

# Policy Paper

## Energy Innovation in Poland: Frameworks, Programmes and Strategies

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### Introduction

Innovation is one of the key concepts of contemporary economies. Energy is one of the sectors where efficiency and new solutions are sought for with great interest, but at the same time, where path dependent processes and various technological lock-ins often inhibit swift change. Despite various obstacles, energy innovation is a global trend today and the European Union, as well as its particular member states, are actively shaping innovation strategies at various levels: sectorial, cross-sectorial or inside companies. Globally, the 3Ds are setting a framework for innovation in energy: decarbonisation, decentralisation and digitalisation. Certainly, an important global document guiding innovation in Energy towards decarbonisation is the Paris Agreement of 2016.

At the EU level, decarbonisation, and more generally, climate change policies are also the main trends giving direction for innovation in national power sectors. The EU Climate Change and Energy Package of 2009, was the first main package of directives that gave a clear signal for renewable energy development, and at that time, also to work towards the deployment of carbon capture and storage at an industrial scale. And even though CCS is still rather an expensive option for the future than an



economic option for industries, EU regulations have given many positive stimuli in the sector of energy efficiency and renewable energy (including photovoltaics). These areas may count on financial support from banks and investment funds. Also, the Europe 2020 strategy gave an impulse for various innovations in European economies, among which one can list smart grid technologies.

Poland is still waiting for a new 2050 Energy Policy Strategy, which was announced to be ready in Autumn 2017 by the Minister of Energy.<sup>1</sup> One of the challenges of constructing this document is how to account for the Winter Package of the European Commission, which consists of eight legislative acts under a common name 'Clean Energy for All Europeans'. The Winter Package proposes changes on the energy market in order to make it fit better to a wider deployment of renewable energy technologies. Among other things, the European Commission proposed to ban administratively regulated energy tariffs, enable selling energy produced by household installations and introduce more flexible contracts. In general, the package aims to improve the position of consumers on European energy markets. Additionally, the Commission proposes to increase the target of energy efficiency up to 30%.

The previous project of the 2050 Energy Policy Strategy, presented for consultation in September 2015 by the previous government, made a note about a low-level of state funding channelled into research and development in the energy sector in Poland and a low level of engagement of the industry into this type of research. Therefore, the document identifies the need to increase investment in innovation into the Polish power system. The areas that show the greatest potential for innovation in the Polish context are: clean coal technologies, energy efficiency technologies throughout the whole production and distribution chain, technologies for a more efficient use of domestic fossil fuels, renewable energy technologies, grid modernisation and smart grid technologies and nuclear power technologies. (Project of Poland's Energy Strategy 2050).

The Polish energy sector, even though so strongly dependent on coal, has undergone many changes in the last few decades. The share of energy from renewable sources increased, some conventional energy sources were modernised and digitalisation of the power grid management progressed. At the same time, some projects in the energy sector failed to take off, such as carbon capture and storage (CCS) or shale gas extraction. However, what we can observe now is that surely there is a boom in interest in energy innovation coming both from the Polish government as well as various companies. In the following paper, we propose to examine government policies in several areas of the energy sector in which various concepts of innovation are being developed and sought for: energy clusters, smart grid, the programme for prosumers and efforts to modernise conventional power sources. Further on, we provide examples of companies' involvement in energy innovation and of various funding sources for innovation. We conclude by listing challenges for a successful development of energy innovation in the Polish power sector and proposing some recommendations.

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<sup>1</sup> [http://energetyka.wnp.pl/tobiszowski-do-jesieni-strategia-energetyczna-polski-do-2050,296816\\_1\\_o\\_o.html](http://energetyka.wnp.pl/tobiszowski-do-jesieni-strategia-energetyczna-polski-do-2050,296816_1_o_o.html)

## Energy innovation in Poland Energy clusters

The concept of energy clusters<sup>2</sup> has been introduced by the Ministry of Energy in the current government. Two types of clusters are being distinguished: micro clusters at the community level (*gmina*) and macro clusters at the county level (*powiat*). A cluster is a legal agreement which can involve physical persons, legal persons, persons without a legal status, scientific units, research and development units and local authority units. A cluster may be involved in production, balancing, distribution and trade of energy from renewable energy sources or from other types of fuels within a single energy grid. The form of this legal agreement is very loosely defined—it can be a cooperative or a commercial law company. Both micro and macro clusters are obliged to obtain certain licenses to produce, distribute or trade energy. The Third Party Access rule is not uplifted in this case, however, a more vertical integration is allowed within clusters. A cluster can integrate production, distribution and trade of energy under the condition that they supply no more than 10,000 consumers with energy in the case of a micro cluster and no more than 50,000 consumers in the case of a macro cluster. At the same time, the Office for Energy Regulation (URE) will maintain strict control over the clusters—they will need to submit tariff proposals for approval.

The concept is unique at a European scale, but the main challenge resides in the ability to construct locally integrated energy markets, both for electric energy and for the heat, and to avoid the monopoly that can be observed in the sector of energy distribution today. This comes along with other challenges, such as the ability to balance supply and demand in real time with the use of

<sup>2</sup><http://www.me.gov.pl/Energetyka/Klastry+energii/Czym+sa+klastry+energii>

smart meter technologies, to work out business models that can be economically sustainable in the long run without additional financial support and to work out rules of cooperation between energy producers and distributors. The main objective is to trigger local communities' initiatives to produce energy from renewable energy sources for their own purposes. Clusters could also help to restructure rural areas and improve local environment. By the end of July 2017, the Ministry of Energy listed around 60 clusters from all over Poland who want to be part of the government's strategy for energy clusters.

## Smart grid

In 2012, the National Fund for Environmental Protection and Water Management launched a programme 'Smart Power Grid' (*Inteligentne Sieci Energetyczne*, ISE) to finance various smart grid projects. One of the goals of this programme was to create active energy consumers—prosumers—who are not only consuming but also producing electric energy. In 2012, smart grid development already had a foresight for electromobility development as smart grid technologies would be necessary to support infrastructure for charging electric cars. The programme was addressed to households, small and middle-sized enterprises, service and commercial building to finance small pilot projects developed within spatially bounded areas, such as housing communities, villages and cities. Additionally, the programme provided financial support for education and information projects. ISE came as a second step towards innovation and efficiency in the energy sectors, after the 2011 programme 'Efficient Energy Use,' which financed energy saving schemes.

ISE has been operating for 7 years, starting in 2012, and will end in 2018. Applications for financing were accepted between 2012 and 2016 for a total budget of 340 million Polish Zloty. The non-investment projects were funded up to 70%



and the investment projects from 30% to 50%. The beneficiaries of the programme included: power grid operators, energy traders, managers of the special economic zones, self-government units and higher education institutions. More specifically, the type of projects eligible for funding included: decentralised renewable energy sources, smart lightning grids using energy efficient bulbs, microgeneration, co-generation and tri-generation with gas, emerging storing technologies, installation of power compensation technologies, measuring of energy consumption which involves information technologies. More generally, the financed projects could include smart meters, integration of dispersed energy sources, dynamic management of power grid, new quality in energy management, communication systems between energy market participants, automation of energy distribution and reliable and safe energy supply.

Another programme that supports smart grid development is the Operational Programme Infrastructure and Environment (2014–2020). Three smart grid projects proposed by Tauron (one of the four state-owned power companies) were financed within this scheme.<sup>3</sup> The projects involve: development and implementation of smart distribution systems operating at low and middle range voltage levels and support for constructing pilot smart electric grids. This year, Tauron plans to allocate around 1.8 billion of Polish Zloty to developing transmission grids and smart grids. The three financed projects are being developed in four different voivodships: Silesia, Lower Silesia, Opolskie and Łódzkie. The total budget of the project is 41.4 million Polish Zloty and the level of support is 19.4 million Polish Zloty. Tauron Distribution currently has 17 contracts for financing its investments for about 104.4 million Polish Zloty. Thirteen contracts were signed within the Regional Operational

<sup>3</sup><http://www.cire.pl/item,147478,1,0,0,0,0,inteligen-tne-sieci-elektroenergetyczne-aurona-dofinansowane.html>

Programme of the Lower Silesian Voivodship and covers renewable energy production and distribution projects for a total sum of 55 million Polish Zloty. Three contracts are signed within the Operational Programme Infrastructure and Environment for developing smart storage systems, energy transmission and distribution for a total sum of 30 million Polish Zloty. In Poland, the concept of smart grid has also been developed in relation to the gas transmission grid.

## Prosumer

The Polish state has started to shape conditions for consumers' involvement in energy innovation more strongly over the last couple of years. A good example of such a programme is the Prosumer. The programme runs between 2014 and 2022 with a budget of 800 million Polish Zloty. It is addressed to small energy consumers who want to produce energy for their own needs, but are also able to sell it to the national power grid in case of surplus. The programme offered low-rate loans for buying and installing energy and heat sources with a possibility of partial remission of a loan (up to 40%). Three types of institutions could directly benefit from loans: territorial communities (*gminy*), the Voivodship Environmental Protection and Water Management Fund (*WFOŚiGW*) and banks (e.g. Environmental Protection Bank, *BOS*). Different Voivodship Funds had different rules, but most frequently they targeted housing communities or cooperatives.

One of the outcomes of the Prosumer programme is a relatively large number of small-scale investments in PV installations. The year 2017 was announced the best year for photovoltaics in Poland. Today, the installed power of PV in Poland is over 150 MWp, while 5 years ago it was only 2 MWp. There are around 11,200 domestic installations with a total capacity of over 62 MW. Most of them were installed in the first half of 2016 and the trend may be stable due to low

prices of PV technologies, a growing environmental consciousness, new systems for energy storage and a more stable system of regulations and accounting for the installations below 40 kWp. The largest number of applications submitted to the Prosumer programme came through banks. PV made around 90% of all applications.

In the meantime, the new Renewable Energy Law, which entered into force on 1 July 2016, set a definition of a Prosumer which makes it possible to offer more measures addressed to this type of energy system participants. A Prosumer is defined as the final consumer purchasing electric energy based on a comprehensive agreement and producing electric energy exclusively from renewable energy sources in micro-installations for one's own needs and not for economic purpose as regulated by the law on the freedom of economic activity. This should be noted as a positive move on the side of the legislator, despite the fact that some questions remain, for example as to whether this definition is not too narrow.

## Electromobility

The concept of electromobility was introduced into Polish debates on energy policy more decisively by the current government. The Polish Programme for Electromobility is a response to the EU activities aimed at popularising electromobility and alternative fuels. The Programme should last from 2016 until 2025 and it is divided into two sub-programmes: e-car and e-bus. The Ministry for Energy is the institution in charge. Four strategic documents that constitute the base for the regulations to come are:

- Plan for Electromobility Development 'Energy to the future,' adopted by the Council of Ministers on 16 March 2017;
- National Framework for developing alternative fuel infrastructure, adopted by the Council of Ministers on 29 March 2017;

- Law proposal establishing a Fund for Low Emission Transport, that is a Law proposal amending the Law about biocomponents and liquid biofuels and other laws (UC 79);
- Law proposal about electromobility and alternative fuels (UC 89).

The Programme for Electromobility has been built into several policy areas. It is one of the key programmes in the wider Strategy for Responsible Development.<sup>4</sup> The benefits for the Polish citizens, however, mainly those living in the city, should be manifold. Development of electromobility aims to lower levels of air and noise pollution and improve accessibility and comfort of public transportation in the cities. The Ministry for Energy foresees that in 2020 there will be around 50,000 cars fuelled by electric energy driving in around 32 urban agglomerations. Around 6,000 charging stations of a normal charging capacity and 400 charging stations of high charging capacity will be constructed. In the CNG sector, there should be 3,000 cars driving on Polish roads and 70 fuelling stations. By 2025, there should be 1 million electric cars driving in Poland, 54,000 CNG-fuelled cars and 3,000 LNG-fuelled vehicles. An important challenge of the Programme is to coordinate all components of electromobility development with the development of the electric power grid.

A company called ElectroMobility Poland S.A. was created in October 2016 with the intention of promoting the concept. It was established by four state-owned power sector companies: Tauron, PGE, Energa and Enea. The package of regulations that the government has been working on in this area, aims at defining boundaries over a new market and increasing the use of alternative fuels such as LNG and CNG. Here, natural gas in a liquefied form enters the discourse about the Polish electric car. The Minister of Energy is in charge of the Fund for Low Emission Transport. It will support construction of

<sup>4</sup> <http://www.emobilitypoland.pl/pl/o-projekcie.html>

the infrastructure for alternative fuels and a market for vehicles charged with these fuels. Its yearly fund will be of around 155 million Polish Zloty, which is a mere 35 million Euros. Moreover, the Plan for Electromobility Development should stimulate demand for e-vehicles. The actors that may benefit from the programme, as listed in government documents are: drivers, infrastructures constructors, public transport institutions, innovative companies and car producers.

## Modernisation of conventional energy sources and clean coal technologies

One of important areas of innovation in energy sectors in Poland is modernisation of conventional sources of energy and clean coal technologies. These are two areas that, on the one hand, are important in the situation when the consequent Polish governments have been declaring coal as the main fuel for electricity production in Poland. On the other hand, any investment in coal technologies can be perceived as controversial as it locks energy systems into burning more of this fossil fuel, even if the process gets more efficient. For example, the Winter Package proposes a limit of carbon dioxide emissions to be set at a level of 550 grammes per 1kWh for energy producers included in the capacity markets. A capacity market is a support scheme which subsidizes not only the energy that is supplied, but also the readiness to supply energy. The proposed limit would make it impossible to build new power production sources based on coal with the capacity market support scheme.<sup>5</sup> Another controversial point for the Polish government is shifting the powers over energy governance from national governments to Regional Operational Centres. It is also still not clear whether to move

forward with nuclear energy in Poland and what kind of financing scheme would be appropriate for this investment.<sup>6</sup>

Despite these uncertainties, some companies, for example Rafako, are betting on conventional energy production. Rafako is working on several innovative solutions. One of them involves methanisation of CO<sub>2</sub>—this project is carried out in cooperation with Tauron. Rafako is also working to develop 'duoblocks,' which use the existing elements of infrastructure to build blocks with supercritical parameters which allows increasing efficiency of the existing units from 35% up to 45%. Construction of duoblocks may be less expensive than construction of new blocks from scratch.

Clean coal technologies are also perceived as a vital area of energy innovation in Poland by other power sector companies, for example Enea.<sup>7</sup> However, as companies admit themselves, this concept is quite broad and includes a wide range of technologies used at different stages of the production process. For example, the Institute of Chemical Coal Processing in Zabrze (*Instytut Chemicznej Obróbki Węgla w Zabrzu*) works on a more energy efficient type of coal for domestic heating purposes. The process involves gasification of coal as a result of which one gets 'blue coal' ready to be used in various types of stoves (e.g. tiled stoves) and giving more energy and less CO<sub>2</sub> when burnt. CCS and its variations is another example, however, high costs of its exploitation makes CCS economically unviable. Enea and PGE are members of the Polish Platform of Clean Coal Technologies (*Polska Platformy Czystych Technologii Węglowych*) which provides a forum for learning and exchanging ideas. Enea is

<sup>5</sup> [http://energetyka.wnp.pl/tobiszowski-do-jesieni-strategia-energetyczna-polski-do-2050,296816\\_1\\_o\\_1.html](http://energetyka.wnp.pl/tobiszowski-do-jesieni-strategia-energetyczna-polski-do-2050,296816_1_o_1.html)

<sup>6</sup> [http://energetyka.wnp.pl/tobiszowski-do-jesieni-strategia-energetyczna-polski-do-2050,296816\\_1\\_o\\_1.html](http://energetyka.wnp.pl/tobiszowski-do-jesieni-strategia-energetyczna-polski-do-2050,296816_1_o_1.html)

<sup>7</sup> <https://businessinsider.com.pl/firmy/strategie/innowacje-to-jedyna-szansa-dla-energetyki-co-w-tej-kwestii-planuja-polskie-spolki/p6odyv4>

investing in modernization of its coal-fired blocks. In 2016, Enea declared plans to construct an IGCC installation. The new coal-fired power blocks in Opole or Koźienice, investment of PGE, are also going to operate in a more efficient way. Some of the power blocks that are still in operation today, were constructed in the '60s, '70s or '80s. Therefore, a gradual modernization of the blocks is vital for the stability of the whole system. Innovation in mining is also what occupies power sector companies. For example, Bogdanka Mine, owned by Enea, can be regarded as a smart mine as it uses various technological and organizational innovations to improve efficiency of production.

## Companies' strategies for energy innovation

In 2016, three state-owned power sector companies, Enea, Energa and Tauron, declared to allocate around 200 million Polish Zloty for innovation in the energy sector in Poland. This includes Energa's projects of power storage. Enea itself plans to spend tens of millions of Polish Zloty for innovation and transform Enea Innovation to be in charge of all innovative projects, including decisions on investments into start-ups.<sup>8</sup> A number of companies operating in Poland got to work on energy innovations in various configurations and business set ups. Thinking about technological innovation drives innovation in the ways that business is organised and financed. We can observe the development of new business models, new cooperation arrangements and in particular, investment in a new, flexible organisational form of companies—the so called start-up sector.

A great challenge to any innovation, maybe in Poland in particular, is its commercialisation. Polish innovations have often been born in university laboratories or in specialised institutes

which, however, are not active as business actors in a wider economic context. Good ideas, new technologies, new solutions, often stay with the inventors and do not turn into market products, thus having little impact on various sectors of the Polish economy. This challenge is taken up by various companies, among which, InnoEnergy Poland Plus makes a good example of a business actor who is trying to create conditions favourable for commercialisation of energy innovation. InnoEnergy Poland Plus works together with small as well as big companies to help them work on new technologies and new business models from the moment they are born in labs and inside organisations to the moment of commercialisation and production.<sup>9</sup> InnoEnergy invests up to several thousand Euro in a single start-up company. In the case of big companies, the offered support may be up to several million Euro. Apart from financial support, InnoEnergy offers advice in company development. A criterion for selecting projects is the ability of the company to show how their idea can enter markets within 2–3 years' time. InnoEnergy supports building project consortia around particular projects, where a potential client for the product is one of the consortium partners. Frequently, the client is a big player in the utility sector or a big energy consumer. One of the main obstacles to seeing an energy innovation boom in Poland are cumbersome regulations of public procurement. A logic of public procurement goes in an entirely opposite direction than an innovation. In public procurement law, there is no space for various risks inherent to innovating—for example, the risk of product failure on the market, which is a statistically viable option. Innovation is always burdened with uncertainty and can develop well in conditions which provide some flexibility to companies and to the projects that they work on. Another example comes from PKP Energetyka, which opened a unit for research and

<sup>8</sup><https://businessinsider.com.pl/firmy/strategie/innowa-cje-to-jedyna-szansa-dla-energetyki-co-w-tej-kwestii-planuja-polskie-spolki/p6odyv4>

<sup>9</sup> [http://energetyka.wnp.pl/innowacje-w-energetyce-reforma-czy-rewolucja,298891\\_1\\_o\\_o.html](http://energetyka.wnp.pl/innowacje-w-energetyce-reforma-czy-rewolucja,298891_1_o_o.html)

development and created a team for innovative solutions. The company cooperates closely with academia and various scientific institutions where many interesting ideas are born and are waiting for implementation. However, and this opinion is also shared by the vice president for development at PGNiG, better conditions for energy innovation need to be created at the level of Ministries as well as inside companies that want to launch closer cooperation with start-ups. Development of an organizational culture of innovation is something different from establishing departments responsible for innovation with the existing structures and cultures.

Also, the power grid operator, PSE, created a company called PSE Innovation (*PSE Innowacje*) which employs around 60 people. Projects that the company works on include: information systems addressed to the Grid System Operator and various solutions to lower the cost of operating on the Energy market. For example, the company launched a service to reduce demand for energy upon request of the Grid System Operator. Other areas of innovation are technical solutions that lower the cost of electric energy transmission and enhance security of the National Electro-Energy System, such as the new construction of cables with a low energy loss in transmission or anti-frost systems. Information systems are key for PSE, in particular for the integration of the systems applied by PSE with the systems used by the companies which provide the energy supply reduction services.

There is also innovation coming in the renewable energy sector. A Polish company, Saule Technologies, works on photovoltaic panels which use perovskites. The company abandoned the existing photovoltaic technology based on silicon to use a different type of crystals called perovskite. Saule Technologies is working on very thin, flexible and printed photovoltaic cells which should be much cheaper to produce than the traditional photovoltaic cells. Additionally,

perovskite cells are light and semi-transparent which makes them easy to install on different kinds of buildings. The biggest challenge of the new technology is keeping the stability of the cells'. However, Saule Technologies wants to fix this problem soon and provide the first photovoltaic cells for commercial use in 2019. Also, foreign companies actively support energy innovation in Poland. Schneider Electric gives around 5% of its income to innovation—a sum of about €25 billion.

## State and EU funding for energy innovation

There are several public schemes and institution under which innovation in energy can be financed:

- Programme Infrastructure and Environment (2014–2020) €4,905,881,206 from the European Fund for Regional Development and €22,507,865,679 from the Social Fund;
- Environmental Protection Bank;
- Fund for Environmental Protection and Water Management offer funding within domestic funds, EU funds, Norwegian funds, European Economic Zone funds, system of green investments GIS, national budget funds and public support;
- National Centre for Research and Development within its strategic funds, domestic funds, programmes and project in security and defence, international programmes and European funds;
- Horizon 2020 Programme of the European Commission (e.g. UPGRIP with Polish partners Energa Operator, Politechnika Gdańska, Instytut Energetyki, ATENDE and a budget of €15.7 million and €11.9 million funded by the H2020; EU-SysFlex with a Polish partner PSE and a budget of €20 million funded by the H2020)

## Examples

PKN Orlen is a partner in a project financed by the Horizon 2020 programme together with more than 10 partners from other EU member states. The project areas are: electromobility, photovoltaics and energy storage.

PGE launched cooperation with the National Centre for Research and Development to implement models of open innovation in the sector of electric energy.<sup>10</sup> The cooperation aims at increasing innovativeness in the Polish power sector in the areas defined by PGE. Each side will allocate 100 million Polish Zloty for this purpose. The fund will support projects selected in open calls that will be organized several times a year. The first call will be announced by the end of 2017.

## Conclusions and recommendations

The main challenges faced by actors who want to develop energy innovation in Poland are: public procurement regulations, organisational culture of companies, finding good models for interaction with other partners and awareness of global trends. Another challenge is commercialisation of good solutions and the ability to combine the flexibility necessary for innovations to be conceptualised and tried on the market with sustainability of developing particular areas where innovation may flourish.

However, the general trend looks positive and promising. The focus on innovation, not only coming from the EU through various funding programmes, but also a very strong impulse for innovation coming from the government and national funding institutions will bring good results in the long run. What seems especially promising is that there is quite a vast variety of funding institutions, mechanisms and set-ups which allow adjusting funding schemes to different sizes of companies and different products and solutions that they want to try and offer. Innovation needs flexibility both in terms of funding and in terms of the organisation of the process. Innovation also needs collaboration as the best solutions are usually found on an overlap of different organisations, different cultures and

disciplines. Such overlaps are called structural folds in social network analysis and are regarded as a locus for various types of innovation.

A strong recommendation for the government is to continue to set the direction towards innovation and create conditions that would enable companies to have various types of activities that fall outside the business as usual—that represent thinking and doing outside the box. And even if the bold prognosis of the government to have 1 million electric cars driving on Polish roads does not come true too soon, we should still expect to see practices of mobility changing. The change may come sooner in the richer sectors of the society, mainly inhabiting bigger cities, but even a mixed usage of electric vehicles (maybe through car renting) and combustion engine cars will already give some relief to the air in the most polluted urban agglomerations. We should also expect to see many other types of smart innovations in the power sector, which might not be as spectacular as producing a Polish electric car, but will impact on our daily practices in more mundane and sometimes invisible ways.

### Author

**Dr Aleksandra Lis** - Assistant Professor,  
**Adam Mickiewicz University in Poznań,**  
**Poland; Expert in Energy Policy, Sobieski**  
**Institute, Warsaw, Poland**

<sup>10</sup> <http://gramwzielone.pl/trendy/16926/ncbr-i-pge-200-mln-zl-na-innowacje-w-sektorze-energetycznym>