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Evaluation of technical efficiency of heat and electric power generation

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Abstract

This paper presents an evaluation of technical efficiency and time-dependent changes in productivity of Polish professional electric power and heat & electric power stations by using Data Envelopment Analysis non-parametric method. The research covered the enterprises whose total available electric power amounted to about 98% of that of all professional thermal electric power stations in this country. The analysis has concerned the years 2000÷2004. Impact was considered of such factors as: scale of enterprise activity, form of ownership as well as type of carried out activity, on technical efficiency and time-dependent productivity changes. Changes in productivity of the power generation sector were determined by means of Malmquist index.
Keywords*: Data Envelopment Analysis (DEA), technical efficiency, Malmquist index, thermal power generation*

Introduction

An important factor which determines enterprise competitiveness level is optimum use of its resources to generate higher profits. In other words, the obtaining of higher economic efficiency by an enterprise impacts its competitiveness level. One of the economic efficiency components is technical efficiency which is understood as the achieving of the highest output in presence of a determined number of production factors. Level of the technical efficiency is influenced by a.o. technical progress and economic scale.

One of the methods for measuring the technical efficiency is the Data Envelopment Analysis (DEA) based on the linear programming where appropriate technical efficiency levels are obtained by determining optimum values of objective function at certain constraints imposed on it.

The sector of heat and electric power generation industry, crucial for Polish economy, was selected for this analysis. More comprehensive research into technical efficiency of power production eneterprises has been lacking so far. In this paper an evaluation of relative technical efficiency (as well as its components) of domestic professional electric power and heat & electric power stations is performed by using the DEA method, and of time-dependent changes in their productivity in the years 2000÷2004 - by applying the Malmquist productivity index.

For power industry enterprises effective use of their resources, i.e. increasing technical efficiency level, is of special importance. In the case of the industry sector technological changes and rationalization of internal organization are of a great influence on technical efficiency level.

Technical efficiency and productivity

Technical efficiency determines enterprise capability of achieving maximum level of effects at given inputs or consuming minimum amount of inputs to achieve assumed effects, at a given technology, i.e. structure of production inputs.

Economists are unanimous that the technical efficiency is the most important efficiency component as its level is influenced mainly by technical progress and better use of applied technology.

The reaching of maximum technical efficiency means that from a given combination of resources an enterprise manufactures the maximum possible amount of goods and services, in other words it cannot increase amount of its effects without increasing amount of its inputs or reduce its inputs without reducing its effects, which is unambiguous to the statement that resources are not wasted during production process. And, the technical efficiency measure orientated towards inputs shows to which degree to reduce consumption of inputs without reducing amount of effects, is possible. However the technical efficiency measure orientated towards effects shows by which amount the generated effects can be increased without engaging any greater amount of inputs. The technical efficiency can be assessed independing on prices.

A way of measuring the eneterprise technical efficiency consists in relating an observed level of production at given inputs to their potential level. And, the potential level is determined by limit values, i.e. minimum amount of component inputs (or their combimation) necessary to produce a given amount of effects (or their combination). Distance from the analyzed enterprise production level to the curve which shows relevant limit values is a measure of technical inefficiency. If the point which symbolizes current production of a given enterprise lays on the limit curve then the enterprise is assumed fully efficient; and if the point lays below the curve then the enterprise is considered technically inefficient. The ratio of observed output and potential output at given inputs and definite technological conditions constitutes the efficiency level of the enterprise in question.

The components of total technical efficiency are as follows:

$$TE \equiv PTE \times SE \tag{1}$$

where:

TE - technical efficiency;
PTE - purely technical efficiency;
SE - scale efficiency;
TE, PTE and SE - take values from the interval <0÷1>.

The purely technical efficiency is the part of technical efficiency, which cannot be considered as that caused by deviations from the most favourable scale of enterprise activity.

The enterprise productivity is the ratio of quantity or value of one or several categories of the effects generated to a certain quantity or value of one or several caregories of the inputs by means of which the effects have been obtained.

Description of Data Envelopment Analysis (DEA) method

The DEA method is aimed at measuring efficiency of a certain number of enterprises. Entities belonging to a considered group are compared to each other. The DEA method finds the best entities and shows to which degree others are inefficient as compared with those fully efficient.

The investigations presented in [2], [4] have formed a background to relative efficiency evaluation.Their authors have introduced the Data Envelopment Analysis method which consitutes operational research methodology based on linear programming technique and aimed at measuring relative efficiency of the decision making unit (DMU) when it is difficult to compare general efficiency measures in situation of many kinds of component inputs and effects.

The DEA method belongs to non-parametric ones. Hence, in contrast to the parametric methods, it does not necessitates a functional relation between inputs and effects to be determined, neglects inflation influence on results, does not make taking into account prices of production factors in technical efficiency calculations, necessary. The Efficiency Measurement System (EMS), version 1.3, a special computer software (elaborated by Universität Dortmund, Germany, and kindly released for scientific use) was used to perform the technical efficiency analysis for the industrial sector in question. This paper presents the technical efficiency analysis based on DEA measures orientated towards inputs, which show how far it can be reduced without worsening the effects. The DEA model orientated towards inputs, written as a linear programming problem, is of the following form:

$$\min\left\{\Theta \middle| \left(\Theta X^k, Y^k\right) \in T\right\} \qquad (2)$$

In the model, T stands for the set of production capabilities, defined on the basis of available empirical data about n objects; X^k, Y^k -vector of k-th entity inputs and effects, respectively. The parametr Θ determines technical efficiency level of a given object and simultaneously informs which perentage of inputs would suffice to be kept in the enterprise to obtain present effects in the case of using the technology implemented in the enterprises deemed efficient. Solving the above mention problem consists in finding minimum value of Θ. The value of Θ for the most efficient objects is equal to 1, for the remaining ones the value is adequate to the efficiency level achieved by them and is smaller than 1.

In calculating the efficiency a kind of economic scale can be assumed, namely it used to be assumed that either constant scale effects or variable ones occur. Depending on that, different results as to different kinds of efficiency, can be obtained. Let's attribute the following symbols to the different efficiency measures depending on an assumed kind of economic scale:

- M_CRS - stands for the efficiency measure in the case of constant scale effects;
- M_VRS - stands for the efficiency measure in the case of variable scale effects.

If the measures differ from each other then one will be able to conclude as to occurrence of scale effects in a considered sector. It can be assessed by means of the following measure:

$$E\_S\_VRS = M\_CRS / M\_VRS \qquad (3)$$

If it yields a value smaller than 1, then the entity in question can be said inefficient with respect to scale.

In this paper comparisons of time-dependent productivity were performed by using the Malmquist index. The index applicable to comparing changes in efficiency has the following form:

$$M_o^G\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = \left[\frac{D_o^t\left(x^{t+1}, y^{t+1}\right)}{D_o^t\left(x^t, y^t\right)} \frac{D_o^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_o^{t+1}\left(x^t, y^t\right)}\right]^{1/2} \qquad (4)$$

where:

$D_o^t\left(x^{t+1}, y^{t+1}\right)$ -the efficiency in the case of making use of t-th year technology for data from (t+1)-th year,

$D_o^t\left(x^t, y^t\right)$ -the entity's efficiency in the period t in the case of making use of the then available technology and data from the period t.

$D_o^{t+1}\left(x^{t+1}, y^{t+1}\right)$ -the entity's efficiency in the period (t+1).

$D_o^{t+1}\left(x^t, y^t\right)$ -the efficiency in the case of making use of (t+1)-th year technology for data from t-th year.

And, the notion of technology is deemed to represent a level of technological development of a given enterprise in a given period. Such approach to the technology makes it possible a.o. to investigate productivity improvement resulting from technological development.

When $M_o^G\left(x^t, y^t, x^{t+1}, y^{t+1}\right)$ is equal to or smaller than 1, then productivity increases, remains constant, or decreases, respectively, in the period (t+1), as compared with that in the period t.

Data and results of the investigations

In this work 39 eneterprises were analyzed for the years 2000÷2001 and 38 for the years 2002÷2004. And, 27 heat & electric power stations and their complexes were analyzed for the years 2000÷2001 and 26 of them for the years 2002÷2004. Also 9 electric power stations and their complexes were analyzed in this work. Three complexes combining electric power stations and heat & electric power stations were taken into consideration as well.

The model's variables were selected on the basis of the literature sources dealing with DEA method application to analyzing technical efficiency in the power industry sector. The model was so formed as to comply with specificity of Polish electric power industry.

In this work for every investigated entity six categories of input data to DEA model were assigned, four of which concerned inputs and two – effects. The input categories taken into account were:

- mean yearly number of employees [number of persons];
- available electric output power [MW];
- available heat output power [MW];
- amount of chemical energy loading contained in fuel, e.g. coal, consumed to produce heat and electric power [TJ].

Amount of sold heat energy, counted in [TJ], and amount of sold electric energy [TJ] appear in the model as the effects.

In this work efficiency measures for the successive years: 2000, 2001, 2002, 2003 and 2004, were calculated. As these authors have been obliged to respect confidentiality of the input data achieved from the enterprises the obtained results were assigned only to symbols of particular enterprises. The example results of estimation of the efficiency measures are given in Tab. 1.

The technical efficiency measures orientated towards inputs inform on which perentage of inputs would be sufficient to produce such amounts of heat and electric energy as to operate as efficiently as the electric power stations which obtained the highest marks. For instance to get 70% measure value in a given year means that to produce the same amount of energy by using 70% of inputs for this aim will be possible if only the enterprise in question uses its resources as efficiently as the best enterprises among the analyzed ones. The productivity analysis is more suitable to present time-dependent changes in results of the sector's operation than the presenting of mean measures of relative efficiency as the latter quantity may increase whereas the productivity may decrease. Apparent improvement expressed in the form of mean relative efficiency tells mainly about degree of differentiation of enterprises with a view of their skill in using inputs to transform it into effects. Whereas changes in productivity shows whether relation of effects to inputs has really increased or not. Diag.1 shows the mean measure of Malmquist index, taken from the measures as well as their components for all the investigated entities in the years 2000÷2004.

Tab. 1. *Technical efficiency measures orientated towards inputs obtained by means of DEA model for the years 2000÷2004, at the scale effects assumed constant (M_CRS)*

Symbol of entity	Year 2000	2001	2002	2003	2004
F1	100,00%	100,00%	100,00%	96,79%	100,00%
F2	91,62%	87,60%	92,86%	92,76%	95,39%
F3	95,50%	84,66%	79,88%	74,23%	73,81%
F4	83,77%	81,11%	76,28%	71,74%	70,77%
F5	100,00%	100,00%	100,00%	100,00%	100,00%
F6	82,66%	77,50%	76,02%	73,84%	72,96%
F7	100,00%	100,00%	100,00%	100,00%	100,00%
F8	100,00%	100,00%	100,00%	100,00%	100,00%
F9	98,25%	90,21%	94,79%	90,87%	92,50%
F10	91,80%	88,39%	90,46%	81,28%	87,18%
F11	100,00%	100,00%	100,00%	100,00%	100,00%
F12	83,32%	95,64%	100,00%	97,01%	100,00%
F13	100,00%	100,00%	97,64%	100,00%	100,00%
F14	86,06%	80,82%	87,03%	100,00%	100,00%
F15	100,00%	100,00%	100,00%	100,00%	100,00%
F16	100,00%	100,00%	100,00%	100,00%	100,00%
F17	100,00%	92,21%	91,82%	88,58%	90,64%
F18	85,49%	87,87%	84,97%	89,27%	86,64%
F19	89,60%	91,34%	93,13%	90,52%	90,33%
F20	65,58%	67,36%	71,89%	78,10%	69,10%
F21	96,28%	93,24%	89,78%	96,21%	94,85%
F22	100,00%	100,00%	99,98%	99,89%	100,00%
F23	62,45%	65,34%	67,58%	60,99%	63,82%
F24	100,00%	100,00%	100,00%	100,00%	100,00%
F25	96,95%	97,15%	100,00%	100,00%	100,00%
F26	81,74%	81,62%	83,47%	93,29%	97,95%
F27	98,85%	97,93%	89,32%	86,56%	88,17%
F28	100,00%	100,00%	89,37%	85,29%	83,30%
F29	70,78%	73,70%	76,44%	82,48%	93,09%
F30	100,00%	100,00%	95,47%	100,00%	100,00%
F31	84,02%	91,42%	100,00%	100,00%	100,00%
F32	50,69%	65,80%	65,52%	73,74%	81,13%
F33	98,86%	81,55%	54,96%	69,75%	70,17%
F34	57,30%	59,47%	100,00%	100,00%	100,00%
F35	100,00%	100,00%	76,36%	78,21%	80,11%
F36	74,87%	79,50%	72,77%	57,95%	68,57%
F37	72,79%	74,32%	76,98%	100,00%	100,00%
F38	76,13%	71,13%	81,53%	73,48%	74,04%
F39	83,28%	83,71%			

The performed analysis of Malmquist index shows that the high productivity level for the year 2001 has resulted from the large amount of heat energy sold in this period, that can be explained a.o. by different atmospheric conditions, namely low temperature values. And, for the years 2002÷2003 the low level of the index (abt. 0,6%) resulting from economy slowing-down, can be observed. In the year 2004 the productivity increase is greater than in the preceding years. And, changes in relative technical efficiency, as well as technological progress resulting from technological changes in the subsector of electric power generation, have been to a similar extent responsible for the increase. The technological progress, a component of the productivity index, results in that the limit line

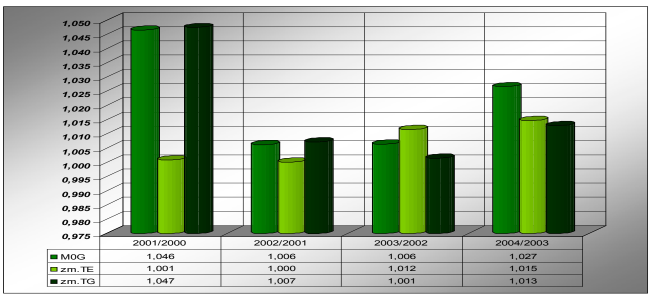

Fig. 1. *Mean measures of the Malmquist index (M0G) and its components: the relative efficiency (zm. TE) as well as the technological progress (zm. TG), observed in the professional heat & electric power and electric power stations for the years 2000÷2004.*

of the set of production capabilities moves upward in the diagram. It tells about changes in general tendencies for the investigated group of entities. The mean yearly increase of productivity of the investigated professional thermal electric power and heat & power stations installed in Poland in the years 2000÷2004, was equal to 2,1%. For comparison, in China the mean productivity increase for the years 1995÷2000, measured by TFP index, amounted also to 2,1%, whereas in Australia was equal on average to 1,6% for the years 1981÷1991.

The observed mean yearly increase, on 2,1% level, of productivity of the investigated power industry enterprises was mainly caused by technological progress. The productivity increase of the domestic power industry sector resulted from employment rationalization as well as modernization of permanent assets, and installation of modern devices in electric power and heat & electric power stations. As a result, higher efficiency of their equipment, manifested by lower specific fuel consumption for power generation, was obtained.

In the investigated period the productivity increase was also influenced, apart from atmospheric conditions and economy trends, by other factors such as political decisions as to rebuilding and modernizing the power sources installed in this country, as well as multi-year continuation of the long-term contract system not including any requirements as to introducing improvements to the power industry enterprises, that could not be conductive to taking care of increasing energy generation efficiency in the enterprises.

Apart from the general changes in productivity of the sector in question also impact of internal factors on efficiency and time-dependent changes in productivity were analyzed for the investigated group of enterprises. The factors selected for the analysis were as follows: scale of enterprise activity, form of ownership, as well as type of carried-out activity. Verification of impact of scale factor on activity results shows whether the making use of a greater scale of activity by power generation enterprise does allow to achieve inputs savings and this way higher efficiency measures. The influence analysis of ownership form verifies the opinion whether private power industry enterprises are more efficient and faster developing than the state ones. And, the activity type factor, i.e. differentiation of enterprises with a view of prevailing share of either heat power or electric power production in a given enterprise, reveals differences in specificity of activity of the enterprises.

In order to analyze impact of size of the considered enterprises on their efficiency, and of changes in their productivity they have been split into three groups: those of the total available heat and electric power: below 500 MW, between 500 and 1500 MW, and over 1500 MW. Mean values of particular efficiency categories were then calculated and time-dependent changes in productivity for the particular groups were evaluated (see Tab. 2 and Tab. 3). As results from the analyses the enterprises of the total available power below 500 MW have achieved the lowest scale efficiency measures in the particular years, however the mean measure of their scale efficiency has increased in the years 2000÷2004. For the entities the scale efficiency constitutes an important element of the total technical efficiency, and the efficiency limit line in the case of assuming changeable scale effects, is the most distant from that in the case of constant scale effects. The group forms the main source of scale inefficiency

Tab. 2. *Technical efficiency versus size of power industry enterprise, measured by its total available output power.*

Year	Enterprises of total available heat & electric output power of	M_CRS	M_VRS	E_S_VRS
2000	below 500 MW	80,90%	92,27%	87,46%
	500 MW÷1500 MW	91,65%	92,51%	99,02%
	over 1500 MW	96,80%	97,49%	99,25%
2001	below 500 MW	83,34%	92,06%	90,50%
	500 MW÷1500 MW	87,27%	88,33%	98,76%
	over 1500 MW	95,25%	97,52%	97,65%
2002	below 500 MW	83,64%	91,27%	91,75%
	500 MW÷1500 MW	87,65%	88,21%	99,31%
	over 1500 MW	94,55%	97,15%	97,28%
2003	below 500 MW	88,92%	92,16%	96,52%
	500 MW÷1500 MW	85,29%	85,82%	99,35%
	over 1500 MW	91,73%	94,04%	97,54%
2004	below 500 MW	90,13%	92,62%	97,37%
	500 MW÷1500 MW	86,82%	87,44%	99,24%
	over 1500 MW	92,40%	94,63%	97,63%

Tab. 3. *Productivity versus size of power industry enterprise, measured by its total available output power.*

Year	Enterprises of total available heat & electric output power of	Malmquist index M_0G	Relative efficiency (zm. T^E)	Technological Progress (zm. T^G)
2001/2000	below 500 MW	107,19%	103,83%	103,31%
	500 MW ÷1500 MW	101,68%	95,43%	106,77%
	over 1500 MW	103,37%	98,40%	105,20%
2002/2001	below 500 MW	99,71%	101,67%	98,12%
	500 MW ÷1500 MW	101,07%	98,13%	103,10%
	over 1500 MW	101,42%	99,27%	102,27%
2003/2002	below 500 MW	100,60%	107,15%	94,47%
	500 MW ÷1500 MW	101,76%	96,81%	105,65%
	over 1500 MW	99,89%	96,78%	103,31%
2004/2003	below 500 MW	103,52%	101,52%	102,07%
	500 MW ÷1500 MW	102,41%	102,38%	100,31%
	over 1500 MW	101,78%	100,77%	100,99%

Tab. 4. *Technical efficiency versus form of ownership of power generation enterprise*

Year	Category of enterprise	M_CRS	M_VRS	E_S_VRS
2000	Polish private enterprises	92,01%	100,00%	92,01%
	Polish state enterprises	87,49%	93,20%	93,65%
	Foreign enterprises	100,00%	100,00%	100,00%
2001	Polish private enterprises	88,61%	92,84%	95,20%
	Polish state enterprises	86,90%	92,37%	94,09%
	Foreign enterprises	98,05%	98,25%	99,78%
2002	Polish private enterprises	88,76%	91,70%	96,53%
	Polish state enterprises	87,43%	92,52%	94,55%
	Foreign enterprises	92,00%	93,42%	98,51%
2003	Polish private enterprises	92,70%	92,75%	99,93%
	Polish state enterprises	87,95%	90,95%	96,76%
	Foreign enterprises	90,90%	91,83%	98,99%
2004	Polish private enterprises	92,28%	92,58%	99,57%
	Polish state enterprises	88,95%	91,63%	97,14%
	Foreign enterprises	92,07%	92,96%	99,08%

***Tab. 5.** Productivity versus form of ownership of power generation enterprise*

Year	Category of enterprise	Malmquist index M_0G	Relative efficiency (zm. T^E)	Technological Progress (zm. T^G)
2000	Polish private enterprises	107,94%	104,41%	103,30%
	Polish state enterprises	104,81%	100,06%	104,95%
	Foreign enterprises	100,59%	97,40%	103,29%
2001	Polish private enterprises	102,25%	103,86%	98,42%
	Polish state enterprises	97,06%	96,62%	97,31%
	Foreign enterprises	101,54%	98,70%	103,10%
2002	Polish private enterprises	103,09%	105,32%	97,99%
	Polish state enterprises	100,13%	101,50%	99,48%
	Foreign enterprises	101,18%	97,42%	103,91%
2003	Polish private enterprises	98,35%	96,16%	102,41%
	Polish state enterprises	103,66%	101,95%	101,76%
	Foreign enterprises	101,22%	101,84%	99,53%
2004	Polish private enterprises	92,28%	92,58%	99,57%
	Polish state enterprises	88,95%	91,63%	97,14%
	Foreign enterprises	92,07%	92,96%	99,08%

for the years 2000÷2002. And, almost in the whole investigation period, i.e. in the years 2001÷2004, their technical efficiency, in the case of assuming changeable scale effects, is higher than that of the enterprises of the output between 500 and 1500 MW, and lower than that of the enterprises of over 1500 MW output. The enterprises of the total available power between 500 and 1500 MW are characterised, almost during the whole investigation period, by the lowest technical efficiency measures in the case of assuming changeable scale effects, however they achieve the highest scale efficiency measures. The enterprises of the total available power of over 1500 MW are the most efficient group as their technical efficiency at scale effects assumed constant, as well as its main component, i.e. technical efficiency at scale effects assumed changeable, have achieved the highest values in the whole investigation period. As results from the analysis of Malmquist indices, the improvement of productivity has resulted from activity rationalization by means of increasing the relative efficiency of electric power and heat & electric power stations of the total available power below 500 MW, as well as due to significant technological progress obtained by the entities of the power output greater than 500 MW. To compare efficiency and time-dependent productivity changes in function of ownership forms the enterprises were divided into relevant groups. To this end Polish private enterprises, state enterprises and foreign ones were distinguished. On the basis of the results presented in Tab. 4 it can be stated that in the years 2000÷2004 Polish private enetrprises as well as foreign ones achieved on average higher measures of technical and scale efficiency. Generally the state-owned entities obtained lower estimates in particular categories of efficiency. However disproportions between the state and foreign enterprises were decreasing in the investigated period. As results from the analysis of productivity indices (see Tab. 5) the productivity of Polish private enterprises was increasing a little faster, and that of the state-owned and foreign ones – a little slower. The higher technical efficiency measures achieved by

***Tab. 6.** Technical efficiency versus type of activity carried out by enterpriseenterprise*

Year	Category of enterprise	M_CRS	M_VRS	E_S_VRS
2000	Heat & electric power stations and their complexes	86,36%	93,81%	91,79%
	Electric power stations and their complexes	95,16%	95,71%	99,39%
	Complexes of electric power stations and heat & electric power stations	90,13%	91,47%	98,49%
2001	Heat & electric power stations and their complexes	86,94%	92,76%	93,65%
	Electric power stations and their complexes	93,02%	95,25%	97,68%
	Complexes of electric power stations and heat & electric power stations	85,32%	88,74%	96,35%
2002	Heat & electric power stations and their complexes	87,10%	91,98%	94,71%
	Electric power stations and their complexes	93,06%	95,02%	97,96%
	Complexes of electric power stations and heat & electric power stations	84,76%	90,19%	94,14%
2003	Heat & electric power stations and their complexes	89,53%	91,57%	97,81%
	Electric power stations and their complexes	90,50%	91,68%	98,68%
	Complexes of electric power stations and heat & electric power stations	80,16%	87,82%	91,79%
2004	Heat & electric power stations and their complexes	90,69%	92,26%	98,34%
	Electric power stations and their complexes	91,49%	92,67%	98,70%
	Complexes of electric power stations and heat & electric power stations	81,08%	88,79%	91,71%

***Tab. 7.** Productivity versus type of activity carried out by enterprise*

Year	Group of enterprises	Malmquist index M_0G	Relative efficiency (zm. T^E)	Technological Progress (zm. T^G)
2001/2000	Heat & electric power stations and their complexes	105,01%	101,47%	103,64%
	Electric power stations and their complexes	103,48%	97,63%	106,09%
	Complexes of electric power stations and heat & electric power stations	104,85%	94,93%	110,54%
2002/2001	Heat & electric power stations and their complexes	99,72%	100,12%	99,73%
	Electric power stations and their complexes	102,59%	99,95%	102,69%
	Complexes of electric power stations and heat & electric power stations	102,46%	99,25%	103,36%
2003/2002	Heat & electric power stations and their complexes	100,80%	103,35%	98,31%
	Electric power stations and their complexes	100,57%	97,08%	103,66%
	Complexes of electric power stations and heat & electric power stations	99,34%	94,31%	105,51%
2004/2003	Heat & electric power stations and their complexes	102,89%	101,65%	101,38%
	Electric power stations and their complexes	101,93%	101,09%	100,81%
	Complexes of electric power stations and heat & electric power stations	102,91%	101,01%	101,86%

Polish private and foreign entities could result from the fact that privatization was mainly focused on the enterprises of good or average financial situation hence they had better production potential right from the beginning. The below presented conclusions were drawn as a result of the performed comparison of the efficiency and changes in productvity of the electric power stations and their complexes and those of the heat & electric power stations and their complexes, i.e. impact analysis of type of carried-out activity on effects (see Tab. 6 and Tab. 7): In the investigation period of 2000÷2004 the mean measures of technical efficiency as well as scale efficiency for the group „electric power stations and their complexes" were higher than those for the group „ heat & electric power stations and their complexes". However the superiority was decreasing along with time in the period in question. The superiority of the electric power stations could result from an advantage they take from large-scale production. The decreasing disproportions could result from growing importance of co-generation.

Summary

The occurring economy transformations, energy marketisation as well as ownership transformations of power industry enterprises have resulted in that power producers more and more attention have focused on the category of efficiency and its measurement. The improving of efficiency of the entities is very important for their functioning in conditions of power market consolidation and liberalization. Technical efficiency, an important element of economic efficiency, is decisive to the future of domestic professional thermal electric power stations. The performed verification of impact of various factors on the effects obtained by power producers provides us with interesting conclusions as to influence of privatization, scale of activity, type of carried-out activity on chvanges occurring in the sector. This work verifies to some extent common opinions dealing with influence of selling-up power generation enterprises to domestic private and foreign entities.

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