Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 15, Issue 1, 2015
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE MATRIX OF ENERGY MANAGEMENT – AN EFFICIENT MANAGEMENT TOOL FOR FOOD INDUSTRY OF THE REPUBLIC OF MOLDOVA

Corina GRIBINCEA

National Institute for Economic Research, Academy of Sciences of Moldova, 45, Ion Creangă Street, Chișinău, Republic of Moldova, Mobile: +37379458431,
Email: corina.gribincea@gmail.com

Corresponding author: corina.gribincea@gmail.com

Abstract

The article analysed the evolution and current practice of engineering and economic approach regarding the issue of efficient energy management in food entreprises from the Republic of Moldova. The problem of reducing energy costs in addition to energy price growth factor has a major impact on managerial effort to reduce energy consumption. In this sense, the matrix of energy management is an effective tool for strategy and monitoring the efforts achieved in energy management in food enterprises, and the problem of minimizing energy costs is presented as an isoquant map described by classical production function.

Key words: *efficient energy management, food entreprises, matrix of energy management, Republic of Moldova*

INTRODUCTION

Currently, evolution of the phenomena from energy sector shows that energy consumption increases and energy efficiency and is one of the most effective way to support the improvement of an enterprise performance. Energy resources are an important part of material resources, once the oil crises affected the industrialized countries that import energy. The reactions of developed countries have been structured and developed the concepts of alternative energy, renewable energy, energy management and energy efficiency. All these concepts have had practical character and beneficial consequences on the entire economic activity in these countries. [10]

At global level, the issue of energy efficiency emerged in the early 70s, when the UK has paid attention to the issue of reducing energy consumption in the industry and public institutions. Since then, there have been many changes in the companies, all regarding energy savings, with positive results on energy efficiency. This was caused by the increase of prices from the energy and the need to improve competitiveness. Then the issue of energy efficiency has spread to Western Europe, North America and Japan. In Romania, the priority of reduction energy consumption has emerged with a considerable increase in fuel prices after 1973 [10]; and in Republic of Moldova these concerns appeared until the 90s, when the planned economy has transformed into the market one. But a greater magnitude of this notion among entrepreneurs from food industry of Moldova appeared ten years later.

MATERIALS AND METHODS

In determination the quality management of energy consumption in the food enterprises from Moldova has been used the energy benchmarking methodology. For monitoring the efforts achieved in energy management in food enterprises has been used the matrix of energy management. In the analysis of energy costs minimization was used an isoquant map described by classical production function.

RESULTS AND DISCUSSIONS

With the substantial increase in the cost of energy, given the industry's consumption share of 30% in energy consumption structure, Moldova’s energy efficiency is low

compared to European countries. Energy consumption in global food industry covers only a small part of the total cost of production (about 3%). As a result, until recently, Moldovan enterprises have been weak involved in energy management. Today, even if food industry remains a non-intensive energy industry, with increasing energy prices and environmental awareness it's also increasing the growing role of energy efficiency in Moldovan food industry.

According to experts V. Moroz, Poisic M. and Ignat A. [8], the main constraints for energy efficiency in the country are: high energy consumption, increasing energy prices, technology and equipment morally and physically outdated, lack of knowledge and skills in energy efficiency and renewable energy use, excessive dependence on imported energy resources (95% import energy). They also argue that the competitiveness of the food industry is directly affected by the used technology and low efficiency of the energy sector in the country has a negative impact on industry development of local agricultural raw material processing.

The following solutions are targeted to reduce maintenance costs, increase competitiveness and reliability:

1. To reduce energy consumption by reducing costs, namely:

-Framing consumption in contracted values;

-Tracking the specific consumptions in locations and areas, empowering local and central monitoring;

-Taken measures from analyzed reports;

-Manage energy consumption by systems;

-Elimination of parasitic energy consumption and strengthening discipline use.

2. Increase competitiveness by:

-Exact calculation of cost and energy intensity per location;

-Efficient use of energy resources and utilities.

3.Increase the reliability and reduce maintenance costs through:

-Analysis of the distribution quality of energy consumption;

-Analysis of incidents in case of emergencies;

-Prevention of major equipment faults by monitoring consumption parameters and preventive maintenance.

The experience of energy management in the European food industry demonstrates that reduction of energy consumption can be achieved politically through technical measures (application of efficient engines, fuels and materials); replace and improve techniques and procedures; and also changing social aspect by decreasing various products consumption, including those imported.

It can be concluded that entrepreneurial effort of Moldovan industry focuses on production costs minimization and less on energy costs. Moldovan food industry faces many challenges that require a reassessment of current practices in production and trade, cooperation between firms along the vertical supply chain, government influence on business management activities to optimize the potential of production systems and balance the industrial structure in production.

The structure and dynamics of energy consumption in Moldovan food industry.

Generally, companies make major investments to meet working conditions, improve product quality, increase tools productivity and achieve energy savings. Increasing competitiveness among competitors within same field showed that introduction of advanced energy management led to consolidation and growth of companies and recall of those who have not taken adequate measures in time to reduce energy consumption.

The supreme argument for investment in energy efficiency is the ability to reduce spending on electricity and fuel, as an indicator that can be immediately seen on company profit, as well as a security measure to ensure competitiveness in the future, given rising energy prices. The European Bank for Reconstruction and Development (EBRD) recognizes the growing importance of energy efficiency and in 2009 launched line for Financing Energy Efficiency in Moldova (MoSEFF) in order to support energy efficiency investments in enterprises from Moldova.

Industrial consumption in electricity consumption structure in the country occupies

30%, where other sectors have an insignificant role, which helped to effective changes in the structure of the food industry in the period 2005-2012. Energy efficiency in Moldova is low compared to European countries due to substantial increase of energy costs.

Energy comprises only a small part of total cost of production in the food industry (about 3%) and as a result, food industry was quite reserved involved in energy management, remaining a non-intensive industry. However, with rising energy prices and environmental awareness, sectorial priorities have changed and pay a greater attention to the energy efficiency.

Currently, the food industry face a number of challenges that require a reassessment of current practices in production and trade, cooperation between enterprises along the vertical supply chain and "environmental awareness". In order to meet the above requirements, Moldovan food industry faces implementation of best solutions and seeks to optimize its potential according to the new models of increased competition. Challenge to increase food production keeps the pace with demand, preserving essential ecological integrity of production systems.

A tool to ensure evidence of energy consumption in production under diverse nomenclature is considered Energy Performance Indicators (EPI), which together with the use of measurement technique allows assessing organizations from various sectors and areas according to differential energy consumption for each type of production or comparing countries by technological level.

The use of Internet-Module allows monitoring the level of energy consumption over time and tsb-mobile applications for determining the quality level of energy benchmarking.

Calculation of EPI indicators and of system limitations are important in understanding energy benchmarking methodology, but the differences between companies of the same class can be quite representative, and only attracting more organizations in this system will allow a certain uniformity of data for certain classes of business, types of processes or production.

Based on present research study the author proposes the following 10 key measures of energy efficiency in industrial processes:

1.Continuous monitoring of energy consumption and technological parameters with performance measurement and control systems;

2.Upgrading of old production lines with new technologies, clean, low energy consumption and high productivity;

3.Industrial automation of processes;

4.Reduction of heat loss in soil, air and environment;

5.Reuse of secondary energy resources through technological processes utilization;

6.Heat production with performant equipment with fuels of low emission;

7.Preparation of contracts for the electricity supply at best rates by hourly load curves;

8.Efficient lighting installations and high quality lighting at jobs, depending on specific requirements of the technological processes;

9.Sizing motors under required capacity and use of modern devices for turn on, engine control and regulation;

10.Development of local CHP plants to produce electricity and heat simultaneously at low cost.

From the analysis of domestic food industry can be stated that food industry has a reserved involvement in energy management, considering necessary to revaluation of current practices in production and trade. By implementing energy efficiency programs in food companies, energy intensity per unit of output would decrease, which would lead to a significant increase of market competitiveness and food security of the country. It is also necessary to implement an incentive system of the industry, including data collection, popularizing and maintaining compliance efforts on rational energy consumption in industry.

To increase the efficiency of the food industry in Moldova, a managerial benchmarking mechanism is proposed which would allow improvement of information policies in the field, identification of best companies according to certain criteria and structural subdivisions; and to ensure evidence of energy consumption it would be appropriate

to use EPI energy performance indicators that would allow organizations to assess the level of different branches and areas according to differentiated energy consumption for each type of production or comparison of technological level of the countries.

Republic of Moldova imports about 94% of the resources needed to cover the country's energy consumption because of the lack of own energy resources. The Moldova's energy policy is aimed to promote energy efficiency and use of renewable energy available in the territory, which constitute a prerequisite for reducing dependence on imports. But a key impediment to economic development and competitiveness of domestic industry is the increased energy intensity.

The increase of energy efficiency in the industrial sector is contained in the National Programme for Energy Efficiency 2011-2020. According to this program, the industry is the third largest consumer of energy in Moldova, holding 10% of the total energy consumed (the primary objective of the program being heat supply of the population). [7]

In the scientific literature the concept of *energy management* is presented as the application of professional techniques in energy use.

It can be seen that energy is one of the most controllable costs as each of energy savings are accounted directly in the profits.

Here we can mention the concept of *energy efficiency* that is broadly related to a reduced increase of the absolute or specific energy bill; in a narrow sense the energy performance means the energy saving.

So, improvement of energy efficiency involves identification of energy flows, determination of most profitable measures to eliminate the losses, the prior estimation of the costs and profits and finding the most convenient sources of financing of such projects. [9]

George Vuc argues that an energy management program to work properly it must be effectively integrated into general management programs and procedures. Energy management is based on people – more people involved and motivated, more effective is the program. Their involvement should be structured and planned anyway. However, the energy manager is the key; he must be trained to know how to act concretely in the company, but must also be supported by the administration in achieving the objectives related to energy efficiency. [10]

Economic implications of the implementation of energy saving policies.

Spending's concerning energy consumption are often regarded as constant costs, independent of the value of production; Thus, at enterprise level the economic implications on reducing energy consumption involves both opportunities and impediments as well (Table 1).

Table 1. Opportunities and obstacles on reducing energy consumption in food enterprises

OPPORTUNITIES	OBSTACLES
1. Increase the competitiveness	1.The importance of cost and energy consumption is not fully realized, both administration and employees of the enterprise
2. Increase the profit	2.Energy use in many forms: gas, oil, electricity, steam, compressed air;
3.Increase the job security for employees in the enterprise	3.All staff in the enterprise has the access to facilities that consume energy

Source: author's elaboration

The data from the Table 1 show that both opportunities and impediments concerning the reduction of energy consumption in the enterprises from food industry play an important role in shaping the energy policy.

Effective management of the energy consumption.

Application of a systemic method of management requires the commitment of administration and staff to conduct a series of specific actions over a period of time in order to obtain maximum benefit from the energy outlay.

In addition is quite difficult to assess quantitatively the quality of management in the process of administration of energy consumption in an enterprise from food industry.

Thus, we propose to analyze the energy management matrix.

The matrix of energy management is a structured model that correlates different levels of energy management with the main lines of possible actions concerning the management of energy consumption in an enterprise, involving: energy policy, organization, motivation, information systems, marketing and investment.

These levels may help in determination the quality management of energy consumption in the food enterprises from Moldova.

The energy management matrix based on UK's model is presented in the Table 2.

Table 2. The energy management matrix based on UK's model

Level	Energy politics	Organization	Commitment	Information Systems	Marketing	Investment
4	The active involvement of top management	Fully integrated with other forms of management	All staff have specific responsibilities for energy savings	Well-developed systems with daily reports	Extended inside and outside the institution	Positive discrimination in favor of green schemes
3	Effective policies but without administration involvement	Clear division of tasks and budgets	The majority of big consumers are motivated to save the energy	Monthly M & T system for centers or individual zones	Regular advertising campaigns	The same assessment criteria as for the rest of investments
2	Undecided politics	Assessment of tasks but not established responsibilities	Non-rhythmic or sporadic motivation	Monthly M & T system for different types of fuel	Sporadic actions of staff awareness	Only investment for payback period
1	Directions of unwritten actions	Assessment of tasks on different occasions	Relative staff awareness about the importance of economies	Invoice verification	Informal contacts for promoting economies	Only low-cost measures
0	No explicit policy	Any delegation of responsibilities on energy sector	Lack of awareness of the need to save	No accounting or information system on consumption	Any marketing or publicity	No investment in improving energy efficiency

Source: [2]

Note: The M&T system stands for computer systems to monitor energy consumption.

It should be noted that the Monitoring and Targeting System (M & T) has specialized programs for software that processes data on energy consumption, resulting in an operative and detailed energy analysis, which is followed by a stage involving the establishment of energy efficiency measures in the enterprise.

According to the data from the literature about 25% of enterprises are outside the lower and upper limits. It should be stressed that companies with higher scores continue to strive to achieve improvements in management of energy consumption [10].

The producer and the problem of cost.

In the production process, producers' theory is used to determine the demand of inputs. Also is allowable as in the production process to substitute another input, and the producer will try to find a combination of inputs that will minimize the cost of production. For a general description of this theory, we use a mathematical approach to graphics and presentation.

We consider an enterprise with a single output that is produced with two inputs X_1 and X_2. The cost of production will result in:

$$TC = c_1X_1 + c_2X_2, \text{ where}$$

$$\text{St } q_0 = (X_1, X_2)$$

and Lagrange expression would be:

$$L = c_1X_1 + c_2X_2 + \lambda (q_0 - (X1, X2))$$

the first condition for a minimum is:

$$\delta L / \delta X_1 = c_1 - \lambda \, \delta f / \delta X_1 = 0$$

$$\delta L / \delta X_2 = c_2 - \lambda \, \delta f / \delta X_2 = 0$$

that would result in:

$$c_1 / c_2 = (\delta f / \delta X_1) / (\delta f / \delta X_2) = \text{RTS}$$

$$(X_1 \text{ for } X_2)$$

Thus, to minimize the cost of any level of inputs, the company should produce outputs at that level of the rate of technical substitution equals to the price of return inputs. The solution of these conditions leads to the demand functions. Taking into account that a manufacturer uses capital and energy to produce outputs, resulting in the production function given in equation below:

$$Q = 10K^{0.5} E^{0.5}$$

Isoquant map for this production function may be represented graphically by Q at different levels (50 or 100) and then finding the combinations of K and E, which produces the outputs at the given level (Figure 1).

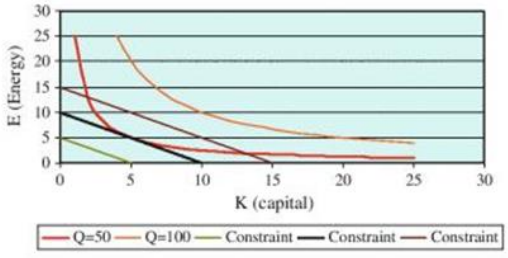

Fig.1. Selection of the optimal inputs for the enterprise
Source: [1]

On suppose that price of capital and energy per unit is $1 each. If K units of capital and E energy units are used in the production process, the total cost will be K + E. The cost lines constraints are presented as in Figure 1. As can be seen from Figure 1, the optimal choice would be the point where the cost line is tangent to isoquant. For a given level of outputs, the demand for energy inputs can then be determined.

While the above theoretical concepts provide an understanding of energy demand, these theoretical ideas are based on assumptions rather restrictive. While traditional econometric models explicitly follow the principles of economic analysis and forecasting energy demand, it is not only economic philosophy proposed in modeling of energy demand.

Although the price, the rationality and behavior in the neoclassical tradition greatly influence the econometric theories, sometimes other theories not always demonstrate the crucial role of these factors. Consequently, other behavioral assumptions and beliefs are used in some approaches as "bottom-up" approach or "economic engineering".

CONCLUSIONS

The article studied the evolution and current practice of engineering approach on the issue of economic and efficient energy management in food enterprises.

The problem of reducing energy costs in addition to energy price growth factor has a major impact on managerial effort in terms of reducing energy consumption.

The matrix of energy management can be used as an effective tool for strategy and monitoring the achievement of efforts of enterprise's energy management in the food industry and the problem of minimizing energy costs is presented as a isoquant map described by classical production function.

REFERENCES

[1]Bhattacharyya Subhes C., 2011, Energy Economics – Concepts, issues, markets and governance, Editura Springer, 2011, p.50

[2]Bîrsan Sorin, 1999, Componenta energetică în politica întreprinderii, Tribuna Economica, nr. 14, 1999, p.16

[3]Duca Aurelia, Gribincea Corina, 2014, Analiza factorilor privind utilizarea eficientă a energiei în industria alimentară a Republicii Moldova. Conferința Internațională ştiinţifico-practică "Creşterea economică în condiţiile globalizării", INCE, Vol.1, 2014, pp.141-145

[4]Gribincea Alexandru, Gribincea Corina, 2014, Minimizarea consumului industrial de resurse energetice ca factor decisiv al dezvoltarii durabile a industriei alimentare din Republica Moldova. Cea de a X-a ediţie a Conferinţei Internaţionale "Dezvoltarea economico-socială durabilă a euroregiunilor şi a zonelor transfrontaliere", ediţia a II-a, Academia Româna – Filiala Iaşi, Institutul de Cercetări Economice şi Sociale "Gh. Zane", Universitatea de Stat "Alecu Russo", 2014 p.285-298

[5]Gribincea Alexandru, Gribincea Corina, 2014, Optimizarea costurilor şi consumului în managementul energetic în industria alimentară şi a băuturilor din Moldova. Revista Economica, ASEM, nr.1, p.7-13, 2014

[6]Gribincea Corina, 2013, Principii de management energetic. Conferinţa ştiinţifică Internaţională Jubiliară ed.VII „Modalităţi de eficientizare a sistemului economico-financiar în scopul dezvoltării economice durabile a Republicii Moldova", CEP USM, 2013, p.112-117

[7]Programul national pentru eficienţă energetică 2011-2020
http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=340940

[8]Poisic, M, Moroz, V. Ignat, A, 2012, Transformarea industriei agroalimentare in Republica Moldova. Materialele Conferinţei VII-a ştiinţifico-practice internaţionale „Creşterea economică în condiţiile globalizării", Vol. II, Ch., IEFS, 2012, p. 108-116

[9]Răducanu Cristian, Roxana Pătraşcu, 2006, Evaluarea eficientei energetice, Editura Agir, Bucuresti

[10]Vuc Georghe, 2004, Gestiunea energiei şi managementul proiectelor energetice. Note de curs pentru managerii energetici. Editura Orizonturi Universitare, Timişoara