# MODERN POWER INFRASTRUCTURE VERSUS DEVELOPMENT OF SERVICES OF GENERAL INTEREST

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**Abstract**

Services of general interest are one of the most important factors of growth of society life level (including safety). They are an important field of application and innovation carrier at the same time and contribute to growth of entrepreneurship. One of basic types of services of general interest is supply services of various types of energy. Their development depends to high extent on the level of power infrastructure modernity covering energy generation sources, industrial and distribution networks, metering and IT devices. Effective and ecological technologies of electrical energy and heat production and smart grid and smart metering are determinants of the infrastructure modernity (including especially renewable energy sources). The paper analysed options and barriers related to introduction of innovations in energy services and benefits for customers concerning the use of modern power infrastructure. It presents the role and meaning of services and power infrastructure in execution of the Regional Innovation strategy in the Silesian Province. In particular, the option of creating the market of energy prosumers was emphasized. Creation and development of such market to high extent depends on owning and skills within the scope of utilizing modern (smart) power infrastructure.

**Keywords:** Infrastructure, services of general interest, renewable energy sources, innovation strategy

## 1. INTRODUCTION

The shape and growth of society welfare is affected by availability, scope and quality of services of general interest. Such services should be provided in order to put the users good at the first place. Meaning of the services of general interest results from their character and wide range of actions. They cover both the operations related to high-scale industry of corporation character and services provided on the local level by small businesses and other organizations. Services of general interest in the general meaning are related to power industry, communication, postal services, waste management, water supplies, education, health care, culture, social welfare and public safety. Their nature makes them necessary for everyday life of citizens of modern societies. Their development is related to the level of society wealth, achieved amount of gross domestic product as well as social and economic policy of the country, effectiveness of the whole budget zone and national administration. Quality, availability and reliability of these services are affected by application of various forms of innovations, frequently related to the level of infrastructure modernity. Services of general interest on the one hand represent an important area of absorption and application of innovations and on the other hand this type of services is treated as an important carrier of innovations (understood in wide meaning).

Considering the meaning of services of general interest for the social and economic development dynamics (both to national and regional scale), treating the infrastructure development as their important factor, it is justified to explore the research area devoted to these issues. The research problem presented in this paper will focus on the innovative changes in the services of general interest, in particular in the power services, development of which is connected with radical changes of the power infrastructure. The purpose of the paper is to show the benefits and threats related to implementation of innovative power infrastructure as an important factor of services of general interest. The research was performed within the scope of works related to Regional Innovation Strategy for the Silesian Province within 2013 - 2020.

## 2. MEANING OF PUBLIC SERVICES WITHIN THE SPACE OF THE STATES AND REGIONS

Services of general interest are necessary for everyday life of almost all citizens and organizations (including business ones).

As far as citizens are concerned, they play an important role in strengthening social coherence. This is about important social issues such as:

- preventing and fighting the social exclusion,
- acting in aid of fighting and limiting poverty,
- creating social solidarity,
- supporting justice and social protection,
- harmonization and unification of territorial development

Services of general interest also play an important role in the strategy of sustainable development adopted by UE. They apply to elements like:

- shaping high level of employment,
- social integration,
- sustainable economic growth,
- rational resources utilization,
- social integration,
- natural environment protection

Their scope and organization are different in individual countries depending on their traditions and culture, the level of domestic product and the scale of state influence. Significant importance and role of these services for the social and economic development corresponds with their type and scope which can be very wide and can include:

- supplies of electric energy, water, heat and gas,
- waste disposal,
- educational services,
- health care protection,
- passenger transportation,
- social aid and care,
- postal services,
- activity in aid of culture and art,
- physical development, recreation and sport,
- public safety,
- telecommunication services and supply of electronic media,
- securing the dwelling needs.

In the legal regulation of EU [1] one can distinguish two types of services rendered in the general interest:

**1. Services rendered in the general interest of economic character.** Supply and organization of this kind of services are subject to principles concerning internal market and competition, specified in the European Union Treaty, because operations undertaken within this scope are of economic character. In case of large network industries, operating at the European level, such as: telecommunication industry, services related to supply of electricity and gas as well as transportation and postal services; provision of services is subject to special legal frames of the Polish legislation which represents implementation of the EU legislation. Part of services rendered in the general interest of economic character are subject to legal frames determined by so called Service Directive [2].

**2. Services of extra-economy character.** These services, including traditional ones owned by the state - police, justice or social security system, are not the subject of special EU legislation and are not subject to

principles related to internal market and competition specified in the EU Treaty. In case of services rendered in the general interest quoted in the Announcement [3] it is emphasized that all citizens and entrepreneurs should be provided with:

- real access to wide selection of such services,
- high quality and safety of services,
- price availability,
- variety of services,
- equal treating of customers,
- promoting the rights of the recipients (right to education, health, safety, employment, energy, water, transportation, communication, etc).

These demands and requirements put before the services of general interest justify active implementation of different innovations forms within the services. At the same time, wide spectrum of recipients of such services represents the field of the following innovations implementation: new technologies and new products. This places the services of general interest among the most significant challenges of innovation strategy, either to the national, regional or local scale. The need to increase the scope and quality of actions undertaken within the area of rendered services of general interest in obvious in the face the challenges of social and economic development. The role of innovations continuously grows within the scope of services of general interest improvement, thus these services are treated as important carrier of different solutions within the scope of new technologies, products or business models [4]. This is because this type of services generates many results important from the point of view of innovation and innovativeness growth dynamics.

The most important are as follows [5]:

1. Effect of crossing the barrier of new technologies absorption.
2. Effect of technological change acceleration.
3. Effect of awareness and satisfaction from using the state-of-the-art organizational, technological and product solutions.
4. Demonstration effect.
5. Network effect.
6. Economic effect resulting from the possibility to manage the demand.
7. Effect of stimulating the customer of services of general interest.

**Table 1** presents classification (according to generic criterion) of services of general interest, for which the most important types and incentives of innovativeness were specified, that enable their development. The following is based on situation diagnosis and Regional Innovation Strategy of the Silesian Province.

## 3. MODERN POWER INFRASTRUCTURE IS THE CONDITION OF SERRVICES DEVELOPMENT WITHIN THE POWER INDUSTRY

The Regional Innovation Strategy adopted for execution within 2014-2020 in the Silesian Province [3] is based on three smart specialisations: power industry, medicine and ICT. These are closely related to and at the same time include many types of services of general interest. In case of the power industry, development of services within this specialisation is conditioned to high extent on having and using modern infrastructure, covering innovative (including renewable) resources and smart grid. Application of this type of power grids is well supported by directives that make the energy market [6] more liberal and by recommendations and guidelines of EU [7]. Smart grid represents the basis to build so called advanced metering infrastructure (AMI) also known as smart metering. Information system is the central part of it and it is used to store, process and make available metering data to other systems operating outside the company and in other companies. This is central metering management system (Meter Data Management - MDM).

In general AMI system structure (smart metering) includes four functional areas [8]:

- metering layer that is represented by electric energy meters equipped with communication modules to exchange data with the reading system,
- communication layer with meters covering passive and active communication infrastructure and
- routers, data hubs, transmission systems,
- measurements recording layer, covering reading systems specified in the information systems technology as back office,
- metering management layer so called MDM (Meter Data Management).

**Table 1** Classification of the services of general interest in the aspect of their innovativeness

| **Groups of services of general interest** | **Categories of services of general interest** | **Predominating types of innovations and incentives of innovativeness of services of public interest** |
|---|---|---|
| Administrative services | Issuing documents based on request and needs of a citizen, which are not administrative decisions, permits, licenses | Process innovations.<br>Social and organizational innovations.<br>Large databases (e.g. EPUAP, SEKAP)<br>ICT systems (including digitization) on central and local level. |
| | Issuing permits and decisions in the meaning and mode of the administrative proceeding code | |
| | Record, settlement and control over taxes of citizens and economic entities | |
| | Registering a business. Issuing permits and licences related to the business operations control by the state. | |
| Services of general interest (covering safety, health protection, education and culture) | Health protection<br>Social aid and care | Product, process and marketing innovations.<br>ICT systems (including digitization).<br>Logistic systems.<br>National and local databases. |
| | Education | Process, organizational and social innovations.<br>Local ICT systems.<br>Information resources digitization. |
| | Physical development, recreation and sport | Product innovations.<br>Differentiated “hard” structure. |
| | Collecting, saving, making available the public information (e.g. in libraries) | Process and social innovations. Digitization of information resources. |
| | Social housing | Social innovations.<br>Passive houses. |
| | Public safety (army, police, fire fighters, street wardens) | Product and process innovations.<br>Modern logistic systems and resources, central ICT systems. |

| Groups of services of general interest | Categories of services of general interest | Predominating types of innovations and incentives of innovativeness of services of public interest |
|---|---|---|
| Logistic and technical services | Public transport | Process and organizational innovations. Intelligent systems of urban and regional transport.<br>Modern infrastructure and means of transport. |
| | Supplies of energy (power, gas, heat), water supplies and sewerage | Marketing, process and organizational innovations.<br>Smart grid and smart metering systems Differentiated sources of energy, renewable energy sources.<br>Using ICT and digitization in prosumer power industry |
| | Waste management and maintaining order and cleanliness | Marketing, process and social innovations.<br>Heat sources utilizing waste |
| | Remaining operations (e.g. green areas management, cemeteries) | Product innovations<br>Modern logistic systems and resources |

Source: own study

Efficient information transmission technology that was created within the past few years, and which uses low and mean voltage grids provides extensive options for the development of smart metering system within the power sector.

Implementation of smart grids will bring many benefits. They can be grouped within the following areas:

- Increase of power efficiency. Implementation of smart metering systems causes less losses of energy in the transmission and distribution grids, this means that in order to deliver the same amount of energy to a recipient, less amount of primary energy is needed, which in Poland is generated based on coal.
- Increase of economic efficiency. The same amount of energy may be delivered to a recipient at lower costs and at the same time, this may bring a company more profit, because it is possible to implement modern methods of settlements with recipients, including tariffs.
- Improvement of process efficiency. Most of the grid management and operation activities will be performed automatically. Employees will be able to increase efficiency. It will be important to develop close cooperation.
- Improvement of customer satisfaction. This is related to earlier detection of breakdowns, earlier rectification of breakdowns and finally reduction of breakdowns frequency. Knowledge about customers will be broader. Understanding of their expectations will be better in order to provide them with e.g. complementary services[9 ].
- More effective utilization of existing sources of power generation, which fact would delay the necessity to build new power stations, as a result of the change of customers behaviour, thanks to application of so called dynamic tariffs.
- Enabling demand management. Smart power grids provide both the recipient and supplier with the information about current energy consumption. This in turn allows active participation in energy consumption management in a household, its reduction and adaptation of energy consumption to the

needs and financial abilities of a household as well as energy supply conditions. Experience of UE states show a potential within the scope of energy effectiveness growth at the level of 6-10%.

- Limitation of electric energy prices increase for a final recipient because of implementation of new competitive mechanisms on the electric energy market, in particular, revealing the price flexibility of the demand.
- Strengthening power safety - improvement of energy supplies quality and energy parameters quality.
- Creating a method of exchanging values between a prosumer and energy supplier, in particular energy surplus take-off conditions from renewable energy sources owned by a customer.

Smart metering systems will not only affect the power market. There will be many modern products that will minimize energy consumption costs by the final recipients by means of proper devices software. Sector of vehicles using electric energy may develop. Many companies currently not present within this sector will compete with power companies. This is about smart meters technology suppliers, operating in various sectors, among other things communication, vehicles, construction and power sector.

One must realize that implementation of so called smart meters means at the same time a whole network of devices cooperating within this system. This applies to reading systems, metering management systems, radio networks, household terminals, company terminals as well as other grid configuration.

It is necessary to emphasize that implementation of smart metering system requires significant investment expenditure. At the moment, to the scale of the European Union, this is 20 billion EURO annually, this amount may reach 100 billion EURO before 2030. In case of Poland, Energy Regulatory Office ordered power companies to implement pilot programs within 2011-2013. At this moment , it is necessary to point out that before implementing smart metering system, it will be evaluated. This evaluation is required based on item 55 of the Directive 2009/72/EC [10], and it covers:

- analysis of all long-term costs and benefits on the market and individual client,
- economic effectiveness of specified methods of metering,
- dates and feasibility of the implementation.

Positive evaluation of smart metering systems cost-effectiveness and their efficient implementation is an important change in rendering power services representing a key element of regional innovation system.

Creating and using modern power infrastructure, except the expected benefits, is also related to limitations and barriers. They include:

- necessity to sustain significant capital expenditures. Expenditures on implementation of smart metering system and support for recipients covering effective control of energy consumption will amount 8 - 10 billion PLN [11]. They may be sustained by 2020 by the distribution grid operators, who will be able to transfer them on the final recipients in the tariffs, which will be translated to short-term increase of energy price. In case of the Silesian Province, this type of expenditure will exceed 1 billion PLN;
- there are no clear legal regulations in Poland that apply to management (management entities, grid operators), smart grid, principles of connecting distributed energy sources cooperating with such grids, principles and responsibility of many entities cooperating because of the grids, in particular details on the status and function of a prosumer,
- application of smart grid is related to recoding many sensitive personal data. Issues related to personal data, its dissemination, use and safety of storage and distribution require adjustment.
- organizational, legal, proprietor and technical solutions must include liberalization of energy markets regulations adopted in EU, in particular the principle of operations separation - *unbundling* - and the principles of market access - *Third Party Access (TPA)*. This may complicate and delay smart grid implementation;

- obtained effects to high extent depend on the management of assets belonging to many different entities. Just and power infrastructure development motivating mechanism and system of share of profits, adequate to the invested capital, should be developed.

In case of power infrastructure, its development will be affected by two, very important, driving forces, from the macroeconomic and social surrounding, i.e.:

1. Power policy adopted and executed by Poland, in which power saving of the economy and increase of share of renewable energy sources in the production of energy, plays important role. Numbers characterizing the power policy goals within this area are characterized by the information given in **Table 2**.

The presented numbers show significant dynamics of electric energy demand structure change and the need to execute the energy-saving program that changes the demand.

2. Meaning of power industry in the "Regional Innovation Strategy of the Silesian Province in 2013-2020", where it was selected as a smart specialization of this Region. This leads to preferences in the selection of undertakings and projects related to modern power infrastructure, thus their significant support by EU aid sources. This type of infrastructure is treated as an important carrier and factor of innovation, either of process, product and organizational character (construction of prosumers market).

**Table 2** Value of indexes (actual and forecast) of renewable energy share and energy consumption of gross domestic product (GDP) in Poland within 2006 - 2030.

| Years / indexes | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| share of renewable energy in the sales of energy to final recipients (%) | 3.6 | 7.0 | 14.0 | 19.0 | 24.0 | >25.0 |
| Energy-consumption (TOE / million PLN) | 89.4 | 73.1 | 56.7 | 46.6 | 38.6 | 33.0 |
| Energy-consumption (MWh / million PLN) | 137.0 | 110.4 | 90.4 | 77.8 | 67.8 | 60.6 |

Source: developed on own basis [11], [12].

## 4. CONCLUSIONS

Modern services of general interest require application of various types of innovation, representing at the same time a carrier of innovation used to increase the resources of knowledge and skills of regional and local society. One of the important types of these services is energy supplies. At this moment, their development requires significant investments in the energy infrastructure. In particular, this applies to power grids (smart grid and smart metering) and renewable energy sources. Application of modern power infrastructure may bring economic (reduction of energy supplies costs, energy-saving) and ecological benefits (reduction of gas emission, improvement of waste management). Investment into smart grids requires thorough and complex evaluation of economic and social effectiveness as well as transparent legal regulations considering power safety, principles of competitive energy market as well as common good, including good of the energy prosumers. Adoption of power industry (smart specialisation) to be one of the pillars of Regional Innovation Strategy represents significant chance for positive changes for energy recipients in the Region and development of prosumers market. This will be empowered by rational and effective investing into the power infrastructure.

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