ELECTRICAL ENERGY SUPPLIES SAFETY VERSUS BUSINESS MODELS OF POWER COMPANIES IN POLAND

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Abstract

Provision of power safety is one (next to growth of competitiveness and power efficiency of economy and reduction of power industry impact on the environment) of the main goals and priorities of Polish power policy until 2050. It level depends on many factors among which electrical energy supplies safety is very important. To high extent, it does and will depend on business models of power companies operating on even more competitive energy market. Electrical energy supplies safety is found to be one of value components created by power company business model. Purpose of the paper was the evaluation of business models in the aspect of their ability to contribute to power safety. Subject of the research is structures of power companies' business models and the results they attain, in particular related to electrical energy supplies safety. It also shows the directions of strategic operations for its improvement. The research was performed in four Polish power corporations owing over 90% of share in the electrical energy supplies in Poland.

Keywords: Power safety, power companies, business model

1. INTRODUCTION

Energy safety is one of the conditions of stable economic and civilization growth of each developed country. Electrical power engineering is an important aspect of safety. Socially and economically effective production of electrical energy and its reliable distribution affect both the competitiveness of economy and energy safety of the country. Electrical power engineering is also important for the quality of public services, representing an important carrier of innovation. Prices of electrical energy and safety of its supplies to households affects the quality of life of citizens. Companies producing, transferring, distributing and selling electrical energy are significant players on the energy market. Effectiveness (costs, prices) and safety of supplies (quality, reliability, and care for natural environment) depend on the level of their functioning as well as applied strategies and business models. In particular, business models of power companies form the value for clients which is based on safety of electrical energy supplies. Purpose of the paper was the evaluation of business models in the aspect of their ability to contribute to power safety. Subject of the research is structures of power companies' business models and the results they attain, in particular related to electrical energy supplies safety. It also shows the directions of strategic operations for its improvement. The research was performed in four Polish power corporations (Tauron Polska Energia SA, PGE SA, Energa SA, Enea SA) owing over 90% of share in the electrical energy supplies in Poland.

2. VALUE CREATED BY BUSINESS MODELS OF ENERGY COMPANIES

Treating business models as the major creators of value increases the interest in them of both the practitioners and theoreticians of management. Especially this is about the following qualities:

- Option to apply business model as a comprehensible and rational concept for creating value, both for the client and owners of company. In case of power energy, it is a value created at the stage of energy production, distribution and sale.

- Building business models creating unique value for clients and beneficiaries, and in case of power energy, these can be elements of energy safety such as quality and reliability of electrical energy supplies.
- Utilization of business model as a carrier of various types of innovations, i.e. process, product, marketing, organizational and social. In power companies, there are practically all of them, however process innovations (new technologies) and marketing innovations (customer - prosumer relations) are of key meaning.
- Search for instruments and methods of achieving various competitive edges. In case of power energy, cost edge is especially important, however quality features (e.g. reliable energy supplies) are becoming more and more valid.
- Treating business model as an architecture of business operations, which is able to provide a company with economical effectiveness through generating income and environment friendliness. Influence of energy and climate policy companies of the EU is very important for such architecture.

The basic categories representing traditional foundation for building business models, are so called dominant logic or core logic - company operations that allow it creating the value and retain value. Shafer, Smith, Linder [1], authors of this concept use four categories: strategic selection, value network, creating value regardless of assets and processes as well as capturing value. Chesbrough and Rosenbloom [2] also use the mentioned categories and elements, stating that business model is a „structure the binds technical potential with economical value". Focus on creating value is also manifested by a very compact definition of a business model, presented by Demil, Lecocq, which says that this is a "notation of dependence between elements of company, cooperation of which allows creating and delivering value for client" [3]. Similar approach is also presented by Johnson, Christensen and Kagermann [4] by defining four fundamental elements of business model: proposal of value for client, formula of profit, key resources, key process, i.e. method and rules for creating value. However, Brzóska [5], Hamel [6], Obłój [7], Szmal [8] describes the role of innovations in creating value in business models. One of the most acknowledged researchers representing the school of "creating value" is Osterwalder and Pigneur, who define business model as follows "Business model describes premises behind the way an organization creates value as well as provides and benefits from the created value." [9]. Business model, according to these authors, consists of nine basic elements, which compose the logic of making money by a company: client segments, value proposal, channels of communication, distribution and sale, customer relations, streams of income, key resources, key operations, key partners, structure of costs. Proposal of Newth [10] can also be included in the mainstream of business model concept based on value, and categorizes it into six elements: value proposal, dynamic abilities and processes, strategic resources, streams of income, formula of profit, and structure of costs. Thorough research of business models in the Polish economy were performed by Gołębiowski, Dudzik, Lewandowska and Witek-Hejduk [11], where it was assumed that they are composed of: value for the client, resources and competences, location in a value chain, sources of incomes.

The presented concepts of business models are only some selection from wide spectrum of business modelling issues. Brzóska [12] presented classification and full characteristics of business models. It should be emphasized that in many business model concepts, the meaning of creating value both for the client and company is underlined. Therefore, the contemporary business models are based on strict global arrangements with customers and suppliers, putting special emphasis on the development and broadly-understood innovations in operating [13].

In case of power companies, energy safety element directly related to electrical energy production and its supply to recipients is one of the pillars of creating value for a client and development of a company. Energy safety is one of key goals in the energy policy of the EU. This issue is also strongly emphasized in Polish energy policy. In currently applicable document Energy policy of Poland until 2030 [14] growth of fuels and energy supplies safety is one of six strategic direction of the Polish energy development. The main goal of

energy policy in this area is the provision of continuous coverage of energy demand, considering maximum utilization of domestic resources and environmental friendly technologies. Among detailed goals in this sector, one can find such goals which apply to energy supplies safety:

- Building new power generating plants in order to balance domestic electrical energy demand and keep the available surplus in the peak of attainable power of domestic conventional and nuclear generating resources at the level minimum 15% of the maximum domestic electrical power demand.
- Building emergency resources of electrical energy generation, necessary due to power system operation safety.
- Development of domestic transfer system, that allows sustainable economic growth of the country, its individual regions and providing reliable supplies of electrical energy.
- Modernization and development of distribution networks, that allow for improving reliability of supply and development of decentralized energy, using local sources of energy.
- Until 2030, modernization of transfer and distribution networks in order to reduce emergency shutdowns to 50% comparing to 2005.

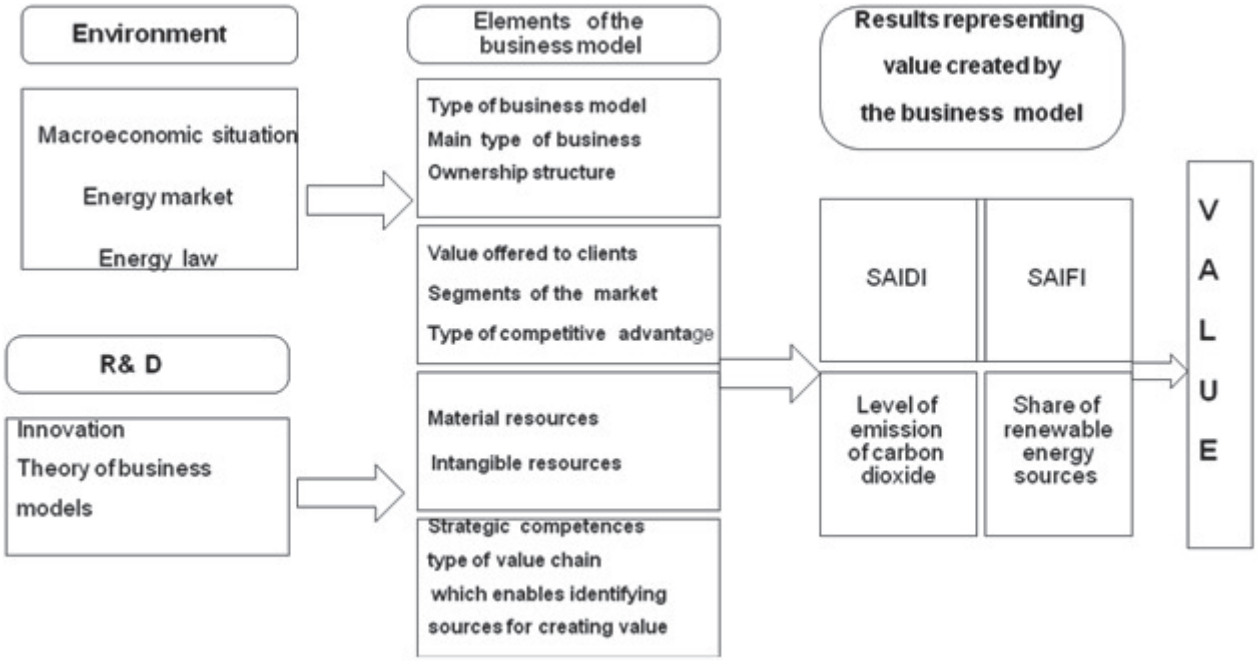

Fig. 1 Scheme research methods

The most important action to implement these goals, from the point of view of the research problem, is the introduction of quality element to transfer and distribution tariffs, that is attributed to transfer and distribution systems operators for reduction of failure indexes and their maintenance at the level determined by the Energy Regulatory Office for this type of network. Provision of energy safety is one of three major strategic goals stated in the project Energy Policy of Poland until 2050 [15] is treated as a priority project, allowing, among other things, for the increase of electrical energy supplies safety and development of prosumer energy. Analysis of business model concept and energy policy in the aspect of energy supplies safety allowed for developing a research method, applied to the analyzed energy companies cases (see **Fig. 1**). When analyzing the presented figure, note the power company business model elements that allow for their structural analysis (quality). In turn, quantitative measurement of created value is represented by the structure indexes of energy production, level of emission, and first and foremost, two indexes for measuring electrical energy supplies interruptions: SAIDI and SAIFI. The System Average Interruption Duration Index (SAIDI) is commonly used as a reliability indicator by electric power utilities. SAIDI is the average outage duration for each customer served, and is calculated as:

$$SAIDI = \frac{\sum U_i N_i}{N_T} \quad (1)$$

where N_i is the number of customers and U_i is the annual outage time for location i, and N_T is the total number of customers served. In other words:

$$SAIDI = \frac{\text{sum of all customer interruption durations}}{\text{total number of customers served}} \quad (2)$$

The System Average Interruption Frequency Index (SAIFI) is commonly used as a reliability indicator by electric power utilities. SAIFI is the average number of interruptions that a customer would experience, and is calculated as:

$$SAIFI = \frac{\sum \lambda_i N_i}{N_T} \quad (3)$$

where λ_i is the failure rate, N_i is the number of customers for location *i* and N_T is the total number of customers served. In other words,

$$SAIFI = \frac{\text{total number of customer interruptions}}{\text{total number of customers served}} \quad (4)$$

3. EMPIROCAL RESEARCH -CASE STUDY

The developed method of research was used to analyze business model of four power corporations: Tauron Polska Energia, PGE SA, Energa SA, Enea SA. These companies share over 90% of energy supply market in Poland. Research was performed in 2010-2014. Structure of business model was carefully analyzed in each of the mentioned corporations. **Table 1** synthetically presents structure of business model of one of them, i.e. Enea SA, considering the selected, crucial elements. The Enea Group integrates the areas of production, distribution and sale of energy. It distributes over 17 TWh of energy, which is almost 14% market share in Poland, almost 8% of the national production is received from its power plant. Distribution grid owned by Enea is 132 thousand km and is located on the area of ca. 58.2 km^2, which is 18.6% of the country. The Enea Group employs ca. 10 thousand employees, who supply the energy to almost 2.5 million clients. Enea has relatively limited options to create competitive edge. One (however big) system source of energy and small share of renewable energy does not enable cost competitiveness concerning electrical energy from own resources. In the analyzed model, innovation elements represent investment in modernization of power units and new energy sources (highly efficient hard coal unit, utilization of biomass), renewable sources (development of wind power industry) and modernization of the network.

Table 1 Elements of the business model of Enea SA

Periods / **Elements and features of the model**	**2010 - 2014**
Type of business model	Model of unique configuration of resources that enable creating value for client (value - reliable and effective electrical energy distribution services, satisfaction of regulatory demands).
Main types of business	Production, distribution and sale of electrical energy.
Main products	Electrical energy and its supply (including distribution).
Ownership structure	51.5% the Treasury, 48.5% diffused shares.
Value offered to clients	Supplies of electrical energy, partially from own resources (to some extent based on hard coal, also from ecological resources), supplied via own networks. Distribution services for other entities.
Segments of the market	All groups of electrical energy recipients in Poland (sale of energy).

Periods / Elements and features of the model	2010 - 2014
Type of competitive advantage	Natural edge, resulting from the owned electrical energy distribution system and location.
Material resources (quantity of assets, characteristics of production and transfer potential)	- Growth of assets value from 12.8 billion PLN (2010) to 18.8 billion PLN, i.e. by 46.8% attained via own investments. - Unused production potential based on hard coal. Small share of RES (8.1% in 2014, 3.6% in 2010). - Enea owns 132 thousand km of power grids (2014) increase comparing to 2010 by ca. 4% via own investments.
Intangible resources (number of employed persons, development of resources, public relations)	- Negligible drop of employment from 10 280 (2010) to 10 020 (2014) means drop of employment by ca. 2 %. - Annual costs of employee work amounted in 2010 - 91.0 thousand PLN and in 2014 - 94.0 PLN, which means 3% increase. - Shaping company's image using modern conventional resources. Investment in highly efficient hard coal power unit (Kozienice Power Plant) and RES acquisitions (wind farms).
Strategic competences	Management of regulated operations. Production of electrical energy.
Type of value chain which enables identifying sources for creating value	Predominating type of chain: Elements of integrator model (electrical energy): production (limited harmonization) - distribution - wholesale and retail sale of energy. Chain does not include electrical energy transfer which is implemented by capital and contracted outsourcing.

Table 2 presents the results representing electrical energy supplies safety, i.e. percentage share of renewable sources of electrical energy in the production potential, level of emission and the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI). The results were compared to Vattenfal AB and RWE AG concerns. Based on the presented reliability information, Polish corporations significantly deviate from RWE AG and German corporation Vattenfal AB. Improvement of SAIDI and SAIFI indexes in Polish power companies is a positive tendency. Increase of share of renewable energy sources in power production is also noticeable. Energa's share in such sources is better than in RWE AG and Vattenfal AB. Energy supplies reliability and safety (SAIFI and SAIDI indexes) by Polish distribution companies improves. However, they significantly diverge from German achievements in this area. This especially applies to PGE SA Due to obsolete, high emission production infrastructure, the future plans include replacement of electrical energy production sources. Moreover, development of transfer and distribution infrastructure is going to be necessary due to increasing share of renewable energy (investment into smart grids).

Table 2 Results representing electrical energy supplies safety

Company	SAIDI		SAIFI		Level of emission of carbon dioxide		Share of renewable energy sources	
	2010	2014	2010	2014	2010	2014	2010	2014
Tauron	234	151	3.9	2.7	994	876	5.1	11.6
PGE	343	474	4.7	3.8	1072	1069	1.9	5.3
Energa	473	203	4.8	3.2	829	647	29.6	36.0
Enea	362	219	4.9	3.2	880	830	3.6	8.1
RWE AG	15	16	0.25	0.30	745	732	6.4	7.5
Vattenfall AB	168 (S) 13 (G)	177 (S) 15 (G)	2.4(S) 0.25 (G)	2.4 (S) 0.20 (G)	416	421	23.0	23.0

(S) - Sweden, (G) - Germany

4. CONCLUSION

Development of renewable energy sources, especially prosumer power engineering, means the necessity to face real technological, innovative, legal and social challenges by the distribution sector within the scope of development and modernization of grids. Investments into smart grids is a very important development direction for the improvement of electrical energy supplies safety. Operations covered by Smart Grid: optimization of transfer systems, new grid management methods, integration with distribution network, reduction of mortality, separated systems that limit the range and effects of system failure. Energy storage is a very important issue related to utilization of renewable energy sources and application of smart power grids. This is a key factor of electrical energy supply safety from renewable energy sources. The most important issues related to energy storage: extension of time the energy is stored and life of storages, search for solutions concerning scaling the energy storages, development of technology increasing the efficiency of energy storage, integration of energy storages with RES systems. Cybernetic safety and protection of personal data is an unappreciated, but very important problem. Proper regulations in this scope are necessary to apply smart grids.

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