Energy Efficiency Improvement Ways in Industrial Clusters of the Region

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Abstract

Performance results of Companies in territorial and industrial clusters of Russia in many ways determine the different level budgeting, including in particular regional ones, dramatically influencing the development of the social and cultural sectors of the region. Therefore, it's no coincidence that their efficiency in performance is in the focused attention of regional administration authorities. A number of external and internal factors influence the operating efficiency of the companies in regional clusters. Recently, a particularly strong influence on the final results of their work has a constant rise in prices for energy resources, suppressing the growing competitiveness of the products in the world markets. The article analyzes the dynamics of changes in the main indicators characterizing the efficiency of energy use of the large industrial company, forming the core of the petrochemical cluster in one of the Russian regions. The factors with the greatest impact on improving production energy efficiency have been identified. The perspectives to reduce energy consumption in the conditions of electricity and power market liberalization have been reviewed. It is shown, that the adaptation of the companies' activity in regional clusters to the changes in macroeconomic conditions of economic entities functioning, predetermine the necessity to address a whole range of fundamentally new methodological problems, methodic and organizational strategies to build their behavior in competitive electrical power market.

Keywords: *region, industrial clusters, petrochemical complex, energy saving, energy efficiency, energy resources*

1. Introduction

The most important condition for transition to the sustainable development of regional economic systems is to increase significantly the energy efficiency of the Russian economy. The problem of energy efficiency is obvious to be solved taking into account the special aspects of socio-economic development of different regions, accompanied by creation of a specific cluster infrastructure. It should be noted that the cluster infrastructure plays an important role in the development of regional systems. First of all, it is determined by creation of the conditions for the production sector performance and implementation of the auxiliary functions for development of socio-economic system. Secondly, the cluster infrastructure can be regarded as a locomotive of regional development, ensuring the achievement of the expected results of expanded regional reproduction. This is precisely why adoption of energy-efficient technologies should be integrated into the strategies of socio-economic development of regions and considered in elaboration of the strategic plans for the development of regional industrial clusters, territorial clusters, separate companies and production facilities.

Management of Industrial Complex in one of the largest and most industrialized regions of Russia – Republic of Tatarstan is based on the cluster model of development since 2008 (Melnik & Dyrdonova, 2014a). Its basic principle is to use all the advantages of cluster development, including comprehensive deepening of inter-company cooperation, effective subcontracting, the application of modern managing technologies, etc. Improving the competitiveness of key companies, forming the core of the cluster, should serve as a basis for the development of all other cluster members, including small businesses entities, maintenance and service enterprises, scientific and educational centers, etc.

Tatarstan Republic economy priority development area is petrochemical industry. Accordingly, the petrochemical cluster's development is paid special attention. PSC 'Nizhnekamskneftekhim' is the core company for petrochemical industry development not only in Tatarstan Republic, but all over Russia (Melnik & Dyrdonova, 2014b). At the same time, it is also the largest energy consumer among all industrial companies of Tatarstan Republic, using up to 10% of electric power and up to 30% of thermal power, which is generated by the entire energy system of the region. Therefore, the

issues of energy efficiency improvement in the modern conditions are particularly topical for it.

2. Literature Review

Fundamentals of the cluster approach were set up by the US school of new forms of production process management, which was represented by theoretical and applied investigations carried out by M. Porter, M. Larenzen, P. Maskell, S. Rosenfeld, M. Storper, M. Enright and others (see Anisimova, 2013). The founder of the cluster approach M. Porter (2005) created a theory of industrial clusters which was based on the following conclusion from the theory of the Diamond Model of Competitive Advantages: conditions for giving rise to a competitive advantage for the involved regions become better when the firms functioning in one particular industry sector are geographically concentrated. According to the theory of regional clusters developed by M. Enright, competitive advantages resulting from performance of clusters emerge at the regional level rather than at the national one (Enright, 1992). Regional clusters represent the specific objects where the cluster policy can be implemented. It is the regional clusters that require the state authorities' attention and support for R&D organizations. From this point of view, the basic determinants for development of the regional clusters are the four sides of the rhomb of competitive advantages as defined by M. Porter.

Another foreign scientist S. Rosenfeld further developed the theory of regional clusters and investigated the communication channels between the firms (members of the cluster) and related organizations. Rosenfeld (1997) considered such communication channels as a significant element of the clusters. According to his approach, a regional cluster is more than just a geographically outlined concentration of interdependent firms. The firms also should have channels designed to facilitate production related transactions, dialogues and communication between middle and small size enterprises. This idea was further explicated by Maskell and Larenzen (2003) in the conclusion that setting up a networking cooperation between the firms based on a trust in the partner principle is the main prerequisite for formation of a competitive regional cluster and enhancement of the competitive ability of the firms being members of the cluster. French scientists J. Tolenado and D. Soulie defined a cluster as 'draw dies', or an interdependence between different economic sectors in terms of technological complexity levels, which is based upon a necessity of creation of technological links between industrial and economic sectors for proper realization of their potential advantages (Soulie, 1989; Tolenado, 1978). A Swedish scientist E. Dahmen defined a cluster as a combination of sectors, or 'development blocks' where a prerequisite for progress is availability of a linkage between an ability of one sector to develop and its ability to contribute to progress in another sector (Dahmen, 1950). In such conditions, development should take place on a phased basis, or along 'a vertical line of actions' within one industry sector connected with other sectors. Such a method may help achieving competitive advantages. According to V. Feldman's point of view expressed in his later theory, a cluster is a diversified group of industries interconnected by the supply and purchase correlations based upon a «cost – output» matrix (Feldman, 1999). A benefit of such an approach is that it proceeds from extensive empirical studies of diversification forms in different countries.

The problem of efficiency increasing in the strategic management of stable development of the economy in general and in regional industrial clusters, as well as the development of an effective regional and energy policy have been reviewed in the writings of I. Bergman, M. Fether, D. Husby, M. Enwright, A.G. Granberg and others. Significant contribution to development of energy-saving theory of chemical-technological processes and chemical engineering systems in the companies of petrochemical complex was made by R. Smith, J. Klemesh, V. Dowy, L. Puijaner.

Despite the numerous researches of the above problems, the lack of cohesive theory in energy-saving management and integral methodology of energy efficiency increase in the industrial clusters of the region is observed.

3. Research Methodology

The analysis of the energy resources price dynamics in relation to the conditions of production and economic activity of PSC 'Nizhnekamskneftekhim', the results are given in table 1, revealed that within the period from 2010 to 2014 the price for the electric power increased by 2.1 times, for thermal power by 2.5 times and for the fuel consumed by 2 times. All this could not but affected, firstly, the total costs of the company, and secondly, the change in the share of energy costs in the production costs. Let's analyze the dynamics occurred on the basis of the data during the period under consideration, provided in table 2.

Table 1. Price dynamics for the energy resources, purchased by PSC Nizhnekamskneftekhim, RUR

Energy resource	2010	2011	2012	2013	2014	Increase in 2014 to 2010, %
Electrical power	0.81	0.97	1.19	1.51	1.70	110.26 (by 2.1 times)
Thermal power	388.71	505.75	657.99	821.15	955.40	145.78 (by 2.5 times)
Fuel	1 334.93	1 547.54	2 010.78	2 244.78	2 692.30	101.68 (by 2,0 times)

The information analysis, given in table 2, allowed drawing the following conclusions. First of all, it should be noted that throughout the duration of the entire period under study the continuous growth of energy costs share in total production costs is observed. In 2014 , due to agitation of consumer demand in the world market for the products of the company and the measures taken in the field of energy saving, the situation was significantly improved by reducing the share of energy costs in the production costs almost to 2% with an overall increase of production costs. A similar trend accompanies the change in the production energy intensity throughout the studied time interval.

Table 2. Dynamics of efficiency indicators in using the energy resources of PSC 'Nizhnekamskneftekhim'

Indicators	2010	2011	2012	2013	2014
Share of energy costs in production costs, %	19.39	18.94	19.12	22.75	20.81
Return on costs, %	27.34	24.74	22.73	16.07	24.60
Energy efficiency (energy productivity), thous. rbl / thous rbl.	6.57	6.59	6.42	5.10	5.99
Energy intensity, thous. rbl/thous rbl.	0.15	0.15	0.16	0.20	0.17

Return on costs within 2010 – 2014 had a clearly expressed downward trend. This may be due to the gross profit growth rate over the specified period, which is inferior to the production costs growth rate. In 2014 the situation improved due to the reasons above enabling the company to increase the gross profit to 8.53% at the increase of return on cost.

Another efficiency indicator in the use of energy resources – energy efficiency (energy productivity), which characterizes the return on each ruble spent on the acquisition of energy resources, has a direction opposite to the dynamics of production energy intensity change.

Figure 1 shows company energy costs structure by energy types. As you can see from the information above the largest share in the structure of the energy costs is taken by the thermal power (in average ≈ 63%). The share of electric power costs is ≈ 27%, and of fuel ≈ 11%.

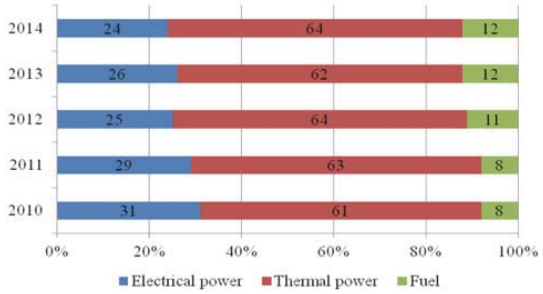

Figure 1. Energy costs structure in PSC Nizhnekamskneftekhim, %

Thus, in 2014 PSC Nizhnekamskneftekhim succeeded in overcoming the consequences of the financial crisis, as evidenced by the growth of business profits, increasing profitability and other indicators improved. It should be noted a significant contribution to improving the company performance was made by the increase of production energy efficiency, which allowed lowering the share of energy costs in the production costs structure in 2014 due to the measures taken, energy intensity was lowered, energy efficiency (energy productivity) was increased, thus enabling the increase the return on production investment.

This is largely due to implementation of energy saving programs in PSC Nizhnekamskneftekhim. Within the Third Energy saving program duration, implemented during the period under consideration from 2010 to 2014, over 300 energy-efficient measures were taken, which priorities were aimed at lowering the power consumption share for

petrochemical production; removal of the equipment exceeding the life cycle from service; introduction of advanced energy-saving technologies; increasing the energy efficiency of the existing units; reduction of energy losses in the energy networks; optimization of heat, steam supply; reduction of energy consumption for own needs; training and retraining of personnel in the field of energy saving and etc. Due to their implementation the economic effect achieved was equal to 189 mln. rubl. At the present time some additional actions aimed at curtailment of energy resources, feedstock and material consumption are being incorporated into the Program.

4. Findings and Discussion

Comprehensive energy efficiency policy execution in all structural subdivisions is going to become the most important strategic task, aimed at improving the competitiveness of its products on the Russian and foreign market (Sadriev, 2014). The absolute company achievement in energy saving field over the considered period is the fact that they managed to maintain the production energy intensity within the range 0.15-0.20 (table 2) despite the constant growth of energy tariffs. However, despite the global work performed, in our opinion, the opportunities to reduce the energy costs at present are not fully taken. First of all, it refers to the new possibilities, created by the conditions of the wholesale market for electricity and power.

The point is that liberalization of the energy market in Russia in the nearest future will have a significant impact on development of the domestic economy and will result in significant changes both in the energy producers performance and its customers, including, in particular, the petrochemical industry, characterized as it was shown above, by a high level of production energy intensity. By now, the energy market has almost fully formed new conditions and opportunities for improving the efficient use of energy resources not only through the use of the internal reserves of energy saving, but also as a result of implementing the new features provided by consumers energy products in a liberalized market of electric energy and power. Therefore, electricity and power market liberalization in Russia can be assessed as a new factor appeared, having a significant impact on competitiveness of the industrial companies. First of all, it refers to the petrochemical industry enterprises.

At that the greatest possibilities are open to the companies entered the wholesale market. Market mechanisms being used may ensure the measurable benefits (Melnik & Lukishina, 2014). Firstly, this is the opportunity to purchase electricity and power under favorable market conditions at a lower price or sell it at a higher price. Secondly, electric energy costs saving within the predicted values regardless of external factors change with the help of hedging instruments provided on the wholesale market. Thirdly, the additional profits resulting from the use of the derivative financial instruments, available on the energy market.

Special emphasis should be made on the fact, that the activity of the company in the wholesale electricity and power market for the purpose of additional profit taking is brand new for the Russian companies with very specific implementation nature. Therefore, in our opinion, it may be separated into an independent type of business, where two directions are clearly traced. Firstly, the purchase of electrical power directly from the generating companies within the frame of bilateral agreements for the purpose of further resale at a higher price on the market for the day ahead. Secondly, purchase and sale of the derivative financial instruments at power exchange.

In case of receiving a new status of a full member of the electricity and power market in terms of its liberalization, companies also for the first time gain massive opportunities for shaping their own energy strategies (Melnik et al., 2014). However, they will no longer be limited only by looking for the ways to reduce energy costs by implementing energy saving measures. Their opportunities will be significantly enhanced as a result of the benefits generated in real time market pricing mechanisms for energy products.

5. Concluding Remarks

The lack of researches made by Russian and foreign scientists, aimed at identifying any possible consequences of electricity and power market liberalization for Russian economy performance and development of methods for adapting company energy costs management systems to the conditions of electricity and power market liberalization confirms the necessity of the further works in this direction.

In our opinion, adaptation of PSC Nizhnekamskneftekhim activities to the changes, occurred in the macroeconomic conditions of company performance, predetermine the necessity to address a whole range of fundamentally new methodological problems, methodic and organizational strategies to build the behavior of the companies in competitive electricity power market. However, their solution will contribute to the further company opportunities enhancement in searching the reserves of energy efficiency increase and competitive growth of the products, allowing to switch the

activity in the energy-saving sector to the solution plane of the challenges which the company faces.

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