NEW VISION OF DSM STRATEGY AS THE MAIN TOOL IN COOPERATION SUPPLIERS AND CONSUMERS OF ELECTRICAL ENERGY

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Summary: The paper presents the complex proposal for the implementation of the demand side management (DSM) in the Polish energy sector. The issue of DSM is well known in the world, European and domestic dimensions. The experience of western countries shows that at least to some extent, the DSM strategy is already implemented there. However, Polish experience is far too insufficient.
DSM consists in efficient management of energy demand as well as adoption of this demand i.e. changing the load. The decrease of energy consumption in the moment of its peak demand leads to the balance between the demand and supply in the system, which influences the market price of energy. If certain mechanisms are implemented that will cause that final receivers will be willing to adjust their demand for energy, we will create the Demand Response (DR), which is an efficient tool in the DSM strategy.
It is assumed that electronic meters will bring a real quality change. The undertakings based on initiatives of the Polish Energy Regulatory Office that promote the concept of implementation of electronic metering in the Polish energy sector prove that Poland is determined to improve its energy efficiency.
The report describes the concept of the electronic meters that enables the realisation of the DSM strategy as well as other complementary solutions that make the strategy even more efficient. In this field, it is planned to establish a dedicated loyalty programmes for energy receivers. The concept includes also the combination of the model solutions with the campaign "energy efficiency" organised by the Ministry of Economy, which aims at fulfilling the requirements of the directive 2006/32/EC on energy end-use efficiency and energy services. As complementarry solution in this new vision to add the system of recycling of waste heat home appiance devices.

Keywords: energy sector, energy efficiency, demand side management, energy tariffs

1. INTRODUCTION

According to the Act on Energy Law, one of the main assumptions to the energy policy of the country is rational usage of fuels and energy, especially by promotion of energy saving contruction [2]. That's why all actions aimed at fulfiling the consitions stipulated in this Act shall be given appropriate attention. It is of utmost importance to present issues that so far has been used in the Polish energy sector only to a limited extent [20, 21,24]. There are large possibilities in the marketing area in conection with energy saving, both by ultimate receivers and energy distributors. In order to prove this thesis, four marketing tools commonly used have been analysed i.e. products offered, prices, distribution channels and promotions. In case of energy distibution company, the product offered is electrical energy. The company shall not only deliver the energy of highest quality – appropriate voltage levels, no interuptions, but also react to the complaints raised by various institutions and media. Ultimate receivers may also inform their distribution company about not met quality standards of energy. Assuring the above mentioned features of energy is connected with the long-term development strategy of a company, where in annual budget adequate resources are designed for investments in the network and the guarantee of uninterupted supply is a key condition of marketing success. The second element is the price of energy. Prices are are not the same for the apropriate groups of receivers in the country, but they do not reflect the incurred real costs of supply and distribution. In case the prices can be set up freely, they will become an important tool in financial policy of energy company. Distribution channels consist of customer service units that already assure partnership between the energy company and its customers. In many companies there are special rooms where energy saving equipment used in households is shown. One can take advantage of the presence of customers in these rooms and apply the marketing tool in the form of acquisition, direct marketing, additional promotions e.g. eqiuipment show especially designed for auditors in order to get their support. The model way of preseting equipment would be to involve the auditors in the

presentation, support in choosing appropriate model for different purposes and requirements. The better it is conducted, the better final results i.e. trust of customers and more energy saving equipment in use[6,11,21]. By organising such activities, the company enters the field of Demand - Side Management (DSM). Such actions, commonly undertaken in the USA, consist in modified alocation of resources on the demand and supply sides. Energy sector instead of investing large resources for development (construction of new power plants, lines and stations), promotes energy saving equipment, which leads to reduced need for energy and consequently new investments are not needed. This way of usage of demand resources leads to the situation that due to reduced costs of development, prices and cosuption of energy can be lowered, which has obvious social and ecological effects [15,21,24].
This area needs significant modernisation and for dozens of reasons will be conducted dynamically. This will enable to see the distrubution companies as units that implement modern solutions, especially the IT ones, that form inteligent network.

2. THE CONCEPT SOLUTION

The concept of implementation of the DSM strategy in Poland, despite relatively large engagement of people from science and economy, did not lead to any visible effects. It seems that improvement in this respect is likely, because according to the Declaration of 3rd June 2009 and Parliamentary permanent subcommision for energy as well as Energy Regulatory Office , there are real chances for implementation of the electronic meters in Poland. According to the author of this report, electroning metering is the basis for implementation of the DSM strategy.There are however the following conditions to be fulfilled in order to make the strategy successful [1,8,10,13,14,20,21].

A. Metering units

The proposed solution, which is an extension of the patent no. P 324050 is the energy meter of the newest generation that:

- is the basis for settlements for energy consumption
- presents information about energy consumption both in qualinity and value
- constitutes an element in discussion with energy supplier, which helps to choose the apporiate tarriff – which is the basis for practical usage of DSM strategy.

The meter consists of the following modules: communication, settlement & analitycal and information & discussion [5]:

Communication module assures bileteral communication: supplier-customer and customer-supplier.

Settlement & analitycal module registers energy consuption and costs of energy supply during the settlement period. The module enables also conversions of energy costs according to different tarriffs.

Information & discussion module made as LCD display and keyboard presents all obligatory information for the customer as well as the following data resulting from the additional options:

- calculation of energy costs according to different tarriffs available for the customer e.g. switch from one-tarriff into two-tarriff system,
- submission of declaration for the change of tarriff,
- submission of declaration for joining the loyalty programme „SMARTEFEKT" and realisation of its options.

Such an electronic meter will make the practical implementation of the DSM strategy in Poland possible. The beneficieries of this solution will be both the supplier and the receiver of energy. It should also be mentioned that such actions will play significant role in achieving the energy targets of the EU.

B. Loyalty programme SMARTEFEKT is a set of actions undertaken by the producer aimed at linking the consumer with the brand for a long time. In view of the above, it can be assumed that loyalty programmes implemented in Poland are in fact points programmes. The distinction between these programmes, although justified by different targets, is not made and in practice the terms loyalty

and points programmes are treated interchangeably. The appropriateness of this issue is proved by the fact that already over 30% of Polish people take part in the loyalty programmes of petrol concerns, hypermarkets or mobile networks. According to the research of ARC Rynek i Opinia Institute, during the last two years, the number of participants in loyalty programmes doubled. Experts of the Instiute forecast that there will be a few network loyalty programmes in the market soon i.e. programmes where one can take advantage of the services offered by different companies. Participants will be entitled not only to the rewards offered by the company that organized the programme, but also to discounts to products of other companies [16,20,21]..

The participant of a typical point programmes by entering fills in the questionnaire and gets a plastic card. In exchange for making payments, he/she gets points that are registered on the card. As soon as he/she collects appropriate number of points, he/she gets the possibility to receive a reward. Rewards in hypermarkets or petrol network programmes are quite attractive, but in order to qualify, one has to spend considerable amount of money compared to the value of the reward.

The works over implementation of a loyalty programme must be preceeded by the concept works that set the programme's objectives and its mechanism. The objectives in case of energy seller can be described as follows:

- making relationship between the seller and the customer (building loyalty),
- promotion of payments in time,
- promotion of payment settlements at certain dates and time,
- promotion of payment settlements in certain form.

The described objectives are not typical for points programmes. Mostly, such programmes have the aim to increase the frequency and the value of purchases made by the consumer. The appropriate strategy of the programme may significantly and permanently increase sales. Moreover, appropriate programme may reduce the costs of other forms of promotion and marketing. The basis of the proposed programme constitute points granted for making payments. They are of two categories:

- standard points,
- bonus points (defined by the energy seller).

Standard points are granted in proportion to the value of payment, whereas bonus points are granted only in one, a few or in all locations where the programme is conducted.

Each customer that possesses a programme card will be rewarded with points for making purchases. Points are rewarded in proportion to the value of payment, but the system can have some modifications like: cap for maximum points or minimum value for granting points. The important element of the programme is the list of rewards that the customer can get. According to the research ordered by companies from the south region and made by Pentor with regards to sale of energy, the most important factor for customers is the price of energy and supply i.e. the value of required payment.

In this context, rewards shall constitute discounts for payments received after collection of required number of points. The above described rules of organization of loyalty programmes must be extended with additional elements when the consistent system applying the DSM strategy is to be created.

In this case, electronic meters will send information about customer behavior and through them registration of energy receivers will be done.

The author introduces the energy engagement ratio

(w_{zei}), defined as follows:

$$w_{zei} = 1 - (w_{ppi} \times w_{eoi}), \tag{1}$$

where: w_{ppi} - the ratio of movement of energy consuption of receiver i, w_{eoi} - the ratio of energy consuption of receiver i.

The first ratio is defined by the formula (2),whereas the second is calculated on the basis of ratios of unit consumption of energy by equipments installed by receiver i compared to all receivers supplied by the distribution company. It is described by the formula (3).

At first, one has to calculate the average unit energy consumption of receiver $e_{zi}^{\ u}$ and $e_{z}^{\ u}$.

$$w_{ppi} = \frac{E_{zIi}}{E_{zIi} + E_{zIIi}}, \tag{2}$$

where: E_{zIIi} - energy consumption in tarriff II by receiver i, E_{zIi} - energy consumption in tarriff I by receiver i.

$$w_{eoi} = \frac{e_{zi}^{\ u}}{e_{z}^{\ u}}, \tag{3}$$

$$e_{zi}^{\ u} = \frac{\sum_{j=1}^{j=m} e_{zji}}{m}, \tag{4}$$

$$e_{z}^{\ u} = \frac{\sum_{i=1}^{i=n} e_{zi}^{\ u}}{n}, \tag{5}$$

where: e_{zji} - unit consumption of equipment j of receiver i, kWh/year, $e_{zi}^{\ u}$ - average unit consumption of receiver i, kWh/year, $e_{z}^{\ u}$ - average unit consumption of equipment of all receivers, kWh/year, m – number of types of equipment under analysis (refrigirator, washing machines, dish washers, ovens), n – number of receivers.

It is expected that receivers having the highest ratios for a calendar year will be rewarded. It can be "free energy" of 100 kWh, 200 kWh or material rewards for receivers that were engaged the most in realisation of the DSM strategy.
The presented DSM strategy is consistent with the programme of Ministry of Economy called "Energy Efficiency" conducted through the information campaigne aimed at rational usage of energy

C. Complimentary actions

The additional action, simultaneously further stimulating the presented strategy shall be the contest under the patronage of the Ministry of Economy with rewards for producers of household appliances that introduced the most efficient equipment to the market.
Such a contest will constitute an extension to the actions already made by the Ministry of Economy aimed at increasing efficiency of the Polish economy.
New proposal in this area is ***System of recycling of waste heat from home appliance devices,*** it show it in the figure 1.
De description of main units of this idea on present below [6,17,21]:

1 - home appliance device requiring warm water, 2 - service wire of cold water, 3 - service wire of heated water, 4 - supplying cold water from water supply system, 5 - supplying cold water to a cold service wire in home appliance device, 6 - supplying cold water to recovery heat exchanger, 7 – recovery heat exchanger containing a coil powered by warm sewers, 8 - final heater (electric or other) heating water up to the required temperature, 9 - spiral or coil powered from other source of heat, 10 – draining of waste water (warm or cold) from the home appliance device, 11- outlet to the sanitary installation, 12 - supplying warm waste water to the coil of the recovery exchanger, 13 – draining of

waste water cooled down in the heat exchanger, 14 - thermometer measuring the temperature of waste water drained from the home appliance device, 15 - thermometer measuring the temperature of fresh water in the recovery heat exchanger, 16 - electronic adjuster, 17 - two-state valve cutting off waste water supply to the coil of recovery heat exchanger, 18 - two-state valve cutting off waste water drain directly to canalization.

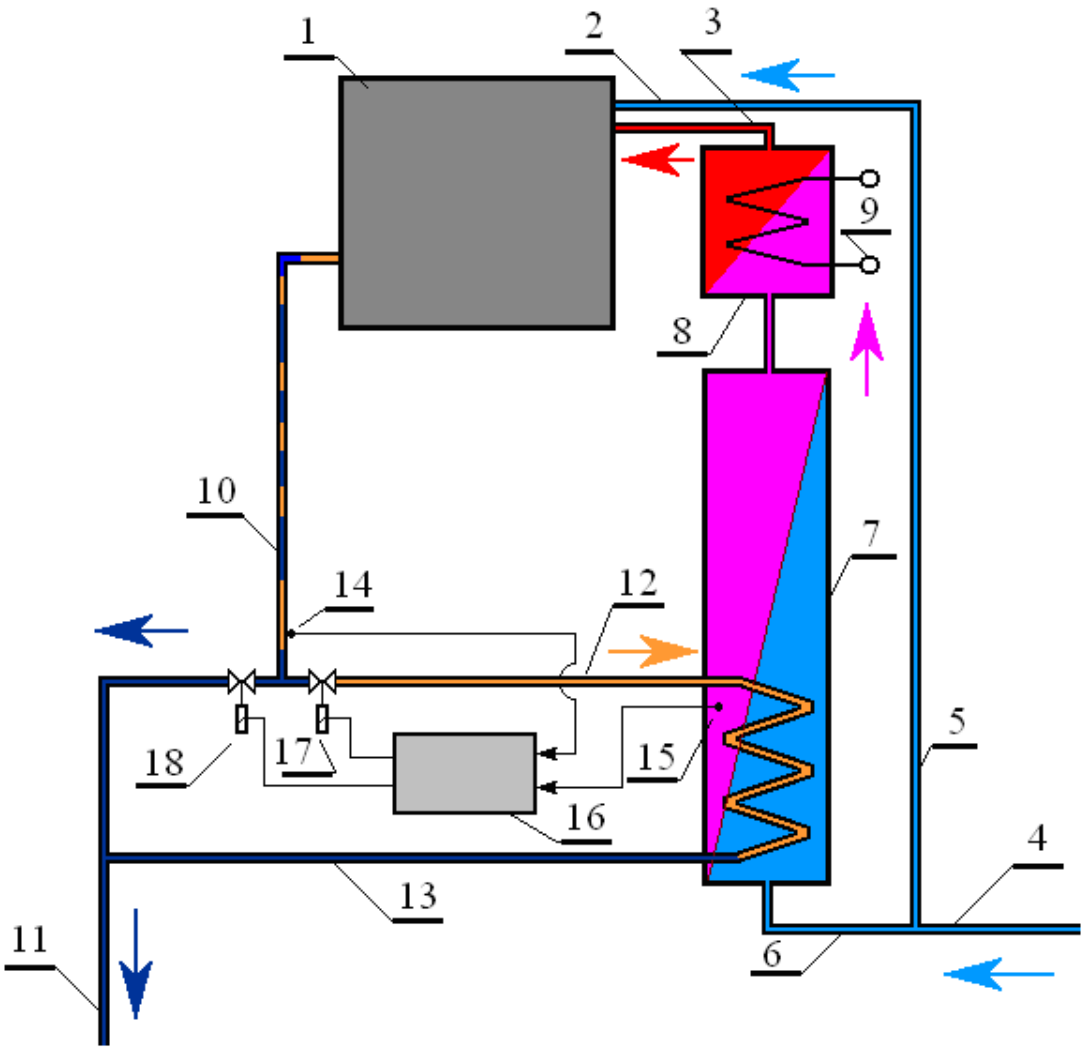

Fig. 1. Scheme of the system exploiting heat contained in warm waste water for heating fresh water to the temperature required by a home appliance device

Description of the system

The system of recycling of heat is intended for any home appliance device requiring constant or cyclical water heating inside this device or supplying water heated outside (e.g. intensively used washing machine, dishwasher, shower cubicle etc.). The system can also be integrated with the solar water heating system as the first degree of heating cold water taken from the water supply system.
Cold water taken up from the water supply system with the temperature ca. 10 ^{o}C is taken to thermally separated low-temperature recovery heat exchanger 7 of a great capacity having also a function of heat accumulator and there it can be initially heated with the waste heat included in warm waste water drained from a home appliance device with wire 10.

If the temperature of warm waste water in interceptor 10 is higher than the temperature of initially heated fresh water which can be found in a bottom part of low-temperature exchanger 7 and the temperature of fresh water in this exchanger doesn't exceed the maximum value of a temperature required by processes carried out in the home appliance device, then valve 18 which is normally open closes disabling the drain of warm waste water directly to a sewer system and at the same time normally closed valve 17 opens enabling the inflow of warm waste water with wire 12 to the coil of the low-temperature exchanger. In this exchanger warm waste water gives a considerable part of the waste heat to fresh water which is in an exchanger and then it goes from the coil to a sewer system.
If the temperature of warm waste water is lower than the temperature of fresh water being in a low-temperature exchanger or if the temperature of fresh heated water in the exchanger exceeds the maximum acceptable value, then the flow of warm waste water through the coil of the low-temperature exchanger is inadmissible because this would cause either exaggerated heating, or cooling fresh water which was previously heated and already being in a low-temperature exchanger. Then valve 17 closes disabling the flow of warm waste water through the coil of the exchanger and at the same time valve 18 opens enabling to drain this water directly to a sewer system.
Two-state alternating switching valves 17 and 18 are carried out by appropriately programmed adjuster 16 steered with temperatures of water measured with thermometer 14 installed in wire 10 of warm waste water and with thermometer 15 installed in water space of low-temperature exchanger 7.
When fresh water initially heated in the low-temperature exchanger can not reach the temperature essential to the correct course of the process in a home appliance device, then additional heating of this water in thermally insulated heater (boiler) 8 would be essential. Boiler is electrically powered. Final water heating may be carried out in the heater outside or in the heater being an integral part of home appliance device. Thermostat or an adjuster provide steering of this heater. The adjuster takes into account the course of the temperature required by a home appliance device, such an adjuster usually already is an integral part of a home appliance device and doesn’t have to be synchronized with the adjuster 16 controlling the functioning of the heat recovering system.
To equip home appliance device with this system it is necessary to equip the device in two separate service wires of fresh water 1). Service wire of cold water and 2). Service wire of initially heated (or hot) water enabling supplying of heated water from this wire only when providing the home appliance device with heated water is necessary.
Applying the above mentioned system enabling to regain large amount of waste heat from home appliance devices using warm water and considerably reducing conscription of the energy essential for heating fresh water from outside sources to the temperature essential for appropriate action of home appliance devices.

The analysis of this proposal can be estimated in two the kind of the electric energy saving:

- the natural connected saving with diminished demand on the electrical energy
- the secondary connected saving with diminished losses of the electrical energy in the network low-voltage.

Savings for 30% the salvage of the waste-heat are (per 1 month and 1 average Distribution Company in Poland:

- the primitive saving- 25106 MWh
- the secondary saving- 947 MWh

3. SUMMARY

It should be stressed that at present there are foundations for development of electronic metering that can assure modern customer service, which is in line with interests of both consumers and suppliers and through the concept presented in this report will lead to increased efficiency of the functioning of the energy sector with safe operations , and with synergy effects coming from commonly used DSM strategy.

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