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Marcin Wierzbiński

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THE MAIN ASPECTS OF ENERGY MANAGEMENT

Summary: In the article the author presents the most important issues regarding energy management. Above all, the most important steps in this kind of management and its consequences are characterized. The author stresses also the increasing importance of energy management in the face of climate change policy and shrinking natural resources.

Key words: energy management, energy effectiveness, CO₂ emission reduction, economic effectiveness.

1. Introduction to energy management

Climate change is a fact whose symptoms we can observe almost every day. Droughts, hurricanes and other weather phenomena are becoming a part of our life causing a lot of damage and changing the way we live all over the world. Climate change is caused by greenhouse gas emissions which are mainly the product of burning fossil fuels like hard and brown coal, natural gas and oil. Greenhouse gases accumulate in the atmosphere and make a contribution to the rise of average air temperature. Our challenge should be not to allow the air temperature to rise by more than 2°C in the future. To meet this target, we have to reduce definitely the consumption of energy, in particular the consumption of fossil fuels.

The reduction of greenhouse gas emissions should be a global challenge. The most important is that every country accepts this challenge and makes its own contribution to reduce greenhouse gas emissions. On the other hand, international community should take into account the stage of development and capabilities of different countries when setting CO₂ emission reduction targets. Otherwise reaching a global compromise on this issue will be very difficult or almost impossible.

The reduction of CO₂ emissions is a global challenge; however, it is realized locally. Each country has its own basis from which it starts reducing CO₂ emissions. Therefore, each country should prepare its own strategy for meeting the targets

concerning CO₂ emissions reduction. In the European Union these strategies should be consistent with the rules imposed by the European Parliament and the European Commission, in particular with the EU ETS, Cogeneration Directive, Energy Efficiency Directive and many others.

Regulations relating to climate change and CO₂ emission reduction in particular are one of the most important drivers of structural change in energy industry. Another driver of this change is also the rising environmental consciousness of societies, in particular in developed countries.

At present, the strategy of the Polish energy industry supported by the government is mainly to fight against tougher and tougher rules regarding CO₂ emissions reduction that are imposed by the European Union. It is justified by the fact that Poland is a developing country and our energy industry is based in 95% on hard or brown coal. At the same time, the capacity installed in the Polish energy industry is obsolete and needs immediate modernization. In such conditions the structural change of the whole sector into a new direction is a great challenge.

To pursue the structural change of the Polish energy industry that would enable us to meet the targets related to CO₂ emission reduction, actions at three levels are needed:

- the governmental level,
- the energy industry level,
- the final consumers' level.

The Polish government prepared a strategy for the energy industry. This strategy is based on four main goals, that is:

- privatization of state-owned companies operating in the energy industry,
- building new capacity including new nuclear plants but also thermal power plants with CCS installations and IGCC installations (integrated gasification combined cycle),
- supporting the development of renewable sources of energy and cogeneration,
- upgrading electricity grids,
- increasing energy effectiveness.

The governmental strategy lacks some very important issues. The most important ones include:

a) The government should facilitate building new renewable capacity (off-shore and on-shore wind farms, small biomass and biogas power plants and others) by simplifying and clarifying the rules of law regarding a building process, connecting new renewable sources of energy to the electricity grid, gaining all necessary permissions. At present, there are a lot of obstacles in terms of the rules of law that make the building process of new capacity in renewable sources of energy very difficult and long-lasting.

b) The government should facilitate not only building large scale renewable sources of energy but also small scale ones. This statement concerns also small scale cogeneration. So far the government has introduced a system based on different

types of electricity certificates of origin supporting development of these kinds of energy sources. There are also European Union funds available for building renewable sources of energy and new cogeneration power plants. However, the problem is that only large scale renewable sources of energy and large cogeneration projects are partially subsidized by means of these funds.

c) The government should introduce a new program supporting the development of small scale renewable sources of energy, like Photo Voltaic (PV), solar panels, small wind turbines. This program should consist in earmarking European and domestic funds on these types of energy sources. What is more, the responsibility for spending these funds should be passed down to the local authorities. Apart from that, electricity distributors should be obliged to prepare special tariffs for households that install small scale renewable sources of energy and pass excess electricity to the grid.

d) At present, the most of renewable electricity in Poland comes from a so-called co-firing process which consists in burning coal with biomass by huge thermal power plants in the same production process. It is the waste of biomass that could be used in different, more environmentally-friendly way. In Poland there are a lot of small coal burning stoves installed in houses across the countryside and also in cities. The biomass could be used in a better way by households in their small stoves and not by large scale thermal power plants. Coal burning stoves installed in houses are not equipped with desulphurization or CCS installations. There is no possibility of installing such devices at homes. Thus, the only way to decrease CO₂ and SO₂ emission coming from small scale coal burning stoves is to change these stoves into biomass ones and to make biomass more competitive fuel in comparison to coal. Biomass price could go down only when co-firing process in huge thermal power plants will be forbidden.

e) Energy effectiveness is called the fifth source of energy. The Polish government is preparing a special law regarding this issue. According to the project of this law, another type of certificate (white certificate) will be introduced and commercialized. This type of certificate will correspond to energy savings gained after doing some investments in energy effectiveness. Owners of white certificates will be able to sell them to electricity, heat or natural gas distributors. Local authorities and public institutions will play the main role in increasing energy effectiveness. This law should be introduced as soon as possible because now local authorities are totally reluctant to do anything that could reduce energy consumption. The problem is that the legislation process lasts too long and now the second bill project is being prepared.

f) In Poland the government does not think about introducing a system supporting production of heat from renewable sources of energy. There are about 70 000 MW_t installed in local district heating systems. Most of them use boilers fired by hard coal. Only 2–3% of total heat produced in such systems comes from natural gas. The percentage of biomass used to produce heat is even smaller. Local

heat producers and distributors are afraid of new requirements regarding CO₂ emission allowances that will come in force after 2012. In contrast to the present system, they will have to buy more and more CO₂ emission allowances at auctions. The large district heating systems should be decentralized in the way that will allow building new small scale cogeneration units (up to 20 MW installed). These cogeneration units should use natural gas or biomass. The special governmental program is needed to support this process.

g) In Poland there is great potential for building small scale biogas power plants. There is also potential for setting up one biogas power plant in every rural community. However, there are many obstacles regarding the rules of law to build such power plants. At the same time, local people protest against building such power plants in the vicinity of their homes. To solve these problems clear rules of law are needed. On the other hand, local people should get special benefits if a biogas power plant is installed near their homes.

h) None of the above propositions will work unless the Polish and other societies are more environmentally conscious. The environmental education beginning in preschool is the best way to make economy and our life less dependent on fossil fuels. If the society pays attention to how much CO₂ was emitted to produce different goods, then greenhouse gas emission could be cut more effectively. Now the environmental consciousness of Polish society is quite low in particular in comparison to northern countries. By the way, many people do not understand why they have to pay more for electricity coming from renewable sources seeing that Poland has a lot of cheap coal (in particular until our electricity producers will have to buy EUA at auctions).

The above propositions that may be introduced in near future and actions taken on by the EU and national governments will change the structure of not only the Polish energy industry but also of many other countries. This is a big revolution that can be compared to the beginning of the Internet era that took place in the 1990s. It can be also compared to the industrial revolution in the 19th century. Companies operating in the energy industry have to take into account these directions that will shape this industry for years to come. Western companies like RWE, EON, EdF, Dalkia and many others include these new directions in their strategies. They try not only to build new renewable sources of energy but also start acting in different business models. For example, they deliver value for customers not only alongside a traditional value chain (from electricity generation through electricity grids to final consumer), but also they offer micro-solutions or services regarding energy efficiency. Some of them start inventing smart grids which will revolutionize the way we use electricity. In many cases they spin off subsidiaries that offer value for customers in different business models.

Energy management is gaining in importance as an occupation in the face of the aforementioned circumstances. It is so also due to the European regulations,

whose aim is to support energy efficiency. Energy management relates also very closely to CO₂ emission reduction because actions aimed at increasing energy efficiency translate into decreasing emission of carbon dioxide.

Energy management can be defined as a comprehensive approach to planning and doing activities and controlling their effects which are aimed at an effective use of energy resources. It comprises of a couple of stages like:

- 1) doing an analysis of a current energy efficiency level,
- 2) identifying potential options of energy efficiency improvements,
- 3) estimating capital expenditures relating to the above options,
- 4) making an analysis of economic effectiveness of energy efficiency improvement options,
- 5) choosing an optimal energy efficiency improvement option,
- 6) introducing a chosen solution aimed at improving energy efficiency,
- 7) measuring effects of undertaken actions,
- 8) making a revision of introduced plan aimed at increasing energy efficiency.

The above steps are a kind of plan, do, check, act methodology. The aim of this article is to present in detail the steps constituting energy management.

2. A detailed approach to energy management

The first stage in the approach to effective energy management is preparing an analysis of a present energy efficiency level. The main aim of this analysis is to assess:

- consumption of energy (electricity, heat, cooling, air compressed and blast furnace in the case of steel mills) in particular stages of a production process,
- a current CO₂ emission level,
- consumption of energy and CO₂ emission in comparison to other comparable competitors on the market or comparable entities (for example, per production unit),
- design of a production process and used technology,
- potential losses of electricity, heat or other media in different stages of a production process,
- competitiveness of current tariffs on electricity, heat and other media,
- current costs of energy supplies in particular stages of a production process, including CO₂ emission allowances,
- other specific issues.

The basis for doing the above analysis is data coming from metering systems. The state and the scope of metering systems are very different in particular companies, local authorities or other entities. Generally, the metering systems installed in companies are much better and technologically advanced than in local authorities. Local authorities overhaul many entities and buildings; they are also responsible for the street lighting. Thus, local authorities oversee a lot of dispersed buildings

and points where electricity, heat and cooling are consumed. In many cases local authorities do not manage the usage of energy properly, and one of the reasons for this situation is that they do not measure energy consumption widely and as a result of that they do not possess a picture of their energy efficiency. As a result, there is a lot to do in terms of metering energy consumption, which should be the first and the most important stage in the process of energy management. One of the reasons for the fact that local authorities and some companies do not care about proper metering energy consumption is that generally electricity and heat is still cheap in Poland and metering systems are quite expensive. However, we can be sure that it will change in near future due to new regulations regarding CO₂ emission allowances that will have to be bought at auctions after 2012.

On the basis of a thorough analysis, it is possible to draw a picture of present energy effectiveness. While doing this analysis, one should identify the opportunities to increase energy efficiency that can be categorized into three groups:

- opportunities that require changing habits and behaviour,
- opportunities that require incurring capital expenditures on IT systems or new devices with which the old ones are replaced,
- opportunities that require a radical change of a technological process.

In many cases a decrease in energy consumption can be obtained by simple changes in present behavior or habits without spending a lot of money on technologically advanced systems. Such opportunities can be identified in companies as well as in public buildings, like authorities' buildings, hospitals, schools etc. For instance, in many schools computers are on for a whole day regardless of being used or not. Instead of using thermostats, one can open windows to reduce temperature in winter. In public offices and companies too much paper for printing e-mails or documents is used – they can be read without doing that. These and other kinds of waste could be eliminated very easily by proper education and convincing people that they can do a lot for the environment in very simple ways. In households there is even greater potential for energy savings that could be obtained by changing people's behavior.

However, in companies, local authorities and other entities the biggest potential for energy savings is linked to activities that require some capital expenditures on new devices, IT systems or better insulation. The array of potential activities aimed at reduction of energy consumption that require some capital expenditures is very broad and embraces among others:

- replacing old devices with new ones that are more energy efficient,
- installing IT systems steering lighting, servers, computers and other devices automatically (for instance, after installing such a system people do not have to think about switching off light, computers, etc.),
- better insulation of buildings,
- installing solar panels to reduce fuel consumption on preparing hot water,

- installing small scale CHPs in buildings like shopping centers, hospitals, universities, office buildings, etc.,
- installing devices (telemetry) uncovering leaks in water and gas pipes,
- designing new buildings that are carbon neutral.

The above initiatives should be taken on not only by final consumers of electricity, heat or water but also by electricity and heat producers or distributors. In Poland there is huge potential for increasing energy efficiency in companies producing heat or electricity and in companies that distribute these products. A lot has been done since 1990. Many heat and electricity producers upgraded its technologies to more efficient and environmentally friendly (investments in new, more efficient boilers, turbines) but most of these technologies still use coal as the primary fuel. At the same time, district heating companies invested in better insulated pipes or HVAC systems.

The great potential of energy savings can be also identified on the side of final consumers of heat and electricity, especially in big industrial companies whose origin is in the communist time. Most of these companies were privatized but not all investors were interested in improvements of energy efficiency, mostly because of still cheap electricity. Presently the attitude to energy efficiency is changing because of a rising electricity price and new incentives created by the European and the domestic law.

In many cases there are a couple of possible ways to increase energy efficiency. For example, one steel mill realized that the blast of wind can be produced by:

- more efficient than present steam turbines operating together with blowers,
- very efficient electric blowers installed closer to a furnace.

Both solutions were more energy efficient than today's technology of blast production that is based on steam turbines which internal efficiency was very low. Then it identified a couple of pros and cons against each option and assessed an aftermath each option using the Value Based Management tools. So, to assess the options the steel mill:

- calculated capital expenditures on each of them,
- calculated all the cost savings related to each of them,
- calculated measures like NPV, IRR, discounted payback period,
- chose a better option from the shareholders' perspective.

As a result of this analysis, the second option was chosen. Electric blowers were:

- more energy efficient,
- less costly in terms of capital expenditures,
- more efficient because of the fact that they allowed avoiding losses of blast while transferring it (electric blowers could be installed very close to blast furnaces contrary to the first option).

On the other hand, the price of electricity used by electric blowers is slightly higher than the unit cost of fuels used in the first option, mainly because of the

necessity to fulfil the obligation for buying certificates of origin relating to green and cogeneration electricity. However, this additional cost did not offset the incremental cost savings.

Analyses like that should be conducted in all cases as far as energy efficiency improvement is considered. In many cases, however, investments aiming at increasing the energy efficiency are not effective from the economic perspective, mainly because of high capital expenditures and a long payback period. This is why the Polish government is going to introduce a special law supporting investments aiming at the improvement of energy efficiency. According to this law, every entity that invests in energy efficiency will get so-called white certificates. The number of granted white certificates will depend on the extent to which energy efficiency is improved. These white certificates will be then traded on power exchange in the same way as today's certificates of origin related to the electricity coming from renewable and cogeneration sources of energy. It will also impose an obligation on electricity traders to buy a certain amount of white certificates that will constitute a percentage of electricity sold to final consumers. This law is going to be introduced by next year. At present, the investments aiming at energy efficiency improvement are supported by the funds coming from the European Union.

Energy management process requires also monitoring the effects after the introduction of new solutions aimed at energy efficiency improvement. The effects should be monitored not only in terms of energy saved but also from the economic perspective. Sometimes the monitoring of effects is required by institutions that supported the investments aimed at increasing energy efficiency. Monitoring of effects is also needed to assess potential, new and more technologically advanced devices that can emerge on the market and allow improving energy efficiency far more than the previously introduced solution. Therefore, energy management requires paying constant attention to potential new solutions aimed at increasing energy efficiency that translates into gaining some financial benefits.

3. Conclusions

Energy management has a couple of dimensions like:

- technical,
- economic,
- environmental
- social.

Energy management is directly linked to technical, economic or environmental dimensions. The primary aim of energy management is to introduce solutions that will allow decreasing energy consumption and gain some cost savings or other financial benefits. This translates very often into decreasing CO₂ emission and

other pollutants. At the same time, energy management has also a social dimension because it improves the quality of life. As people are getting more and more environmentally conscious, more and more companies base their marketing strategies on the so-called green strategies. For instance, the greatest retailers, like Wal-Mart or Tesco, introduced green strategies whose aim is to decrease their negative impact on the environment but also attract more environmentally conscious clients. Therefore, energy management is becoming one of the most important issues in running a business.

PODSTAWOWE ASPEKTY ZARZĄDZANIA ENERGIĄ

Streszczenie: W artykule autor przedstawił najważniejsze zagadnienia dotyczące zarządzania energetycznego. Przede wszystkim zostały scharakteryzowane najważniejsze etapy w tym sposobie zarządzania i ich efekty. Autor zwrócił uwagę na rosnące znaczenie zarządzania energetycznego w kontekście polityki zmian klimatycznych i kurczących się zasobów naturalnych.

Słowa kluczowe: zarządzanie energią, efektywność energetyczna, redukcja emisji CO₂, efektywność ekonomiczna.