identify important energy conservation potential, frequently with low or medium implementation costs. It is worth pointing out that these procedures make up the basis of the Monitoring and Targeting program.

The energy diagnosis reports to be developed for demonstration projects should consist of decision-making instruments for top management of the industries.

For this to occur, they should contain an executive summary, with clear identification of quantifiable costs and benefits associated with the project, the pay-back period, and respective gains in MWh, as well as the identification of unquantifiable benefits and clear recommendations about the measures to be implemented.

Also, the potential for co-generation should be duly evaluated where the energy diagnoses are carried out.

In the phase of the demonstration projects it will be the responsibility of PROCEL to cover the costs incurred in carrying out the diagnoses, through agreements with state partners and industries.

The scope of the ESCO (energy service company) that will execute the energy diagnosis will consider the following activities:

- Energy diagnosis report;

- Financing engineering studies;
- Accompany the implementation of the projects;
- Evaluation of the results.

Financing Engineering Studies

The lack of financial specialists with experience in setting up project financing for energy efficiency projects has caused a barrier between the potential enterprises and the sources of funding available on the market. This is a field where PROCEL will be able to make an important contribution to a greater understanding of the economic and financial benefits of projects associated with energy efficiency.

The financial engineering studies of the demonstration projects will be done to measures that had been selected to be implemented, with the agreement of the top management of industries.

The report resulting from these financial studies should contain:

- The economic-financial evaluation of the approved measures;
- Internal rate of return, pay back time;
- Identification of the loan funds and resources.

The financial engineering studies will be developed according to the existing rules from BNDES (Banco Nacional de Desenvolvimento Econômico e Social), local agents and other funds that may be identified.

Implementation of the Projects, Evaluation of the Results, and Monitoring and Targeting Program

The implementation phase includes the supervising of ESCOs and evaluation of the results obtained in the execution of each project.

In this opportunity, PROCEL, with the participation of the state bodies, will implement an energy management program based on the Monitoring and Targeting program from ETSU (Energy Technical Support Unit - UK) in the selected industries, including the actions as follows:

- Define the energy consumers ;
- Establish the standards to the energy consumers;
- Establish the targets of energy conservation and the plan to implement them;
- Integrate this plan with the other management systems at the industry, as well as the quality program;
- Disseminate the program to all of the levels of the industry, including specific training to the energy manager and technical people;
- Implement the methods of monitoring the program.

The Monitoring and Targeting program consists of: data acquisition, information analysis, reports about the possibilities to save energy and practical actions.

Dissemination of the Successful Cases - Best Practice Program

The methodology, in the stage of disseminating the successful cases, considers that PROCEL develops a program based on the Best Practice Program from ETSU (Energy Technical

Support Unit - UK), that guarantee the dissemination of the results obtained with the demonstration projects.

The main objectives of this program are:

- Identification of opportunities to save energy in the industries, considering the comparison with the existing potentials of energy conservation;
- Dissemination of the implemented successful cases.

The Best Practice program is based on four principal elements:

- Energy consumer guide;
- Successful cases;
- New technologies projects;
- Research and Development projects.

Figure 2 shows the main elements of the dissemination of the successful cases - Best Practice program.

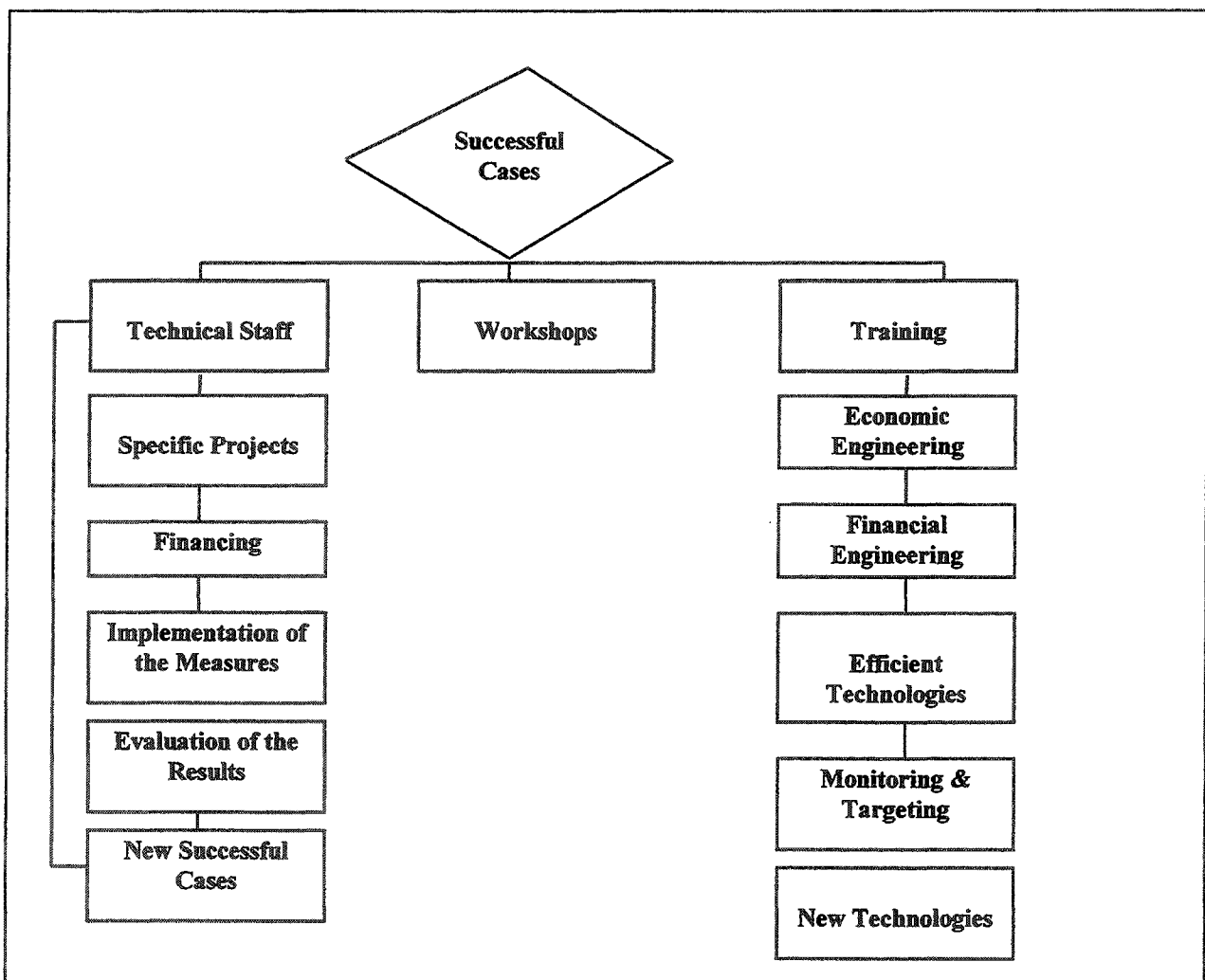


Figure 2. Main Elements of the Dissemination of the Successful Cases - Best Practice Program

Results

Regarding the expected results to be obtained by the implementation of the energy efficiency program for the industrial sector in Brazil, the main objective is to reach the effective reduction in the energy consumption, in terms of MWh/year. The results expected and the respective resources are presented in Table 3 below.

Table 3. Targets, Energy Savings and Resources

TARGETS	ENERGY SAVED TWh/year	RESSOURCES US\$ million
short-term (1998/1999)	0.3	6.5 (staff + consultants) 35(implementation)
Medium-Term (2000/2004)	3.0	14 (staff + consultants) 350(implementation)
Long -term (2005/2009)	12	26 (staff + consultants) 1400(implementation)

Conclusions

The methodology developed to implement the industrial program in Brazil, although it is based on international methods, is fully adapted to the technical and economic Brazilian context.

This methodology was created because of the importance of the industrial sector in the Brazilian economy and the need to implement most efficient methods of energy use.

The main purpose of this methodology is to raise the efficiency of Brazilian industry to the world's best standard, by stimulating a culture of good energy management supported by a thriving national market of efficiency products and services.

Some relevant aspects of the methodology are:

- The pilot program, considering the short-term targets, is a prototype for a national program, and ideally with a smooth transition into the follow-on program;
- Procel's role should be to provide central policy, planning a coordination in support of implementation of the program and also to seek the complementary funding (national and international) for the program and provide a national focus for external donors (e.g. World Bank, European commission, etc.).
- Procel should develop state level performance agreements, ultimately linked to energy saving targets which aggregate towards a national target.

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