POWER QUALITY, ENERGY EFFICIENCY AND THE PERFORMANCE IN ELECTRICITY DISTRIBUTION AND SUPPLY COMPANIES

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INTRODUCTION

Improving the Power Quality and the Energy Efficiency are the strategic goals of the Electricity Distribution and Supply Company – ELECTRICA. In Romania, there are eight subsidiaries as a regional part of the mother company – ELECTRICA. Each of the subsidiaries has about one-milion electricity customers.

Generally speaking, Power Quality has an important influence on the market shares of the company (in deregulated market) and Energy Efficiency has an influence on the profitability of the company.

There is an important relationship between Power Quality and Energy Efficiency, and both have an important influence on the Performance of the ELECTRICA Company. All of these concepts are important in perspective of total liberalisation of the electricity market in 2007 and in the privatisation process – in progress in Romanian Electricity sector.

The paper combines technical aspects with managerial aspects of utility.

Increasing of the efficiency of the activities represents a strategic option for each company. In the general context, efficiency can be appreciated by using of global indices, which mainly refer to economic aspects of the company (specific costs, income per unit sale) or to marketing aspects of the firm (quality of service or product, market share of the company).

The Romanian Electricity and Heat Regulatory Authority (ANRE) have elaborated rules in electricity distribution and supply activities regarding power quality and the quality of services for electricity customers [1].

THE RELATIONSHIP BETWEEN ENERGY EFFICIENCY AND POWER QUALITY

Between energy efficiency and power quality there is a strong relationship. Both act in client’s benefits and bring competitive advantages to the company; energy efficiency creates a cost advantage and power quality creates differentiation advantages of electricity distribution services.

Based on the comparison criteria presented in Appendix 1, Table 1, we can observe similar interests of partners: the electricity customer, distributor and regulator to act in these two important directions – improvement of the energy efficiency and improvement of the power quality.

Underquality can determine inefficiency

It is known that the perturbations in distribution system can be caused by:

1. Electricity Distributor. These perturbations can be:
   - Frequency deviations;
   - Voltage deviations (swells, sags, interruptions);
   - Transients;
   - Overvoltage.

2. Electricity Customer. These perturbations can be:
   - Harmonics;
   - Unbalance;
   - Rapid fluctuations;
   - Flicker.

The compatibility levels of perturbation are included in specific standards. One of the most important standard regarding the quality of services is EN 50160. Based on this, in Romania [2] and [3] operate.

Interruptions represent one of the most important categories of perturbations, based on their effects generated to customers.

Energy efficiency implies, in most cases, the operation in optimum regime of electrical equipment. In the same time, perturbations determine increase of losses, higher heating of conductors, motors, restart of the production process and so one. Interruptions determine restart of the motors, with higher current and finally reducing of life of motors. In fact, underquality determines inefficiency.

Energy Efficiency can determine underquality

Generally speaking, most of new technologies that lead to obtaining the increase of energy efficiency, have a negative influence on power quality, through using power electronic components. The electric device manufacturers must do a balance scorecard between the cost of reducing the emissivity level and the cost of increasing the immunity level of the device. Obviously, the costs are supported by who generates the perturbation.

The Romanian legislation was aligned to the European legislation regarding electromagnetic compatibility of electric devices [4].

According to EN 50160 Standard and Romanian version, a Power Quality Monitoring System (PQMS) is developing in one of subsidiary. This system monitors power quality indices at the common coupling points between electricity
Based on the results obtained from this Pilot Project on a year power quality monitoring period of time, we can appreciate the following aspects (from EN 50160 Summary Report of PQMS):

- No incidents in Power Frequency;
- No incidents regarding to Harmonic Voltage out of the admissible limits;
- 5 events (in five days) regarding Voltage Unbalance. That means over 95% operation within the admissible limits;
- 7 events regarding Short and long interruptions. That means over 95% operations within the admissible limits;
- No incidents regarding Supply Voltage Magnitude;
- Transients, Sags and Swells recorded and presented in Power Quality Report (Appendix 2) include 7 more severe comparative with other (Incidents are sorted by severity).

For interruptions, indices in-use are: number of events, duration of events and severity of events. Establishing the points of monitoring and type of monitoring (permanent or periodical) depends on many factors. It is an important aspect of the strategy of Electricity Distribution Company.

EFFICIENCY AND QUALITY CAN DETERMINE THE COMPANY’ S PERFORMANCE

The training of electricity suppliers and customers regarding energy efficiency and the relationship with power quality represent important options in efficiency of activities. It is known that these aspects increase motivation of employees in their work and finally will determine increase of the performance of the company. These aspects are approached from both points of view: of electricity customer, and of electricity supplier.

Efficiency can be obtained both through using modern technologies, and through “effectiveness” activities in production/services processes. Changing of structure, reorganising and restructuring of the processes and activities lead to the necessity of two steps:

1. Obtaining effectiveness (achieving organisational objectives)
2. Getting efficiency (obtaining maximum output from a given level of resources. The following expression is used: obtaining wanted output using minimum input of resources).

The reversing order or bringing together in one single step, Can lead in many cases to failure. The approach of the strategies in two steps has high influence in getting of the company performance. Besides these two terms the third term is used – Economy (obtaining appropriate resources at minimum cost). These concepts are known as “The Three E’s”: Effectiveness, Efficiency and Economy [6].

We cannot discuss about efficiency without discussing about the Pareto Rule (80% outcomes using 20 % effort). This concept is connected to establishing the priority of our actions.

All of these managerial concepts are applicable in electricity distribution and supply field, too. In this time, when liberalisation of electricity market is applied, and in perspective of a full liberalisation in 2007, according of European Directive 54/2003, and the actions of electricity distribution companies for increasing the energy efficiency and increasing the power quality are very important. Thus the Figure 3 (Appendix 1) presents, The Lawson Matrix show the relationship between “left side actions” for improving quality (and customer satisfaction) and “right side actions” for improving of efficiency. The improvement of efficiency lead to improvement of financial indices of company and finally to obtaining firm’s objectives. The improvement of the customer’s satisfaction lead to maintaining the market share and finally to obtaining company’s objectives.

The improvement of the efficiency of activities and quality of services in electricity distribution / supply field, can be obtained through the education and training of the employees, changes of attitude, mentality and behaviour of the employees of electricity companies. In the same time it
is possible to discuss about the education and training, changes of mentality and attitude of the electricity customer. These presented above show a strong relationship between energy efficiency and power quality. Changes in mentality, attitude and behaviour of employees lead to the improvement of the performance of the company. Practically, these three concepts can be considered to a strong relationship among them. In both cases, the actions for increasing the energy efficiency and power quality must be:

- **Transparent.** It is necessary to establish by neutral body (the regulator is neutral).
- **To encourage operation in this state.** Different incentives and leverages are used (example: adaptive price).
- **To discourage operation with poor efficiency and quality.** Using penalties as leverage for this objective.
- **To be easy to apply.**

![The Company PERFORMANCE](image)

**Figure 4** Relationships among Energy Efficiency, Power Quality and The Performance of Distribution Company

Based on the requirements of European Directive 54/2003, two important directions can be underlined [7]: **Unbundling** of Distribution System Operator (DSO) between distribution and supply activities lead to increase the efficiency of each activity. **Quality of supply** is an important factor for switching the supplier by customer.

The role of regulator in Electricity Distribution Sector is very important. The Regulator can determine improvement of the **quality of services**. Through the standard of performance in distribution activity, it maintains the pressure on the DSO for improvement of PO indices. In the same time, The Regulator can determine improvement of energy efficiency through taking into account of the cost of distributor in adopted model. In a liberalised electricity market, high quality of services is a solution for retaining old customers and price-down, based on the efficiency, is a solution for winning new customers. In these actions of an electricity distribution company, it is necessary to maintain a balance scorecard between the actions for price reduction and the actions for improving the quality of services.

**CONCLUSIONS**

Increasing the energy efficiency, power quality and the company performance can be realized through the strategies and policies for medium and long term that mainly imply:

1. **Education and training of company employees** for efficiency and quality, generally, and energy efficiency and power quality (and quality of services) particularly. We can speak about organisational culture for quality and efficiency. The preparation of future specialists for efficiency and quality begin in universities, including technical, market and economical aspects.
2. **The Management of energy efficiency and power quality** must have a **systemic and systematic approach.**
   - **Systemic:** The approach must be done together for both energy efficiency and power quality, because these have reciprocal influence.
   - **Systematic:** Both of them can be improved through long-term actions, permanent or periodic monitoring, and diagnostic and correction actions. The distribution companies must follow long-term strategies, including more steps.
3. **We must do the monitoring the energy efficiency and power quality**
4. **We must do not forget “The Three E’s: Effectiveness, Efficiency and Economy”**

**REFERENCES**


Table 1. Comparison Criteria between Energy Efficiency and Power Quality

<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>Power Quality</th>
<th>Energy Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Does it act in client’s benefits?</td>
<td>Yes – better service</td>
<td>Yes – lower cost</td>
</tr>
<tr>
<td>2.</td>
<td>Is it wanted by the supplier/distributor?</td>
<td>Yes – lower number of claims</td>
<td>Yes – tight control of the costs</td>
</tr>
<tr>
<td>3.</td>
<td>Does the regulator want it?</td>
<td>Yes – increasing customer</td>
<td>Yes – tight control of the costs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>satisfaction</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Does it lead to improvement of the company performance?</td>
<td>Yes – increasing customer</td>
<td>Yes – more clients</td>
</tr>
<tr>
<td></td>
<td></td>
<td>satisfaction</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Can it be measured?</td>
<td>Yes – through specific indices</td>
<td>Yes – through specific indices</td>
</tr>
<tr>
<td>6.</td>
<td>Is it a priority for the company?</td>
<td>Yes – define in strategy</td>
<td>Yes – define in strategy</td>
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</tbody>
</table>

Figure 3. Lawson Matrix, 1995 [5]
Appendix 2

Power Quality Summary

| From: | 2003-Jun-01 00:00:00 |
| To:   | 2004-Jun-20 00:00:00 |

Number of Incidents: 11
Incident Interval: 2592000 seconds
Number of disturbances: 1606

Worst Disturbances [1996 CBEMA - ITIC]

<table>
<thead>
<tr>
<th>Incident</th>
<th>Meter</th>
<th>Time</th>
<th>Type</th>
<th>Phase</th>
<th>Duration (s)</th>
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<tbody>
<tr>
<td>Incident 2</td>
<td>Crangasi</td>
<td>2003-Jul-02 08:22:27.518</td>
<td>Sag *Outside Graph Range</td>
<td>V2</td>
<td>1.99E+04</td>
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<td>Cotroceni</td>
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<td>4.61E+02</td>
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<td>Sag *Outside Graph Range</td>
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<td>Incident 1</td>
<td>Cotroceni</td>
<td>2003-Jun-10 16:36:47.000</td>
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<td>5.71E-01</td>
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Statistics

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<tr>
<th>Incident</th>
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Totals | 356 | 324 | 926 |