ENERGY PROSUMER OF THE TOFFLER'S THIRD WAVE

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Abstract- In the present paper on the basis of the literature query the Authors introduce the taxonomy of prosumer as a market subject that creates or co-creates values it consumes. The analysis has been conducted in the context of the Toffler's third wave concept - prosumers involved in prosumption activities, expecting not only economic benefits but also social and environmental ones. In this dimension a definition of a prosumer has been introduced, which defines energy prosumers as energy market subjects and prosumer energy connected with the adjustment of products to specific, own energy needs of prosumers, and frequently their close environment. In the empirical part, on the basis of the accepted selection criterion the Authors have aggregated highly relevant determinants that stimulate diffusion of energy prosumers and prosumer energy development. On the basis of the research conducted in the group of the domain experts (purposeful selection), the selected determinants have been summarized according to a five-point scale. These determinants in the context of Toffler's third wave have been determined in four group: economic, technological, environmental and social ones. The link between the taxonomic and empirical parts is an attempt to answer the research question "Does a contemporary energy prosumer fit in the prosumption activities of Toffler's third wave?"

Index Terms- prosumer, Toffler's third wave, energy prosumer, prosumption energy, highly relevant determinants.

I. INTRODUCTION

The term prosumer was introduced by the futurist Alvin Toffler in the year 1980. This concerns a consumer who is involved in co-creation or auto-production as well as consumption of goods and services [19], and promotion of co-created products. A contemporary prosumer is an active client [17], whose activities are not limited barely to purchasing from suppliers but also becomes involved in active relationships with them and wants to be a partner for the producer. Prosumers can be characterized by an extensive knowledge on the products and services created by producers, help to create them, share their knowledge and experience, communicate with the producer and their environment. A.Toffler introduces two categories of prosumers: the first wave ones involved in the prosumption activities and expecting first of all economic benefits and the third wave ones involved in the prosumption activities but expecting not only economic but also social and environmental benefits [20].

It should be stressed here that A. Toffler rejected the traditional concept of a passive consumer, indicating development of an active one, involved in the search for the product that best meets its expectations. In this grasp the prosumer is a specific market subject that carries out production to satisfy own needs. In this understanding production and consumption constitute elements of the same cycle. Value is created when consumers make an effort and attach proper meaning to products they create [7]. Prosumption is a process, not a single act. It consist in integration of physical and mental activeness with social and psychological experience. People who participate in this process engage their money, time, effort and skills expecting particular benefits [12]. According to D. Tapsott and A. Williams in turn prosumption as a process is connected with the desire to possess particular consumer goods in accordance with the own expectations of the co-creator (prosumer). In this view activeness of consumers who adopt prosumer qualities is demonstrated in co-creation of the desired goods [16]. It should be stressed here, in relation to the subject matter of the present article that prosumer activities defined as prosumption basically refer to self-adjustment of products to specific own needs, frequently also the needs of closer surroundings. The consumer becomes a co-producer that plays an active role in production of goods, creating the value, brand and service, frequently being an essential market subject that is socially responsible.

On the basis of the approach presented by A. Toffler another modified concept has been introduced by S. Kirsner where the term "professional prosumer" has been used. According to this definition professional prosumers possess extensive knowledge that lets them participate in a constructive dialogue with the producer. At the same time S. Kirsner emphasizes that two elements, namely producer and consumer should be distinguished in the term prosumer, attributing particular functions to both these elements. Simultaneously he indicates that the term "consumer" refers to the user who possesses an advanced expert knowledge [1]. With reference to the basic subject matter of this paper it should be stresses that the prosumer is open to new technologies and innovations. Bill Quain stresses the fact that the natural environment of value creation by prosumers is the virtual space, in particular social media WEB 2.0, WEB 3.0 or cloud computing [9]. The virtual space has changed a futuristic impression of prosumers to perceiving them in the micro- scale, as a unit that co-creates the consumption value and the macro- scale responsible, among others for GNP growth. In the macro- relation prosumers do not only strengthen the

GNP component through consumption, but are also investors in the scope of new, innovative technologies and products, simultaneously stimulating the demand for new production factors and enriching the goods and services portfolio. Activeness of prosumers can be observed in the virtual space, especially in the social media environment, crowdsourcing and stroturfing business models. An interesting concept of prosumers involved in creation of new values has been introduced by A. Bruns, who, while analyzing the WEB 2.0 communication process, indicated the origin of so called produsagers, that is people who play a hybrid role between the user and producer [2]. Produsagers are creators and at the same time users of content in various internet environments such as: Wikipedia, blogospheres. They do not create products directly but rather their non-material value. Trough sharing their experiences and knowledge with producers they co-create their identity and symbolic value [13].

II. TAXONOMY OF ENERGY PROSUMER AND PROSUMER ENERGY

In accordance with the subject matter of the present article defined in its title the natural area which provides opportunities for prosumers is the electroenergy sector. Energy prosumer is a new term, however, prosumption processes, even if the subjects that implement them are not aware of this fact, have been known and common in the social dimension, which is confirmed by heat production for own needs [8, 9, 10].

Prosumers defined in the present article produce electricity and other secondary and/or final energy (e.g. heat, cold, hydrogen, I and II generation bio-fuels) for their own needs [8].

According to contemporary concepts that reflect the shift in the paradigm in the energy sector the subject of prosumer and the prosumption process itself represent a shift from the large-scale energy based on fossil fuels towards the small-scale one, based on micro- and small installations, prosumer energy [18]. Prosumers create a new integrated dimension, not only technological, organizational and environmental one, but also a social one. In particular, prosumers start production of fuels and polygenerational energy for own needs primarily in Renewable Energy Sources (e.g. production of biomass, bio-fuels, biogas, hydrogen as well as electricity, heat or cold). Thus, energy prosumers change the product-based approach in the scope of satisfying the demand for energy, stimulating the use of the economic energy potential of RES in the given region [17, 18].

Energy prosumers are also defined in the literature of the subject as previous recipients who start production of fuels and energy, in particular electricity, for their own needs [4, 9]. According to the United Nations Industrial Development Organizations they are not only physical persons but also business entities which within supplementary activities produce energy (including electricity) in order to cover the whole or a part of their energy needs on the spot, from renewable energy, with a possibility of selling the surpluses to local networks or local communities [21].

Another interesting definition has been introduced by B. A. Bremdal: "A prosumer is a consumer that becomes resonant with the energy market through systematic action and reactions that aim to increase personal or collective benefits" [1].

Prosumption process in energy in turn is defined as adjustment of products to specific own needs of prosumers, and frequently their close environment. This process is defined as prosumer energy.

Prosumer energy is a transition from products (electricity, heat, transport fuels) bought individually ,as well as from sector (trade) energy producers and suppliers to prosumer value chains, that is energy economy that integrates the demand and supply on the side of the recipient (consumer) - with the use of local energy carriers, in particular RES. Prosumer energy is a synthesis of energy and Smart Grid intelligent management infrastructure [1].

In the opinion of the Authors at present prosumer energy can be equivalent to micro- and mini-installations, which were also defined in the Energy Law of the EU member states (e.g. Poland). A prosumer micro-installation is a renewable energy source of total installed electric capacity not higher than 40 kW, connected to the power network of the nominal voltage lower than 110 kW or total installed heat power not higher than 120 kW.

A prosumer small installation in turn is a renewable energy source of total installed electric power higher than 40 kW and not higher than 200 kW, connected to the power network of nominal voltage lower than 110 kW or total installed heat power not higher than 120 kW and not higher than 600 kW [11, 22].

In view of the above prosumer energy sources are micro- and small-scale RES installations, for example photovoltaic modules, small wind turbines, cogeneration devices propelled with biomass or biogas that generate electricity for the needs of a household or an enterprise (from the SMEs sector) and the surpluses that result from the supply-demand balance are introduced to the centralized market at the level of National Energy Systems or decentralized - on local level.

Values created on the side of energy prosumers, in the scope of electricity production, reduced emission of greenhouse gases and reduction of fossil fuels correspond unequivocally to implementation of 3x20 declaration signed in 2008 by the EU member states. This was also taken into account in the Directive 2009/28/UE determining goals of the 3x20 Package in the scope of RES [10, 11].

It should be also stressed that technologies on the electricity prosumer are not limited exclusively to the above mentioned energy sources. There are also modern (often innovative) devices and technologies included in the prosumer technological portfolio that

are adapted on the prosumer demand side. They include, among others:

– intelligent devices (Internet Things): for example washing machines, clothes driers, dishwashers with a control system - so as to adjust themselves to changeable tariffs of energy sellers,

– central systems managing loads, temperature, humidity in intelligent buildings - so as to adjust themselves to changeable tariffs of energy sellers,

– electric cars that limit energy consumption in transport, they are electricity reservoirs (charged in the "power valley") and energy sources at the time of peak demand for electricity (they smooth daily supply characteristics of prosumers).

Prosumer scope is also presented by so called negate power plants - (negative demand for electricity). The concept of negative power plants concerns reduction of the demand for electricity resulting from heterogeneous energy efficiency actions, including resource efficiency on the side of such prosumers. All actions taken by prosumers connected with improved energy efficiency and resource efficiency can be treated as "negawatt prosumer activeness" [5, 6]. Accordingly to the assumptions these actions correspond to production of negawatt goods, connected, among others, with reduction of the demand for resources, production materials or energy, at simultaneous reduction of threats to the environment. The volume of reduced consumption is the value saved and at the same time "produced and consumed in an abstract way" by prosumers.

To sum up, a unique quality of the prosumer energy is the possibility to separate it completely from the centralized system (e.g. NES), as well as direct production and consumption on the side of the final recipient's "meter". Aggregating the values created on the side of energy prosumers, electricity in particular - prosumer energy as a new production sector should locally stimulate new, social "green initiatives" in the bottom up approach for sustainable development of regions and creating social responsibility [18], which complies with Toffler's third wave.

III. HIGLY RELEVANT DETERMINANTS THAT STIMULATE DIFFUSION OF ENERGY PROSUMERS AND PROSUMER ENERGY DEVELOPMENT

It is estimated that the European market of energy prosumers (in the aggregated grasp of EU-28) is currently in the stage of growth. The number of prosumer RES installations in the EU-28 is estimated to be 10 million (the estimates result from lack of obligation to register prosumer RES micro-installations in the EU-28 scale) [14]. One can observe a large differentiation in the rate of prosumer energy development, in particular in the scope of RES micro-installations. A European leader in this scope is Germany where the number of functioning prosumers is 2 million. They acquire electricity mainly from photovoltaic installations and the total capacity of RES amounts about 36 GW. Prosumer energy is poorly developed in the countries from the eastern part of Europe. For example in Poland the total capacity of RES calculated at the end of the third quarter of 2015 reached 6,5 GW, in this total capacity of installed prosumer micro-installations is estimated to be barely 5 MW [23], while the total capacity installed in the entire system taking into account conventional power plants using fossil fuels is over 40 GW.

Therefore, at this point of the article the cognitive focus of its Authors concerns aggregation and quantitative evaluation of determinants stimulating growth of the number of energy prosumers and growth of the share of installed power in energy balances of the countries where prosumer energy is at the introductory stage.

In the literature on the subject causes and at the same time stimulants of prosumer energy development can be put down to a generalized set which includes [1, 8, 15]:

– forecasts concerning the growth of demand for electricity,

– high cost of system electricity distribution,

– limited access to electricity produced in conventional sources (vast territory of the state, outdated technical infrastructure, scarcity of energy resources),

– the need to use new technologies, RES in particular,

– growth of environmental awareness,

– necessity to protect environment,

– implementation of international agreements on reduced demand for fossil fuels, reduced greenhouse gases emission at simultaneous growth of RES (e.g. pursuant to 3x20 declaration of 2008 the EU-28 member states are obliged to increase until 2020 the share of energy produced in RES by 20%, at the same time reducing resources and fossil fuels by 20% and greenhouse gases emission in CO2 equivalent by 20% - in 2030 reduction of CO2 at the level of 40%) [11].

In the group of prosumer energy development stimulators one can also distinguish ICT technologies, in particular Intelligent Energy Networks (IEN) - Smart Grid, which ensure efficient communication between energy market participants - also in the prosumer decentralized space.

The above summary shows that both reasons and stimulants of prosumer energy growth are of multidimensional nature. In this reference, according to the third wave by A. Toffler's third wave one can notice emergence of energy prosumers involved inactions that aim to obtain not only economic benefits (in this financial ones) but also social and environmental ones. In the present point the Authors attempt to aggregate and evaluate highly relevant determinants that stimulate diffusion of energy prosumers and development of prosumer energy. The portfolio of these determinants includes economic, technological, environmental and social attributes. This aggregation was conducted in the first stage of

the research on the basis of the literature study, legislative documents and interviews - purposeful selection (with the use of questionnaires) in the representative group of domain experts - specialists in the scope of designing prosumer installations and their investors. Detailed summaries have been aggregated in the previous publications by the authors of the present paper [9, 11]. In the paper the Authors have summarized and evaluated with the use of the five-point scale (adapting for the needs of the research the scale by R. Likert) determinants of prosumer diffusion and development of prosumer energy of high relevance level in economic, technological, environmental and social groups.

In order to aggregate highly relevant determinants the Authors used a quantitative selection criterion in relation to all attributes aggregated in the portfolio in the first stage of the research. In particular, in the process of selecting highly relevant determinants the percentage criterion was applied MIN(X) = 50% according to indications of the above mentioned experts (the second stage of research). Determinants of prosumer diffusion and prosumer energy development that fulfill the accepted criterion has been summarized in Figures 1-4. Spider graphs have been chosen in order to present simultaneously average experts evaluations on the five-point scale.

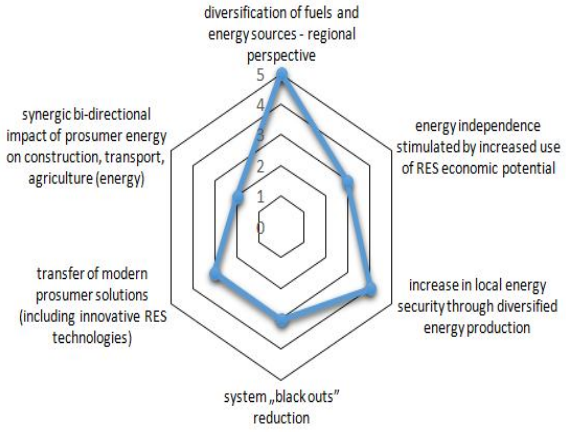

Fig. 1. Technological dimensions of evaluation
Source: Own work

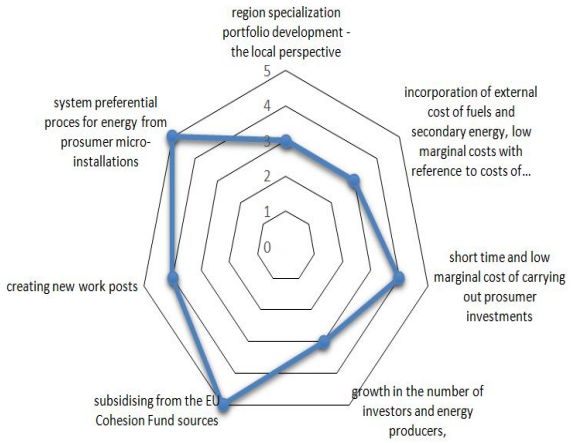

Fig. 2. Economic dimensions of evaluation
Source: Own work

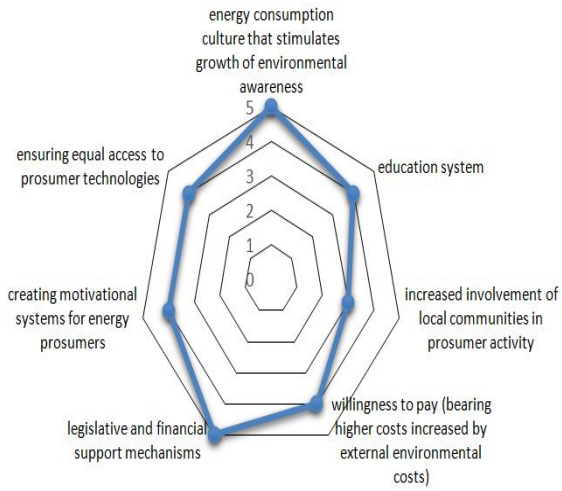

Fig. 3. Social dimensions of evaluation
Source: Own work

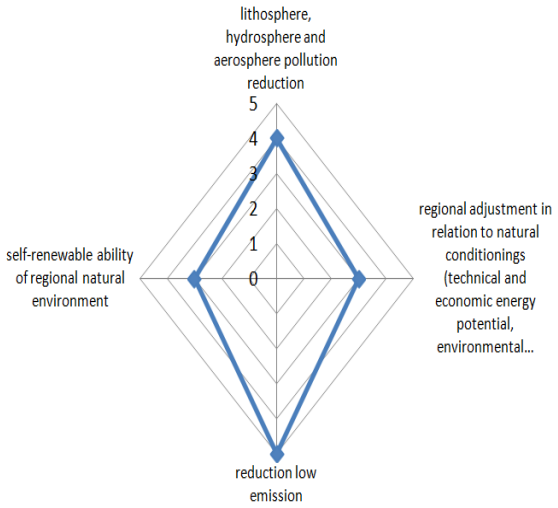

Fig. 4. Environmental dimensions of evaluation
Source: Own work

The summary of highly relevant determinants that stimulate diffusion of energy prosumers and development of prosumer energy and assigning values to them is an attempt to answer the research question "Does a contemporary prosumer fits into prosumption activities of Toffler's third wave?" In this context it can be stated that the contemporary prosumer is not driven exclusively by the need to obtain financial benefits. Prosumers are subjects characterized by high level of environmental awareness (the social dimension point 5), frequently willing to bare higher cost of investments connected with implementation of prosumer technologies and their use. Thus, they are willing to bear higher unit cost for produced autonomous energy, covering external costs - environmental ones (the social dimension point 4). In the environmental dimension a unique determinant of prosumer energy market development is improved environment security in the local perspective, directly connected with the exchange (low emission sources). First of all, in households, this concerns replacement of old boilers fueled with low-calorie coal or waste and combustion vehicles for prosumer technologies,

for example: prosumer RES micro-installations or electric vehicles, that play also the role of energy reservoirs for unlimited RES sources. In this context this is connected with reduction of pollution emission that comes from low-emission sources on the side of the user (environmental dimension point 5). It should be also stressed that energy prosumers are important in the technological dimension, which concerns diversification of fuels and energy sources, with consideration of RES - in the local perspective (the social dimension point 5), which facilitates improvement of energy security (the technological dimension point 4) Simultaneously, this favours stimulation of local communities activeness in prosumer activity (the social dimension point 3). Vital determinants of prosumer energy development diffusion, including the growth in the number of subjects (micro-investors) - energy prosumers are financial and legislative support mechanisms (he social dimension point 5). Mechanisms that take into account subsiding systems, for example from government funds and the EU-28 from the Cohesion Fund (the economic dimension point 5). It should be also stressed that in the macroeconomic perspective it is foreseen that a growth in the number of new work posts will occur (economic dimension point 4), this concerns in particular implementation of prosumer supplementary activity in economic organizations (e.g. in the SMEs sector).

It is stressed that in accordance with the above, the distinguished determinants: economic, technological, social and environmental are complementary one to another, which also confirms that contemporary energy prosumers fit in Toffler's third wave prosumption activities.

CONCLUSION

Contemporary energy prosumers involved in prosumption activities expect not only financial benefits, frequently, they are willing to pay higher costs taking into account environmental ones. They are distinguished by environmental awareness, including being aware of threats that are the result of previous energy model based entirely on fossil fuels.
To sum up, energy prosumers in the above reference are essential subjects participating in co-creating the value of energy which they consume. At the same time they are socially responsible, which confirms convergence with the concept of Toffler's third wave and is the answer to the problem question included in the present paper.

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