EVALUATION OF THE ECONOMIC–FINANCIAL IMPACTS OF ENERGY EFFICIENCY PROJECTS IN SMALL-SIZED INDUSTRIES

Ricardo Wargas[29]
Myrthes Marcele Santos[30]
Tatiana Lauria[31]

1 – Introduction

This paper analyzes some of the impacts that arose from implementation of Energy Efficiency projects among Micro-, Small- and Medium-Sized Companies – MPME.

The experience reported herein is the fruit of implementing "Demonstration Units" in the Efficient Use of Energy at eight companies, three in the brick-making industry, two tire-retreading plants and three bakeries. These units were part of the Project entitled "Energy Conservation at Small- and Medium-Sized Industries in the State of Rio de Janeiro", which began in 1995 when a Bilateral Technical Cooperation Agreement was established between the Governments of the Federal Republic of Brazil and the Federal Republic of Germany.
The main objective of the Project, which is the outcome of a partnership between the Service for Support of Micro- and Small-Sized Companies in the State of Rio de Janeiro - SEBRAE/RJ and German Technical Cooperation Society - GTZ, with support from others institutions, is to foster the Efficient Use of Energy, open up new opportunities for enhancing productivity and quality and lessening environmental aggression, and consequently provide gains in profitability for MPME companies.

We believe that demonstration and dissemination of alternatives resulting in reduction of the amount of aggregate energy employed in producing each unit are key to enhancing the competitiveness of micro-, small- and medium-sized companies. Based on this concept, the Project seeks to identify, from among representative industries in this market, those companies with energy-saving potential, in order to transform them through technological development into model companies for the rest. These companies are identified as "Demonstration Units" in the Efficient Use of Energy.

Since there are certain differences between the industries selected, energy savings are thus directly linked to production line technologies and installations. Hence, economizing energy therefore entails partially or totally modifying these production processes.

After a wide-ranging negotiation process aimed at making businessmen sensitive to the need for formal participation in the SEBRAE/RJ – GTZ Project, diagnoses are conducted at the companies mainly focusing on the energy aspects involved, based on the production process viewed as a whole. By the same token, the proposals drawn up concentrate on energy savings and automatically result in technological changes at all levels of the process. At each participating company, the benefits in terms of energy savings are calculated down to the minutest detail, which makes the advantages for implementing the measures proposed crystal clear.

And besides energy considerations, analyzing the economic-financial impacts resulting from the Energy Efficiency measures implemented at the companies provides an additional view as to the capacity to absorb new technologies and obtain new thresholds of

[29]Technology Area Manager and Coordinator of Efficient Energy Conservation Program – SEBRAE/RJ, e-mail: wargas@sebraerj.com.br
[30]Local Expert – GTZ (German Technical Cooperation Society), e-mail: gtz@sebraerj.com.br
[31]Consultant for the SEBRAE/RJ – GTZ Project, e-mail: ecoeficiencia@sebraerj.com.br

competitiveness for the companies in their reference markets. By and large, the economic results of the changes introduced can be decisive for the companies' future survival.

The evaluation of the economic-financial impacts contained in this paper was conducted after most or all of the measures scheduled at the companies assisted in the first Phase of the Project were concluded. The evaluation is based on the information compiled and presented in the energy diagnostics carried out by the National Technology Institute – INT at the "Demonstration Unit" companies in the Efficient Use of Energy during the period from 1996 to 1999, as well as information obtained during subsequent calls made in the year 2000.

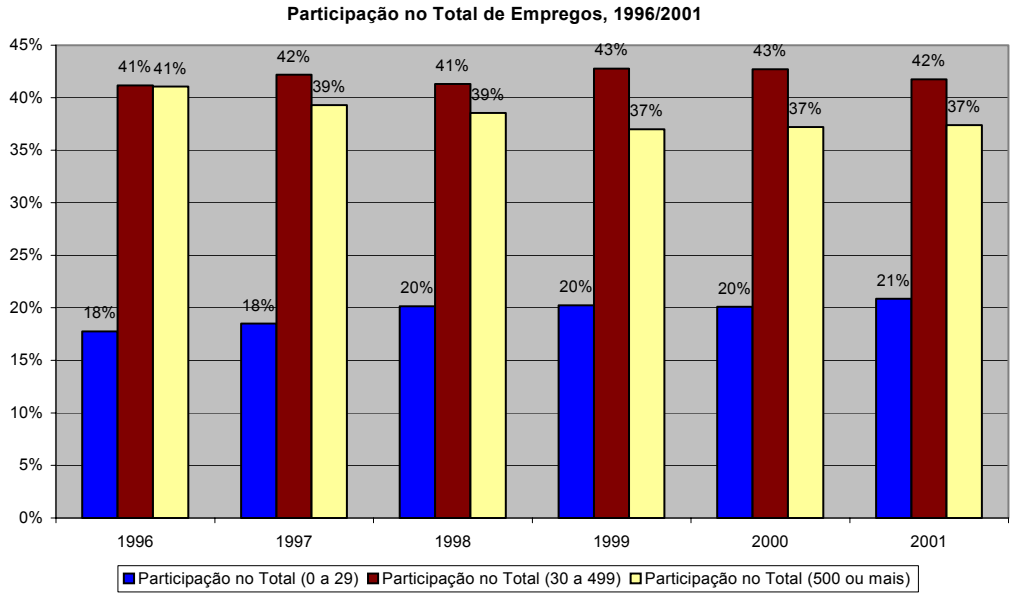
At these companies the savings obtained, in terms of reduction in the amount of energy used to produce each unit, were over 30%. The economic-financial impacts directly related to these results means significant annual savings, equivalent to covering up to nine months' payroll costs (almost three fourths of the annual total).

Moreover, it has been proven that Energy Efficiency projects have other impacts besides, ones that transcend strictly energy-related issues, both inside the company (business management, quality of the final product, lower levels of production losses) and around it (impacts on the region) and – this is of the utmost importance in today's world – reduction in environmental impacts.

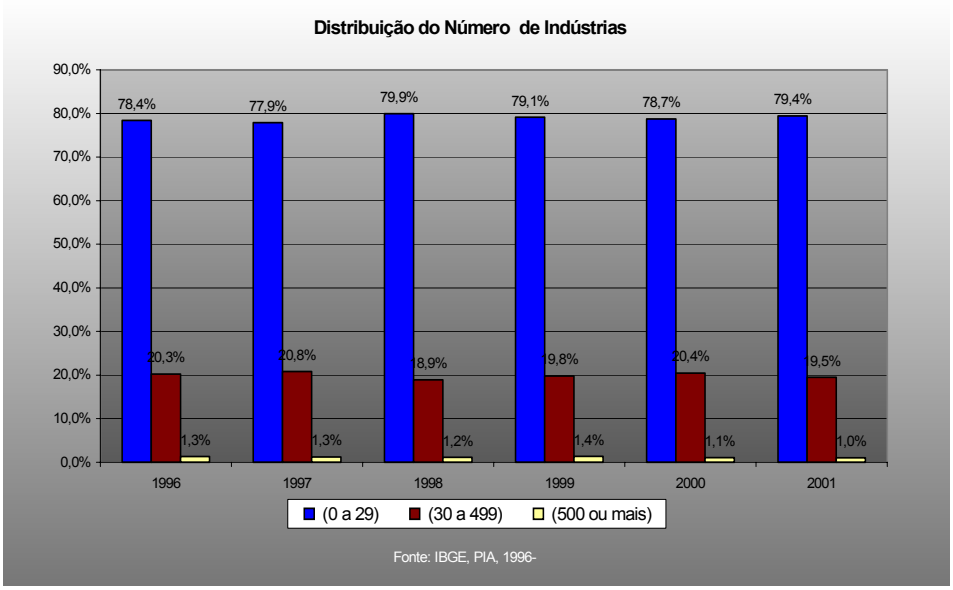
2 Micro-, Small- and Medium-Sized Companies in the Brazilian Economy

Micro-, small- and medium-sized companies are becoming increasingly important in the dynamics of the nation's economy, chiefly with respect to job-creation.

As can be seen by the Annual Industrial Survey conducted by the Brazilian Census Bureau (IBGE), during the period from 1996 to 2001, micro-, small- and medium sized companies created jobs at a rate of 11%, in sharp contrast to the 4% drop in jobs at big companies.



Fonte: PIA, IBGE



The total number of small companies in Brazil is also highly significant: no less than four fifths (80%) of industries in Brazil have between 5 and 29 employees, whereas only around 2% of all companies have over 500 employees.

Further, according to the IBGE's survey, micro-, small- and medium-sized companies account for roughly one third (35%) of Brazil's processing industry output (VTI[1]).

[1] As defined by the IBGE, the VTI incorporates sales of industrial products and services, variation in stocks of finished products and products in process, as well as company-made fixed assets (PP&E).

This ratio is low when compared to big industries (65%) and taking into consideration the quantification and job-creation indices of micro-, small- and medium-sized companies. It is important to remember that the VTI covers the concept of productivity and competitiveness and that energy efficiency programs, like the successful experiments carried out by the Sebrae/GTZ Project, are in tune with these same concepts and hence can produce highly satisfactory results when implemented.

In this context, fostering, encouraging and proposing alternatives for energy-efficiency actions takes on tremendous importance precisely because it is line with the perspective of integrated energy planning and committed to the nation's economic and social development.

3 The results of the Project

The results of the Project entitled "Energy Conservation in Small- and Medium-Sized Industries in the State of Rio de Janeiro" demonstrate that it is both technically and economically possible to implement Energy Efficiency measures even in micro-sized companies, such as bakeries.

Since the degree of waste of energy and production resources is widely known, such measures should naturally draw considerable attention on the part of small businessmen. Even so, actual behavior does not coincide with what one would expect, indicating that it is first necessary to learn more about decision-making mechanisms at companies.

In the first phase of the Project (1995-1999) entitled "Energy Conservation at Small- and Medium-Sized Industries in the State of Rio de Janeiro", eight companies, three in the brick-making industry, two tire-retreading plants and three bakeries, participated as "Demonstration Units" in the Efficient Use of Energy.

This paper presents a summary of the main results of the Project at some of the companies in the industries cited above.

4 Main Results at Industries Evaluated

In recent years the brick-making industry has been undergoing major restructuring in order to modernize its production techniques. The upshot has been the formation of larger brick-making plants and the disappearance of small- and medium-sized companies incapable of remaining competitive.

Further from an energy standpoint, the process of technological modernization carried out at the brick-making companies has resulted in marked increases in electric power consumption, the corresponding costs of which have not always been immediately balanced by the use of more efficient equipment, such as: high-yield motors, installation of generators to guarantee power supply at peak demand times, or further, alteration of the means for contracting supply from local electric power distribution companies. As a consequence, the brick-making plants have sought to optimize their processes, mainly through the rational use of energies, such as fuel oil and bio-mass.

It is important to keep in mind that brick-making plants have a high level of thermal consumption. As can be seen in Tables 1 and 2, with the changes introduced in the production process, the chief gains for the company came about in the form of reduced specific consumption, lower production losses and fuel oil consumption (average specific consumption of fuel oil was cut by over one third – 35.6 % - in the time span observed).

Table 1 - Tijolar Indústrias Cerâmicas Ltda. – Results achieved in 1998/1999 period

Indicator	**Results**		
Finished production (mt of bricks/mo.)	Before	After	
	4,248.8	4,673.8	+ 10.0 %
Specific average consumption of fuel oil (kg. oil / mt of bricks)	Before	After	
	49.6	41.4	- 16.6 %
Specific average consumption of electric power (kWh / mt of bricks)	Before	After	- 3.7 %
	30.6	29.5	
Production losses (%)	Before	After	Additional production (mt of bricks/mo.)
	6.4	1.8	425
Reduction in CO_2 emissions (mt / yr.)	1,862.0*		
Reduction in SO_2 emissions (mt / yr.)	56.8*		

Note: * Relating to lower consumption of fuel oil. Source: Final INT Report, 1999.

Table 2 – Cerâmica Argibem Ltda. – Reduction in fuel oil consumption

Year	**Consumption** (kg oil / mt of bricks)	**Annual production** (mt of bricks)	**Oil price** (R$ / kg)	**Annual expenditure** (R$)
1996	63.3	37,668	0.172	410,114.00
1999	40.8	43,200	0.330	581,645.00

Source: Final INT Report, 1999.

Like the brick-making industry, the tire-retreading sector too, throughout the 1990's, underwent major restructuring due to the availability of more advanced technologies and stiffening competition between companies. Many smaller companies that were technologically and economically inefficient had to drop out of business and hence reduced the number of companies operating in the industry to less than 1,300 units in 1998. Accordingly, the partnership institutions, working together with specialized industry

consultants, concentrated their efforts on modernizing processes and installations for the companies that joined the Project "Energy Conservation in Small- and Medium-Sized Industries in the State of Rio de Janeiro". The major idea was keeping the companies competitive, especially with better quality products.

This approach was likewise fundamental to ensuring that the companies would be sensitive to participating in the Project, inasmuch as negotiations restricted to the energy issue alone would certainly not meet with success. This is because in the tire-retreading industry, energy accounts for a mere 2.0 % to 3.0 % of costs.

Table 3 - Recauchutadora Nova Itaipava Ltda. – Results achieved in 1997/1999 period

Indicator	**Results**		
Consumption of firewood (m^3 / mo.)	Before	After	
	380	300	- 21.1 %
Specific general electricity consumption (kWh/tire)	Before	After	
	3.5	3.3	- 6.0 %
Specific heat consumption (Mcal/tire)	Before	After	
	32.1	25.3	- 21.1 %
Reduction in CO_2 emissions (mt/yr.)	876*		

Note: * Relating to decreased firewood consumption. Source: Final INT Report, 1999.

The baking industry warrants special attention, not just because of the large number of small companies engaged in this business, but also due to the legions of people employed. In Brazil, it is estimated that around 50,000 companies are presently operating in the bread-baking industry, which represents (at the average of 12 employees per company) roughly 600,000 people working at them. At the bakeries that joined the SEBRAE/RJ - GTZ Project, one of the main problems identified was, as a consequence of the new market behavior, the inappropriate size of their baking ovens in the context of the present demand profile. As baking ovens account for no less than 57% of a typical small bakery's energy consumption, a project that begins with reducing the specific consumption of energy takes on great importance in terms of increasing the competitiveness of these companies. At a typical neighborhood bakery energy represents around 10% of the company's costs.

Table 4 - Padaria Santa Terezinha de Ramos Ltda - Results achieved in 1998/1999 period

Indicator	**Results**		
Consumption of electric power (kWh/mo.)	Before	After	
	19,000	15,840	- 16.6 %
Specific general consumption of electric power (kWh/ kg of flour)	Before	After	
	2.9	2.4	- 17.3 %
Specific oven electric power consumption* (kWh/ 50 g unit – "French roll")	Before	After	
	0.036	0.021	- 41.7 %

Note: * new type of ballast and ceiling oven. Source: Final INT Report, 1999.

5 – Overall Evaluation Of Impacts

Evaluation of the work performed at the "Demonstration Units" in the three small- and medium-sized industries in the State of Rio de Janeiro – Brickmakers, Tire Retreading Plants and Bakeries – allows us to make the conclusion that the companies managed to achieve positive and convincing results due to the technical assistance received and investment outlays made, both in terms of energy savings and economic-financial performance of the companies.

From an environmental point of view, it is important to stress the following: just considering the implementation of various programs for energy conservation and optimization of production processes through technological modernization at each company in the brickmaking and tire retreading plants during the period, each year the state of Rio had 6,376 metric tons less CO_2 gases and 136 metric tons less sulfur gases emitted into its air. As is widely known, the former environmental pollutants are among the principal causes of the Greenhouse Effect, whereas the latter are responsible for Acid Rain.

The results also reflect a highly positive influence from a business standpoint as well: all companies became project candidates quite willingly, showing interest, willingness and drive to carry out the energy optimization projects. With this, it has been possible to joint together an interesting group of small- and medium-sized companies with pioneering spirit and receptiveness to changes. The principal benefits obtained from the Sebrae/GTZ Project were the following:

- Reduction of energy consumption.
- Reduction of emissions of CO_2 and other effluents.
- Reduction in the consumption of other inputs (such as water, for instance) and/or raw materials.
- Increase in product quality, making it feasible to obtain better sales prices and hence higher profits.
- Decrease in production losses through better process control.
- Reduction in production costs.
- Indirect quantitative and/or qualitative benefits:
- Increased motivation on the part of both management and employees to implement innovations.
- Creation of organizational infrastructure for making changes inside the company.
- Development of managerial capacity.
- Strengthening of the company's ties to the community surrounding it (institutions, consultants, suppliers, etc.).
- Increased quality of demand for products and services.

The evaluation presented in this paper is merely a summary of preliminary findings, hence subject to enhancement as more data becomes available from the companies and further details are provided with respect to specific aspects.

Other aspects valid for consideration in the future relate to the need for new investments and the service life of the financed equipment and installations, in order to calculate the true net income resulting from the adaptation efforts.

The most important indirect success of the SEBRAE/GTZ Project was having encouraged the growth of entrepreneurial spirit and the capacity to resolve problems, which are positive signs not just for the survival of traditional small firms but also for further development of small- and medium-sized companies.

6 References

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