Central Europe Energy Partners
Policy Paper
2017, Brussels

Energy innovations in Central Europe.

Developments, challenges and the way forward

CEEP
Central Europe Energy Partners

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INTRODUCTION

The European energy sector has been changing rapidly in recent years and one of the driving forces of this process is innovation. Most of energy companies recognised the importance of investments in new technologies which bring substantial economic and environmental benefits and allow to adapt to the new market realities. In Central Europe, though not a forefront region when it comes to innovation, companies are increasingly devoted to developing and transforming their businesses, using new technologies and innovations. The efforts are tangible and Central European countries are more and more advanced in the process of energy transition.

National governments have started to promote sustainable energy, innovation and new technologies in energy systems. Energy companies across the region adapt their business models, develop new-tech expertise and offer innovative solutions. Sector of energy-focused start-ups is developing rapidly, while scientific institutes engage in numerous research projects. All of these developments pass largely unnoticed by the majority of external observers.

Although countries do not introduce spectacular R&D policies, there are few eye-catching examples of technological breakthroughs coming from the region. What is happening in Central Europe is more similar to a quiet revolution—a number of steady changes in policies, businesses and academia, which taken together trigger innovation and improve functioning of energy systems.

This paper aims to briefly present major issues on energy innovation development in Central and Southeastern Europe (referred further as EU-11). The concept of energy innovation is blurred and inclusive and it is difficult to determine its real boundaries. So, we treat this topic widely, showing the general changes that lead to modernisation of the energy systems.

The paper is divided into three main sections. The first describes the general approach of national governments and business sectors in the region towards energy innovation. We show the pattern of growing interest in energy innovation and present the main challenges experienced so far, such as low financing levels. The second part shows several examples of energy innovation 'in action'. In particular, the implementation of the new technologies in power production and transmission (inter alia RES penetration and implementation of smart grids), application of new technologies in traditional energy industries (nuclear and clean-coal technologies) and trends of electrification of transport. We also show a few interesting cases of new business models emerging in the energy sector. Thirdly, we offer several policy recommendations to support energy innovation in the region and move the process of energy transition forward.

This paper presents a broad picture of the region and general trends and was drafted with the support of seven research institutions from the Czech Republic (Masaryk University), Hungary (REKK), Lithuania (Kaunas University of Technology), Poland (Sobieski Institute), Romania (Romanian Energy Center) and Slovakia (SFPA) as well as Electric Vehicles Promotion Foundation (Poland).

CENTRAL EUROPE'S APPROACH TO ENERGY INNOVATION. PUBLIC SECTOR

The European Innovation Scoreboard shows that all EU-11 countries perform below EU average in terms of innovation systems. Only Slovenia manages to acquire 'strong innovator' status. The rest of the countries in the region are in the 'moderate innovators' group (the best results had the Czech Republic, Estonia and Lithuania).

The majority of countries in the region had quite a cautious approach towards energy innovation due to financial and economic constraints. The main driver of development in this domain was EU market realities rather than domestic policies and bottom up dynamics. This was mainly the result of different kind of industrial base and limited financial resources from both the private and public sector. Nevertheless, the role of energy innovation has recently gained stronger recognition across the region. National governments have begun to navigate the process of energy transition by introducing specific strategies, policies and enhancing regional cooperation. Meanwhile, companies and the scientific research sector are shifting their attention to energy innovation more often.

Not surprisingly, national governments, beside of e-mobility, widely perceived as an opportunity to modernise and develop already well-established manufacturing sector, focus on the introduction of innovation to already developed areas: modernisation of an existing portfolio of solid fuels power plants (increasing efficiency and clean coal technologies in Poland), nuclear technologies (Romania) or improvement of energy efficiency (the Czech Republic). National regulations themselves appear innovative, facilitating the emergence of the prosumer model and bottom-up development of energy policy (RES clusters in Poland), standardisation and development of trade in biomass (Lithuania).

Improvement of energy innovativeness has been addressed in various national strategies and plans. The common tendency is that governments do not address innovations in the energy sector alone, usually including them as one of many priorities within complex strategies (the Czech Republic), or those related to climate change and environment (Lithuania), or general priorities of R&D (Poland and Romania). With implementation of the forthcoming Regulation on Governance of the Energy Union, energy innovation could be included into long-term strategies of energy and climate policy (such documents are under preparation in Slovakia and Poland). Such approach is justified, taking into account that innovation from its very nature is a cross-area issue. Common problems concern implementation, indicators of progress, and concrete measures to boost innovativeness. Positive development is that, in recent years, besides these highly complex plans, several sectorial strategies focused on development of smart energy systems or promotion of e-mobility have been developed.

Governmental yearly expenditures on innovation in the energy sector oscillates around the EU average—0.03% GDP, which translates into sums in absolute numbers that are not significant. Also, level of expenditures fluctuate significantly over time. For example, Hungary had one of the highest share of public investments in energy R&D comparing to country's GDP in 2012 (fourth place after Luxemburg, Finland and Norway among IEA countries), but this ratio fell below EU average later. In 2016, public spending on energy R&D was as shown in Table 1.

The main problem is the lack of long-term strategy planning of the public expenditures, both its structure as well as overall yearly spending which vary considerably. Endorsement of specific legislation addressing improvement of a regulatory environment for innovation and discussion on a strategic direction of research (for example in 2016 and 2017, Poland adopted the bills on improvement on innovativeness and Estonia advanced in legal framework and practice of e-services), may be regarded as a step in the right direction.

Meanwhile, countries from the region engage in various platforms of regional cooperation aiming at supporting innovation (not only in the energy sector). The flagship initiative in this area is the EU's Strategic Energy Technology Plan (SET Plan). EU-11 countries participation in working groups for its implementation varies across the region. Precisely: The Czech Republic participates in two out 14 Temporary Working Groups (nuclear safety and energy efficiency); Hungary participates in two groups (energy efficiency, CCS), Latvia: participates in one TWG (nuclear safety); Poland: participates in two TWG (nuclear safety and energy efficiency); Romania: participates in one TWG (nuclear safety) and Slovakia participates in two TWG (nuclear safety, energy efficiency).

Innovation has started to be an important part of cooperation in the Visegrad Group. In the middle of 2014 Poland, the Czech Republic, Slovakia and Hungary launched so-

Table 1. Public expenditures on energy R&D, 2016

Country	Expenditures in million EUR	Share by sector in total expenditures
The Czech Republic	18	37% smart systems / 36% nuclear safety
Hungary	27	70% on smart systems
Lithuania*	2.3	51% sustainable transport
Poland	29	47% smart systems / 30% efficient system
Romania*	10	30% RES / 22% smart systems
Slovakia	18	40% sustainable transport / 36% smart system
Estonia	2.4	62% smart systems

Source: European Commission, Energy Union Factsheets for EU countries, November 2017

called Innovation Task Force, which serves as a cooperation platform between countries' policy making bodies dealing with innovation and start-ups. Also, V4 established a Joint Patent Institute in 2015, which allows innovators from the region to get faster and cheaper protection approvals. In 2015 a cooperation agreement was also signed by the V4, which envisage joint promotion of their start-ups and innovative SMEs on international markets (special presentations and conferences in the US's Silicon Valley and Rotterdam). Additionally, V4 countries decided in 2017 to establish a special financing line for innovation projects within €8 million International Visegrad Fund.

A common feature of the analysed countries is that basic financing is guaranteed from national sources while reliance on EU funds is substantial and can be considered as a game changing factor. The financial sources from the EU Structural and Cohesion Funds, Horizon 2020, Connecting Europe Facility, IPA and InnovFin have a multiplier effect on the number of RDI projects and fruitful innovations.

The EU Framework Programme for Research and Innovation Horizon 2020 provides support for innovative projects in the energy sector, related predominantly to low carbon solution, development of renewables and smart services. A breakdown of CEE entities engagement in this initiative is shown as follows:

Table 2. Participation of EU-11 states in Horizon 2020

Country	Grants in million EUR	No. of participants
The Czech Republic	13	63
Hungary	7.8	38
Lithuania	2.5	27
Poland	15	79
Romania	10.6	69
Slovakia	3.3	30
Croatia	4.6	48
Bulgaria	7.8	64
Estonia	12	35
Latvia	6	42
Slovenia	20	67

Source: European Commission, Energy Union Factsheets for EU countries , November 2017

Compared to the above mentioned numbers, an impressive contribution truly transforming the energy sector of analysed countries is provided by the European Regional Development Fund (ERDF) and Cohesion Funds. Overall, from these sources, investments related to energy, low carbon transport and low carbon R&I are to be covered for the impressive sums of (see Table 3).

Moreover, one should notice that the upcoming IV phase of ETS should bring tools to boost innovativeness, too. The establishment of the Modernisation and Innovation Funds would accelerate the pace of innovative solutions for the sector. The Innovation Fund financed by revenues from the sale of allowances can provide around €3.5 billion of support for innovative technologies in the period 2021–2030. For some of the EU-11, particularly important is the Modernisation Fund as it is addressed to member states in which GDP does not surpass 60% of the EU average GDP. It will be financed by auctioning 2% of the total allowances. Funds will be used to support investments in the generation and use of electricity from renewable sources, the improvement of energy efficiency, energy storage and modernisation of energy networks.

PRIVATE SECTOR

As far as the private sector's approach towards energy innovation in EU-11 is concerned it is worth to note that obtaining updated and comprehensive statistical data in this area is difficult. The European Commission in a recent State of the Energy Union Report provided only some estimations until 2013. Data showed that only 2.5% of the overall EU's private investments into the Energy Union R&I priorities came from the EU-11 in 2013. The European Commission estimated that Poland in 2013 had the highest private sector expenditures in the region (€182 million). It was followed by the Czech Republic (€62 million), Slovenia (€49 million), Hungary (€31 million), Romania (€26 million) and Slovakia (€25 million)

A positive trend however, is that the EU-11 is a big recipient of FDI—large-scale investments are often followed by the development of R&D centres. This may be a case of an LG Chem investment in the biggest in Europe batteries factory located in Poland which will be followed by establishment of research centre. Simultaneously, the biggest R&D investors are branches of multinational companies operating in the region. For example, ABB has a research centre in Poland as well as General Electric with over 100 million USD spend annually on R&D activities (inter alia in the area of steam turbines, generators). Recently, GE also opened a research centre in Romania, dealing with innovative solutions in power grids (so-called Power's Grid Software Solutions).

Simultaneously, local companies are clearly shifting their strategies towards innovation. This is in particular the case of local utilities and companies from the oil and gas sector. They are expanding their research divisions and trying to establish closer links with the start-ups sector and universities. For example, Polish oil company Grupa LOTOS, jointly with scientific institutions, has launched the HESTOR research

Table 3. ERDF and cohesion funds granted for MS

Country	Expenses in low carbon transport in million EUR	Expenses in energy and low carbon R&I in million EUR
The Czech Republic	3,040	2,508
Hungary	2,439	2,121
Lithuania	626	977
Poland	12,954	6,085
Romania	3,745	1,532
Slovakia	1,600	1,061
Croatia	557	760
Bulgaria	668	1,174
Estonia	392	222
Latvia	630	459
Slovenia	188	384

Source: European Commission, Energy Union Factsheets for EU countries , November 2017

project, co-financed by the National Centre for Research and Development. The project is designed to examine the efficiency of storing hydrogen obtained from surplus energy from renewable sources which could be stored in salt caverns and used in technological processes at the company's refinery and for electricity generation, thus reducing the need to generate hydrogen from natural gas; or for energy generation as a fuel firing gas turbines during peak demand hours.

The companies also build innovation consortia as a way to lower R&D financial burden and find synergy between their operations. For example, four Polish power companies (PGE, Tauron, Energa, Enea) created the Electromobility company, which develops a concept electric vehicle. Also, the two largest Czech companies, car producer Škoda Auto and power utility ČEZ, plan to work together to develop infrastructure and electric cars.

Another phenomenon is the increasing popularity of networking formulas between the private and public sector and the emergence of the start-up sector. There is a growing number of participants in competitions such as the New Europe 100 project—a special award for best innovators and political and social leaders from Central and Eastern Europe. The competition is organized by Google, the Visegrad Fund and two prestigious media partners.

In Poland, Warsaw University of Technology together with PGE has been implementing a project "Kampus +" which intends to create the largest innovation center associated with the Smart Living area in Central and Eastern Europe. The aim of the "Kampus +" program is to build an ecosystem that integrates cooperation between the world of science and economy within an organized space and infrastructure, in which concrete solutions of project partners will be tested in real conditions. The effect of research and activities is to create a modern Polish sector of intelligent commercial and residential construction - Smart Living.

Big energy companies are opening also special programmes precisely focusing on the cooperation and support for promising start-ups. Czech utility ČEZ has been actively searching and investing in energy start-ups across Europe through its venture capital arm Inven Capital which has around €190 million budget. Inven Capital invested so far into start-ups dealing with car-sharing, battery technologies as well as heating and cooling solutions. Polish Oil and Gas Company (PGNiG) launched the InnVento programme in 2016, with a budget of approximately €160 million till 2022. MOL engaged in the Design Terminal, a special training programme for start-ups working on e-mobility, loyalty marketing or big data, retail services and parcel delivery. A similar path followed electricity companies from Poland: PGE and Tauron, which decided to establish special entities: PGE Ventures and Tauron Magenta (with a budget €10-20 mln), dedicated to permanently cooperate with start-ups. Also, Lithuania's power utility Lietuvos Energija established €5 million start-up fund.

Lithuania, in cooperation with foreign business and academia, has built a unique LNG cluster around its terminal. Cluster develops innovation projects (inter alia in logistics and LNG distribution) and focuses on education and training activities. Poland has recently launched the energy clusters initiative—unique at the European scale concept of forming local associations which would be involved in production, trade and distribution of energy at their respective level. Another interesting case is InnoEnergy Central Europe—a branch of KIC InnoEnergy—an initiative founded through the European Institute of Innovation & Technology (EIT), which invest in start-ups, advise bigger companies in innovative projects and offer help in the process of building innovative consortia around particular projects. Its local branch InnoEnergy Central Europe—with the office in Poland but focused on EU-11—dynamically expands its partners in Slovakia, the Czech Republic and Hungary by building a network of hubs to provide local services connecting energy innovation companies. InnoEnergy Central Europe has also launched a competition call for energy start-ups called 'PowerUp!' where companies from the region can win prizes up to €20,000 in cash and €150,000 for investment.

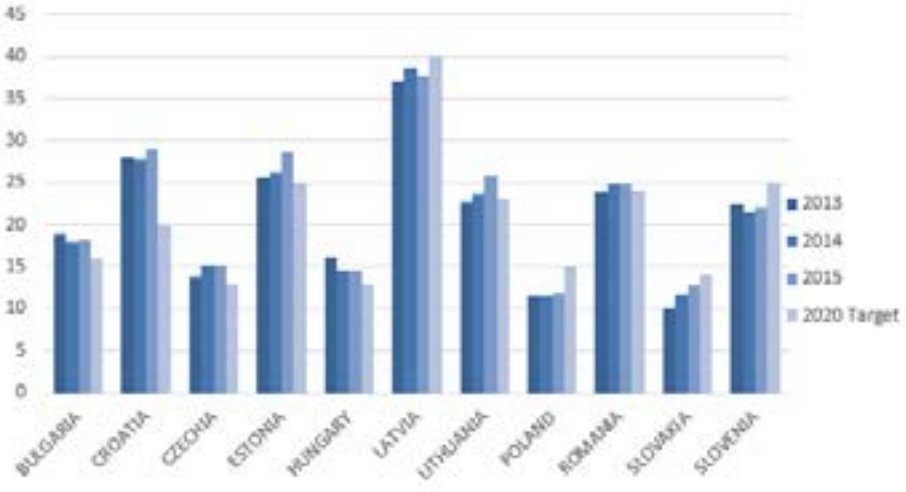
ENERGY INNOVATION DEVELOPMENT

RENEWABLES EXPANSION

A key innovation which gets power generation systems of the EU-11 refurbished is the development of renewable energy. Analysis of this process in CEE proves the importance of technological neutrality principle that guarantees a level playing field for different technologies – particular CEE countries focused on development of different type of RES technologies depending on their natural conditions influencing strategies of market participants (be it prospective development of offshore wind in Poland, or standardisation of biomass trade in Lithuania).

The process has been relatively successful as in 2015, all of the countries in the EU-11 have surpassed their indicative trajectory for RES deployment for 2015/2016 and some of them with a large margin, which means the region is well on track to achieve its respective contribution. Precisely, 7 countries out of 11 have already reached their 2020 targets for the share of renewables, namely Bulgaria, the Czech Re-

Table 4. Development of RES in selected countries of CEE (2015)



Source: Eurostat

public, Croatia, Hungary, Estonia, Lithuania and Romania. The leaders are Latvia with 37.6% and Croatia with 29%. In Poland installed wind capacity grew 20-fold from 2006 to 2012 and this makes it now already the 7th market for wind in the EU. The largest Polish power producer PGE has in total 2.181 MW of RES capacity. It is worth mentioning that Poland, as well as the Baltic States, have a huge potential for growth in renewables, particularly offshore wind, and Romania and Bulgaria in the PV deployment. At the same time biomass constitute the important source of RES in the region.

One of the most profound problems of the development of RES in the region are higher investment costs than in the western part of the EU (particularly cost of capital). The second challenge is the question of support schemes. In this regard, CEE followed wider European trends marked in recent years by series of retroactive changes in existing support schemes due to soaring expenses. Annual costs of the feed-in-tariff system in the Czech Republic in 2012 was around €1.3 billion, in 2015 it was almost €2 billion (45 mld CZK). The costs of Poland's green certificates system was around €765 million in 2012.

NUCLEAR INNOVATIONS

Nuclear energy plays an important role in the energy systems of almost all Central and Southeastern countries (nuclear is not used only in Poland and Baltic countries). Moreover, countries in the region have a well-developed network of research institutes and specialised engineering companies of the nuclear sector. In fact, the most expensive and spectacular energy innovation projects in the region come from nuclear domain. One of the flagship projects is building high-power laser infrastructure (so called Extreme Light Infrastructure—ELI). It will be the world's most advanced research facility dedicated to the study of photonuclear physics and its applications. This is the first project under the European Strategy Forum on Research Infrastructures, which is located entirely in the region: the Czech Republic, Hungary and Romania. The project has been scheduled for operation in 2019 (there will also be another stage). Entire cost of the project is estimated at €850 million and already around €400 million were provided under structural funds. Another key project is the preparation to build the experimental fast nuclear reactor ALFRED in Romania. This project is developed by the international consortium comprised of research institutes from Romania, the Czech Republic and Italy. The total cost of the project is estimated at €1 billion, but its financing remains uncertain and the project is still in the early stages of preparation.

Meanwhile, the Visegrad Group in 2013 intensified cooperation in nuclear research by forming the association of nuclear research institutes cooperating with French CEA. The main goal is to develop a IV generation nuclear reactor cooled by helium. Research is held within framework of the EU VINCO programme supported by the European Commission and Euratom.

GEOTHERMAL

Hungary has been conducting research on its geothermal potential for development of heat and electricity and development of this technology. In 2016, it started construction on a small-size (2.6 MW) power plant which is the first geothermal electricity power plant in Central Europe. The Turawell geothermal power plant started the commissioning phase in September 2017, and it should be officially opened by the end of 2017. The power plant is a combined heat and power plant, with 3 MW electricity and 7 MWth heating capacity. Turawell is using 129°C water coming from underground and should ensure electricity for 800 families during the whole year. In Romania, interesting and already implemented project is "Beius- geothermal city" worth €4.3 million and funded from EU's structural funds. It is the first city in Romania to be heated entirely with geothermal energy (more than 200,000 Gcal of annual heat consumption).

In Poland, from 2001, a geother¬mal plant of 40 MW has been in operation in the south of the country, in Bańska-Biały Dunajec (Ge¬otermia Podhalańska), and provides heat for the local cities and villages. These exam¬ples can be followed by the Czech Republic and Slovakia where favourable geothermal conditions are proven by the geologists' researches.

CONVENTIONAL GENERATION, CCS, CLEAN COAL TECHNOLOGIES, MINING

A significant share of energy supply in Poland, the Czech Republic, Romania and Bulgaria traditionally comes from coal, which makes energy transition more challenging for those countries. The majority of companies focus on modernisation of conventional generation, and implementing projects related to increasing efficiency of existing power units and limit the emissions.

Interesting option is also using integrated gasification combined cycle (IGCC) installations in power plants, which characterize with high efficiency levels (45-55%) and low emissions. The Czech Republic has one operational ICGG power station in Vresova (400 MW) since 1996, which relies on brown coal and installed liquid gasifier from Siemens. The possibilities of using more modern technology was investigated but without investment decisions. Meanwhile, Polish utility Enea announced its plans to construct an IGCC power plant of 300-500 MW near Bogdanka. The investment decision should be made in 2018. In Romania there are works to modernize gas power plant in Iernut till 2019. Power plant is owned by main oil and gas company Romgaz. Modern technology, which will allow to reach 56% production effectiveness and 37% reduction of emissions comparing to current levels, will be provided by Spanish DF Energy, General Electric as well as Romanian Romelectro (research and engineering services). Croatian HEP in his CCGT Power Plant in Zagreb implemented a project 'Piping Construction for Measuring Fluid Flows' which gives possibility of the accurate measurement of waste water flows by conducting classical measurements of small diameter flows regardless of any possible large flow fluctuations.

Poland is particularly interested in the application of innovative solutions that decrease emissions and improve efficiency in the process of using coal. In fact, Poland was the only country from the region which experimented with Carbon Capture Storage (CCS) technology. However, the demonstration power plant with CCS installation in Bełchatów was abandoned in 2013 due to financing, legal, and technical risks. This was, however, not a big surprise as all CCS projects in the EU had failed so far as they are very expensive and difficult to commercialize. In this regard, the future of CCS is seen in the development of small-scale installations comprised within industrial clusters.

Poland seems to be also regional leader in searching for

clean coal technologies. Polish Platform of Clean Coal Technologies, which serves as a discussion forum for learning and exchanging experiences, was established by power companies in 2008. The Clean Coal Technologies Centre (CCTW) was launched in 2012 in Zabrze. This unique in the world research facility involves inter alia an experimental mine. It works on the more energy efficient type of coal for domestic heating purposes (so called 'blue coal'). However, commercialization of the clean coal technologies is still far away.

Also, there is a project of methanisation of CO2 conducted by Rafako and Tauron power companies, while PGNiG is developing technologies to capture methane from coal mines and to reuse it. In 2017, PGNiG established the International Centre of Excellence on Coal Mine Methane. It is a world first institute in this area. It was founded jointly with Polish geological and mining research institutes and operates under the auspices of the UN Economic Committee for Europe. PGNiG runs also a special programme (Geo-Metan) to explore technological possibilities to extract methane from coal deposits.

An interesting case of innovation in the mining industry can be brought by Slovakia's GA Drilling company, which is developing a new drilling technology based on a plasma generator. The technology called PLASMABIT can be used to reach deep underground oil and gas, minerals and geothermal resources. The Slovak company claims that it will commercialize the new technology in 2019.

POWER GRIDS INNOVATIONS

Increased penetration of intermittent RES and an ongoing shift towards decentralized generation poses challenges for TSOs and DSOs. Introduction of innovations are a key tool to upgrade networks and adapt them to changing generation patterns.

Regarding smart metering systems, member states have an obligation on the roll out of the smart metering system, if results of cost-benefit analysis are favourable, which is in line with the EU legislation, particularly Directive 2009/72/EU. Smart energy accounting and management systems, as well as smart meters that allow energy companies to receive data on a number of energy generation and consumption aspects are key enablers to changing pattern of energy consumption and emergence of prosument model. These data will enable the companies to discover new innovations to create better energy services.

Estonia is a leader in the EU in terms of deployment of smart metering systems. Smart meters roll out covers 100% of customers. In the Czech Republic, there is no obligatory roll out of smart metering systems, however in line with the National Action Plan for Smart Grids (2015) it is expected that smart meters implementation will start before 2019. The plan sets four implementation stages of smart grids development with the final date set on 2040. The most ambitious project developed so far by ČEZ in partnership with FUTUR/E/MOTION assumes installation of 32,000 smart meters. In Lithuania, smart solutions are already being implemented by the company Energijos Skirstymo Operatorius (ESO) with the pilot project of 3,000 smart meters and the cost-benefit analysis of the implementation of smart meters which revealed that, after the introduction of smart accounting, the residents would be able to save at least 7% of electricity per year. It is estimated that the 4-year project investment valued at €219 million would generate €88 million of a common economic value.

In Poland, economic analysis proved that the roll out of smart meters is economically viable. Since 2009, it has achieved considerable work on smart metering including the establishment of platforms of cooperation, amendment of the energy law and work on minimal standards and the interoperability process of smart meter installation. The total number of smart meters installed is around 500,000—3% of final-end consumers. By 2024, 80% of consumers should be equipped with smart meters. 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. ISE has been operating for seven years, starting in 2012, and will end in 2018 with a total budget of around €80 million. A particular case worth mentioning is the PSE Smart Grid Demonstration project which aims to test on the assigned grid area functionalities of the Special Protection Scheme (SPS) and hybrid Battery Energy Storage System (BESS) in order to increase power system security. A combination of wind farm and two components—smart grid and storage—makes it unique in the world scale. The project is being developed in cooperation with Japanese New Energy and Industrial Technology Development Organisation (NEDO), Hitachi and Sumitomo Mitsui Banking Corporation.

In Romania in 2013, a study revealed positive results for smart metering. Installation of resources, led by ENEL and E.ON comprise 60,000 consumers. Also in the area of smart grids, Romania is performing well. Smart Grid Brasov is one of the first smart grid projects implemented by Electrica (state-owned distribution utility) together with Ormazabal and Flashnet. In 2010, the Brasov pilot covered seven transformer points and implemented the PRIME (Powerline Intelligent Metering Evolution) and 5–10,000 residential and industrial customers and was worth €5–7 million. In 2015, the Slovakian government approved the roll out of smart meters for selected customers depending on their respective energy consumption. Until the end of 2015, 30,000 devices had been installed, and there is a plan to reach 600,000 by 2020.

Table 5. Smart Grid Project Outlook

Type of projects	CZ	HU	LT	PL	RO	SK
Demonstration Projects	9	10	3	16	14	4
R&D projects	13	7	2	34	16	8
National projects	2	2	0	9	2	1

Source: F.Gangale, J. Vasiljevska C. Felix Covrig, A.Mengolini, Gianluca Fulli, Smart Grid Projects Outlook 2017, 2017

A positive tendency is the emergence of international smart grid projects which require cross-border cooperation of several TSOs and DSOs. An example may be: RE-SERVE—Renewables in a Stable Electric Grid. Its developers are entities from Germany, Italy, Ireland and Romania (Transelectrica and Polytechnic of Bucharest). The Germany-led project aims to develop solution stabilising energy systems with up to 100% RES and features research into new energy system concepts. Romania is one of the two trial sites. Similarly, SINCRO.GRID is a smart grid project that enhances links between the electricity grids of Slovenia and Croatia and gives a boost to the use of renewable energy in the region. The project will integrate several innovative technologies to ensure that grids have the capacity to efficiently transmit electricity across the border between the two countries. Another example is the smart grid ACON project which targets to foster the integration of the Czech and the Slovak electricity markets. ACON aims to efficiently integrate the behaviour and actions of grid users in order to ensure an economically efficient, sustainable electricity system with low losses and high quality and security of supply and safety.

INNOVATION IN TRANSPORT AND E-MOBILITY

Electric vehicles (EVs) market is limited across EU-11. Electric cars fleet has highest car numbers in Czechia, Estonia and Poland. Publicly available charging stations are growing with largest numbers of stations reported in Czechia, Slovakia, Slovenia and Estonia. Nevertheless, the EV's market share in total sales remains low and oscillates between 0.1-0.6% of total sales in 2017 with the best results in Slovenia, Latvia, Hungary and Slovakia (see Table 6).

Estonia clearly distinguish oneself from the region – small country has relatively large EVs fleet and developed network of charging stations. This is the result of the Estonian electro-mobility programme (ELMO) launched already in 2011, which envisaged generous subsidies schemes as well as special mechanism to support development of public charging stations (financed from sales of ETS emissions allowances). Government was covering 50% of new EV costs up to 18,000 euros. As the result EVs market share was high and close to 2% in 2014. However, the sales plummeted after subsidies were scraped after 2014.

Meanwhile, other countries such as Hungary and Poland are putting e-mobility in the centre of their energy, innovation and development policies. Hungary is definitely the most advanced country in the region in terms of creating favourable conditions for the development of the EV market. The government introduced several support schemes for EV buyers (tax reductions, grants) and for municipalities (grants for building electric charging stations). Also, a special body (E-Moby) was launched with the task to develop a charging stations network. Many Hungarian municipalities introduced various incentives for EV users such as free parking. By the end of 2019, new testing ground for the automotive industry will be built in western Hungary with the support of the state. This 250-hectare facility will allow to test new solutions for autonomous car and offer a chance to collaborate with research and educational institutes.

In Poland, e-mobility is becoming a flagship initiative of the current government. The fund for Low Emission Transport was created with the goal to support the EV market and charging infrastructure for alternative fuels. The fund will have an annual €35 million budget starting from 2018. There are no incentives for EV motorists so far, but the government plans to support electric buses deployment by imposing a binding target of 20% electric vehicles in local public transport by 2025. For some of the countries, strong support schemes for EV are still perceived as socially unfair as electric vehicles are more expensive than classic vehicles. Meanwhile, Romania introduced a small-scale support scheme for the development of charging infrastructure.

Another positive development is shifting the strategies of the automotive industry in the region towards e-mobility and the build-up of EVs production capacities in the region.

Table 6. EVs market in Central and Southeastern Europe

Country	EVs market share (2017)		Publicly accessible charging stations (2017)	EVs fleet (June 2017)	
	2014	2017		Passenger cars	Buses
Bulgaria	0.0%	0.0%	21	58	52
Croatia	0.1%	0.0%	234	436	9
Czechia	0.2%	0.2%	546	1.382	18
Estonia	1.7%	0.3%	384	1.220	24
Hungary	0.0%	0.4%	213	567	-
Latvia	1.4%	0.6%	72	324	-
Lithuania	0.1%	0.2%	26	160	-
Poland	0.0%	0.1%	329	976	148
Romania	0.0%	0.2%	110	368	6
Slovakia	0.1%	0.4%	442	568	-
Slovenia	0.1%	0.6%	483	720	-

Source: European Alternative Fuels Observatory

In Slovakia one hybrid model is already produced by Volkswagen. In Hungary, Audi produces EV models and there are two electric bus factories. Poland is also specialising in electric buses. Czech companies Škoda and ČEZ are intensively planning to create a joint venture to develop charging infrastructure and production of electric cars. Romanian Dacia (part of Renault) signals that it wants to produce the 'cheapest' electric car in Europe. Polish consortium of four power utilities ElectroMobility has been working on a new design of electric vehicle, while two local e-buses manufactures (Solaris and Ursus) are ramping up sales. Moreover, Poland can become EVs battery production leader. Korean company LG Chem builds the largest factory in Europe with the capacity to produce 100,000 EVs batteries per year. The factory should be operational in 2019. Meanwhile, Samsung SDI company will open EVs battery factory in Hungary in 2018 with 50,000 batteries produced per year.

In fact, electrification of transport could be a natural area for research and innovation activities in Central Europe. The region plays important role in automotive production in Europe – multinational companies located various plants in Slovakia, the Czech Republic, Poland, Hungary, Romania and Slovenia. Moreover, EU-11 countries are well integrated in global car supply chains. The role of automotive industry is especially important for Slovakia, where it has 12% share of GDP and 44% of the country's industrial production. In short, there is definitely a potential to build R&D activities around strong manufacturing base of automotive industry in Central Europe

Meanwhile, there are numerous examples showing that EU funds are an important driver for innovative low-carbon transport solutions in the region. Slovak company GreenWay, which is already perceived as a regional e-mobility tiger, was awarded two separate grants under the Connecting Europe Facility (CEF), for the Green Hubs Project and the Central European Green Corridors Project to build a network of fast charging stations in Slovakia and Poland along the TEN-T corridors. Hungarian MOL together with Czech, Slovak, Hungarian and Romanian branches of E.ON have recently received almost €19 million under CEF to build more than 250 charging stations across the region by 2020 (so-called the NEXT-E project). Also, the Hungarian Gas Cluster Association is developing a pilot project of using LNG in transport (so-called PANNON-LNG). It received almost €15 million from CEF for the construction of 5 LNG filling stations and a small-scale liquefaction plant in Hungary. The infrastructure will serve heavy-duty vehicles. The association also received almost €10 million to develop CNG filling stations, which will be used by quite widespread CNG buses network in Hungary.

NEW BUSINESS MODELS

There is a growing number of successful business models based almost entirely on innovation in the energy sector across the region. One of the best examples is virtual power plants (VPPs) launched by small-scale combined heat and power plants (CHP) in Hungary. This innovative business model was triggered by cancellation of a generous subsidy programme for small gas-fired CHPs in 2011 (mechanism of guaranteed feed-in tariffs). In order to avoid bankruptcy, several CHP operators teamed up and invested in sophisticated IT solutions, which allow to control production and offer electricity on a more competitive balancing market. In 2016, eight VPPs operators were active on the Hungarian market with overall capacity of integrated units close to 600 MW. Polish company VVPlant is working on a similar project. The company offers an IT service (Enabler Demand Side Response) to shopping malls and office buildings to optimise electricity usage and sell it during peak times on the balancing market. The company estimated that industry and large volume buildings in Poland can offer 1 GW capacity if formed into a virtual power plant. Meanwhile, there are numerous innovative companies, such as Bulgarian ProSmart or Climate, which offer innovative technologies to optimize, via mobile phone applications, heating and cooling systems in households.

As mentioned above, Slovak private company GreenWay has built its business model around integrated e-transport services—building charging stations. However, its business model also includes offering electric vehicles for rent. GreenWay, unlike other companies, focus on light trucks and aims to be an important partner for companies in the transport and logistics sector.

New technologies can completely transform the way energy markets work. A great example in this respect is the story of biofuel exchange BALTPOOL in Lithuania. Before its establishment, the Lithuanian biofuel market was rigid and intransparent—all trading was based on bilateral deals on local markets with no clear price reference. The situation changed when BALTPOOL was created and the government imposed a legal obligation to trade with biofuels exclusively through the exchange (unless there were cheaper options) on all regulated heat providers. This entirely changed the way the market operates—trading become more flexible, simple and transparent. Moreover, the exchange started to be a reference point not only in the country but also in neighbouring states. Currently, more than 30% of all traders in Lithuania (not only those required by law) use BALTPOOL and traders from other Baltic countries and Belarus are also using the platform.

Business models based on energy storage technology are also gaining more presence in the region. One of the examples is the success of Skeleton, an Estonian start-up, which grew into a small-medium company with an assembling facility in Germany. The company offers back-up energy-storage solutions for data centres and manufacturing plants which require uninterrupted and stable power supply. Energy storage projects are also developed by E.ON Hungary and ALTEO, Hungarian power producer. E.ON Hungary works on an 'energy container,' which will include photovoltaic panels, battery and hydrogen cylinders for remote houses which do not have access to the power grid. Meanwhile, the ALTEO project will offer an integrated batteries system connected with renewable sources and a power grid via a designated dispatching centre. This will allow them to not only store energy and regulate production but also to offer ancillary services for the transmission system operator. Another interesting case is a project developed by Polish utility PGE. The company has been investing into energy storage from surplus wind farm production and hydrogen refuelling stations for which within six years, expenditures may amount to approximately EUR 80 million.

CONCLUSIONS AND RECOMMENDATIONS

Tough EU-11 do not appear as the innovations leader, it would be a mistake to treat the region as an innovation 'no man's land'. In fact, the region is buzzling with innovation success stories and energy transition ideas. They should be cherished and embraced, especially taking into account that the region has just begun its energy innovation journey from a much more difficult position than the Western Europe.

In fact, there is an emergence of 'energy innovation culture' in the region. First of all, issues connected with energy transition and supporting innovative industries has become an important part of policy making. And it is not only about approving national strategies or intensification of cooperation within EU and regional frameworks, it is rather the fact that innovation has become a politically fashionable and indispensable part of national public discourses. Public awareness and social acceptance for sustainable and innovative ways to produce and consume energy is growing as is shown by a growing number of smart grids projects and dynamic renewables expansion.

Secondly, energy companies are shifting their attention towards innovation by expanding R&D divisions or building links with flourishing start-ups. Indeed, this is still mainly the case of most resourceful utilities and big oil and gas companies. Nevertheless, there are several small and successful companies, which build their business model around energy innovation. Good examples in this respect are virtual power plants launched by small CHPs in Hungary, the e-mobility champion in Slovakia or the biomass exchange in Lithuania.

Thirdly, research institutions are becoming more active in energy innovation. They are involved in many pan-European projects and the most spectacular example is the world-class laser facility developed in Romania, Hungary and the Czech Republic. At the same time, Polish research institutes supported by the power and coal industry are developing highly advanced expertise in clean-coal technologies.

Despite this positive dynamics, there are number of challenges to be addressed in the region. Below we offer several policy recommendations which can support energy innovation and facilitate the process of energy transition.

Recalibrating national strategies and building innovation-friendly legal frameworks. Despite positive developments in the case of approving national strategies which support innovation industries (such as e-mobility) there is still a need for clear, target-based documents with concrete indicators of progress. Some strategies are bold and ambitious but lack appropriate financing and tailored policy instruments. This is crucial as businesses need clarity and predictability to make decisions about capital-costly innovation investments. Moreover, there is a need to improve public-procurement legislation which usually do not facilitate innovation (with price as usually the only criteria). More transparent rules connected with competitive distributing of the limited public resources on R&D (e.g. through tendering schemes) are needed in some countries.

Public sector financial support for energy innovation. Energy innovative solutions are highly risky endeavours and some public support seems to be inevitable. This is particularly the case where high infrastructure expenditures are needed to develop business. Nevertheless, it is necessary to keep the private sector as a key driver of energy innovation to avoid market distortions. Meanwhile, public institutions, which are large energy consumers, might get involved in testing innovative solutions such as grid management and measurement.

More active involvement in EU funded projects, particularly H2020 and SET plan. It can bring benefits in terms of research of new solutions and technologies, extend their network of contacts and serves as "Europeanisation" of the companies.

Energy companies from EU-11 region should spend more for R&D in order to stay competitive on the global market. The landscape is rapidly changing and without more funds dedicated to the innovations, they can stay out of major trends. There is a positive tendency in this regard in the recent years, mainly related to establishment of start-up platforms, however there is still a need to increase these funds.

Involvement in regional cooperation.
Potential of regional cooperation in innovation seems still untapped in EU-11. The Visegrad Group initiative in supporting start-ups is a good example to follow, but more active regional cooperation seems a crucial tool to obtain access to various research and structural EU funds. Moreover, companies from the region share some common features and challenges which can facilitate their cooperation in this regard. Research organizations should strengthen their cooperation and look for stronger links with business sector.

Improvement of databases on the energy related R&D. Obtaining valid statistical information is a huge challenge across the region as the methodology is complicated and not updated. This is not only the problem for statisticians but also for policy makers and businesses. Lack of data may result in suboptimal policy and investment decisions. It is important, however, that datasets should contain information useful for the market players, as otherwise it would become just an additional bureaucratic burden for the market participants.

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