Economic Challenges of Energy Security Strategies in the European Union: Lessons for Ukraine

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Abstract. *The article analyses current economic challenges of Energy Security Strategies in the EU in conditions of the Fourth Industrial Revolution. It reflects information, economic and technological transformations that lead to formation of Energy 4.0. It shows the areas where decisions need to be taken or concrete actions implemented in the short, medium and longer term to respond to energy security concerns in the EU as well as in Ukraine. The article also highlights the directions for providing energy security in Ukraine with the potential of energy renewables as well as measures for reduction negative impacts on energy security in Ukraine.*

Keywords: *energy security, sustainable development, economic growth, green energy, energy subsidies, Industry 4.0, Energy 4.0.*

1 Introduction

Energy security strategies are the core pillar for economic growth on the way to sustainable development. The Fourth Industrial Revolution brings new challenges and forms the basis for Industry 4.0. The European Union is constantly seeking for information, economic and technological transformations that would lead to formation of Energy 4.0 concept. Current energy security issues are an urgent constituent part of sustainable development strategies. Reflecting on the way how societies and businesses change their modes of action in condition of Industry 4.0 is urgent especially nowadays when the EU is looking for energy security strategies. For Ukraine there is a strong need to develop its own Energy 4.0 sector. The EU energy security issues are raised by A. Alekseev, A. Hadfield, S. Tagliapietra (Tagliapietra, 2014), G. Rabanal Nuria (Rabanal, 2016), B. Yilmaz, etc. Ukrainian energy security issues are in the scope of research interests conducted by V. Dergachova, V. Evtushevsky, V. Loiko, A. Pabat, Ye. Sukhin, A. Sukhorukov, etc. The objective of the paper is to analyze current energy security strategies in the European Union as well, as to suggest directions for providing energy security strategies with the potential of energy renewables in Ukraine. Another goal is to develop measures for reduction negative impacts on energy security.

2 The Fourth Industrial Revolution: Industry 4.0 to Energy 4.0

The Fourth Industrial Revolution is a logical continuation of the Third Industrial Revolutione the last is synergetic basis and driving force of socio-economic systems development. The term “Industry 4.0” is a buzzword used widely in German speaking countries for the Fourth Industrial Revolution currently taking place. Other terms frequently used in this context are cyber-physical systems, internet of things (IoT), smart factory, smart product, big data, cloud, machine to machine (M2M) (Lang, 2016).

The Fourth Industrial Revolution concept has received great significant after the speech at the International Environment Forum in Davos (January 2016) of one of the main theorists of “Industry 4.0” phenomenon Swiss economist Klaus Schwab. He described this phenomenon as the blurring between physical, digital and biologic areas (Schwab, 2016).

For the first time the concept of the Fourth Industrial Revolution has been formulated at the Hanover Fair in 2011. The phenomenon was defined as the introduction of cyber-physical systems in production processes. Currently it is Germany that is taking the leadership in the Fourth Industrial Revolution. A public-private program “Industrie4.0” has developed. Large German corporations having research grant support from the Federal Government are to create a fully automated production lines (smart factories), in which products interact with each other and consumers within the concept Internet of things (Хель, 2016).

The Fourth Industrial Revolution led to new modes of energy production and consumption. We cannot but mention that renewable energy sources such as solar and wind provide energy production with minimal labor costs at the use stage. American economist John Rifkin called this phenomenon as energy with "zero maginal costs". In addition, in the process of renewable energy use costs materialized in the extraction and processing of raw energy are practically excluded compared to the carbon and nuclear energy.

Physical energy world is a quickly changing world. The basic directions for changes here are:

– intermittent renewables;
– nuclear phase-out;
– new transmission and distribution grids;
– new ways of storage.

Ongoing digitalization of industries causes the transition to renewable resources. First of all, we are talking about renewable energy sources. "Green" energy (solar, wind, geothermal heat, tidal energy) allows doing without fuel and chemical processes of burning it. It means that from production cycles are eliminated entire industry links that ensure: the extraction of mineral resources, recultivation of ruined landscapes, transportation of raw materials (cars/dry cargo ships – in the case of charcoal or tanks/pipelines/tankers – in case of oil and gas), fuel combustion in power plants; manufacturing of purification equipment and waste management, as well as the processes of creation of engineering and construction companies, which generated power for the realization of all these processes. Although, we must not forget that installations for generating renewable energy also incurs costs.

Effective energy storage is one more issue that needs a particular attention. This direction for development of technological systems can eliminate the controversy between when to produce energy and when there is a need for its use. Thermal power plants operate most efficiently at a constant mode of operation, i.e., if energy production during the day remains constant. Nuclear power plants generally cannot change its mode of operation. If it stops, it will take a long time to start it again.

The need for energy changes all the time, for example, in the afternoon (when most businesses run) it is significantly higher than at night when plants stop. As long as people do not learn how to accumulate energy in a large amount, we will just lose it. In the night time many power stations so that not to produce more energy than people consume. Otherwise, a trouble may happen, and the power supply grids will be damaged because of over-voltage.

The need for accumulation of electricity will be even higher when solar and wind generators will be used to the full. Sun and wind energy unlimited quantity storage is necessary when there is an appropriate storage grid for renewables. Digitalization of energy storage, smart energy storage grids may help.

Today, smart networks of different levels are created. Here belongs a smart factory, a smart house, a smart city, a smart road. But all of them are formed and function on the basis of a permanent connection to the Internet, EnerNet. Green economy and green energy functioning in its framework requires a radical transformation of communication basis. Moreover, we can confidently say that without such reforms neither green economy nor green energy can be implemented. The main reasons are as follows. In contrast to the traditional energy, which is based on large-volume processing capacity, green energy uses a huge number (hundreds of millions of units planned only in the EU) of small generating plants. It means that there must be a significant deconcentration of energy sources. In fact, every family, while remaining an energy consumer, is converted to its manufacturer. These different separate sources of energy can be a real productive force only when they will be combined into a single information system to provide better energy security system. These are the key issues for the EU and Ukraine.

3 Energy security strategies in the EU

As Rabanal Nuria G. mention "there are major uncertainties surrounding the EU energy system, around future demand as well as the impact of the new technologies and the location of generation" (Rabanal, 2016). The European Union faces a number of very serious challenges because of scarcity of national energy resources.

For the formation of a reliable Energy Security Strategy the so called stress tests were carried out by 28 European countries. The tests simulated two disruption scenarios: a complete halt in Russian gas imports to the EU and a disruption of Russian gas imports along the Ukrainian transit route (Stress, 2014).

The European Commission released its Energy Security Strategy in May 2014. The Strategy aims to ensure a stable and abundant supply of energy for European citizens and the economy (Energy, 2016).

Table 1 Short-term and long term Energy Security projects in the EU (European, 2014)

A	Short-term projects	(2014–2016)	
#	*Name project*	*Details*	*Finished by*
1	2	3	4
	Baltic gas market		
1	LT: LNG vessel	Vessel (not a PCI). Status: under construction	End 2014
2	Klaipėda-Kiemėna pipeline upgrade	Capacity enhancement of the connection from Klaipėda to the LT-LV interconnector. Status: EIA and engineering design	2017
	Gas optionality in Central and South-East Europe		
1	PL: LNG terminal	Terminal in Swinoujscie and connecting pipeline (not a PCI due to maturity). Status: under construction	End 2014
2	EL-BG interconnector	New interconnector to support diversification and deliver Shah Deniz gas in Bulgaria. Status: permitting, EIA (2 years delay)	2016
3	EL-BG reverse flow	Permanent reverse flow on the existing interconnector (alternative/complement to IGB). Status: pre-feasibility	2014
4	BG: storage upgrade	Increase storage capacity in Chiren; Status: pre-feasibility	2017
5	HU-HR reverse flow	Reverse flow enabling gas flows from Croatia to Hungary. Status: feasibility studies.	2015
6	HU-RO reverse flow	Project to enable gas flows from Romania to Hungary. Status: feasibility studies	2016
7	BG-RS interconnector	New interconnector supporting SoS in Bulgaria and Serbia. Status: EIA, routing, financing (issued with Srbijagas unbundling to access finance)	2016
8	SK–HU interconnecter	New bi-directional pipeline. Status: construction	2015
B	Medium-term projects	(2017–2020)	
	Baltic gas market		
1	PL-LT interconnector	New bi-directional pipeline (GIPL) ending isolation of the Baltic States. Status: feasibility/FEED	2019
2	FI-EE interconnector	New bi-directional offshore pipeline ("Balticconnector"). Status: pre-feasibility/permitting	2019
3	Baltic LNG terminal	New LNG terminal with location to be decided (EE/FI). Status: pre-feasibility, permitting	2017
4	LV-LT interconnector	Upgrade of the existing interconnector (including compressor station). Status: pre-feasibility	2020
	Enabling gas from Spain to flow north		
1	ES-FR "Midcat" interconnector	New interconnection (including compressor) to enable bi-directional flows[1] between France and Spain. Status: feasibility study	tbd
	Cluster Gas optionality in Central and South-East Europe		
1	PL-CZ interconnector	New bi-directional pipeline between Czech Republic and Poland. Status: Feasibility/FEED, permitting (CZ)	2019
2	PL-SK interconnector[2]	New bi-directional pipeline between Slovakia and Poland. Status: final investment decision in 2014	2019
3	PL: 3 internal pipelines and compressor station	Internal reinforcements needed to link input points on the Baltic Coast to the PL-SK and PL-CZ interconnectors. Status: pre-feasibility	2016-18

Table 1 (Continued)

1	2	3	4
4	TANAP (TR-EL)	Trans-Anatolian Natural Gas Pipe bringing Caspian gas to the EU via Turkey and opening the Southern Gas Corridor. Status: feasibility/final investment decision	2019
5	TAP (EL-AL-IT)	Intra-EU section of the Southern Gas Corridor. Direct connection to TANAP. Status: permitting	2019
6	IAP (AL-ME-HR)	New interconnector part of the Balkan Gas Ring and connected to TAP. Status: feasibility/FEED	2020
7	HR – LNG terminal	New LNG terminal in Krk supporting SoS and diversification in the Region. Status: feasibility/FEED (financing issues)	2019
8	BG: internal system	Rehabilitation and expansion of transport system needed for regional integration. Status: feasibility/FEED	2017 (tbc)

[1] Flow from Spain to France in case of supply crunch in Western/Central Europe. Flow from France to Spain to arbitrage high gas prices in Spain. The "Artère du Rhône" needs also to be reinforced.

[1] These two interconnectors (PL-CZ and PL-SK) will enable flows between the Baltic and Adriatic, but also gas from DE-NL-NO could thus be transported increasing significantly security of supply situation in whole (South)-Eastern Europe.

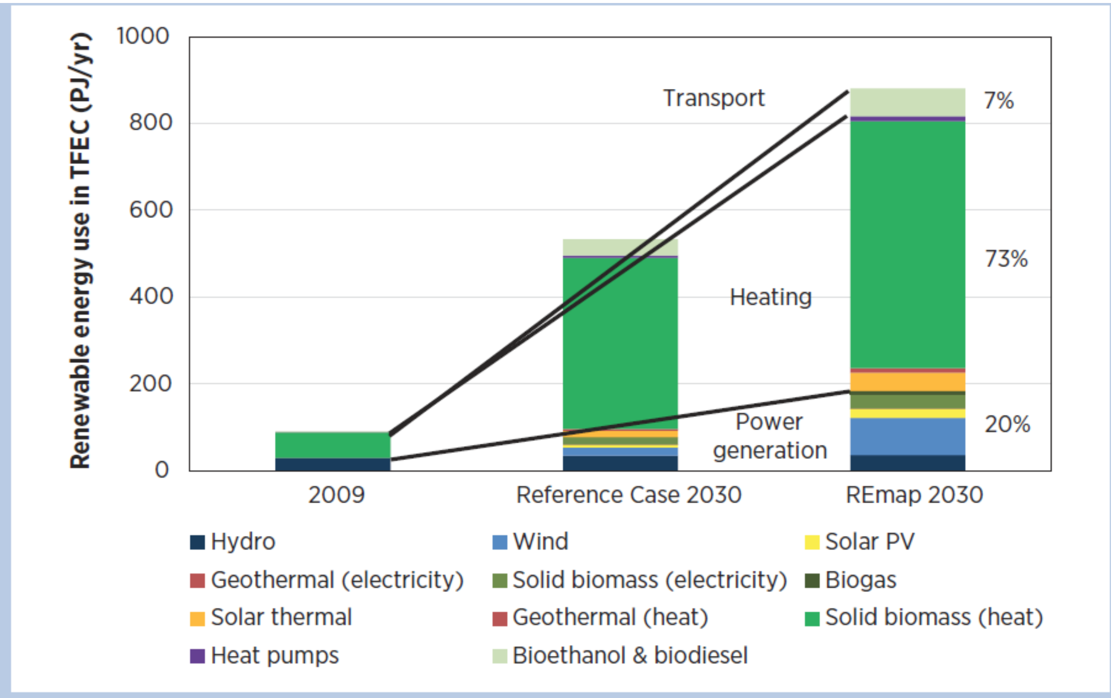

Figure 1 Renewable energy use in total final energy consumption (TFEC), 2010–2030 (IRENA, 2015)

To ensure secure, sustainable, competitive and affordable energy for European consumers the European Commission presented an ambitious Energy Union Strategy. It was launched on 25 February 2015 (The Energy, 2015).

Today, the EU imports 53% of the energy it consumes. Energy import dependency relates to crude oil (almost 90%), to natural gas (66%), and to a lesser extent to solid fuels (42%) as well as nuclear fuel (40%).

The most pressing energy security of supply issue is the strong dependence from a single external supplier. This is particularly true for gas, but also applies to electricity:

six Member States depend from Russia as single external supplier for their entire gas imports and three of them use natural gas for more than a quarter of their total energy needs. In 2013 energy supplies from Russia accounted for 39% of EU natural gas imports or 27% of EU gas consumption; Russia exported 71% of its gas to Europe with the largest volumes to Germany and Italy;

for electricity, three Member States (Estonia, Latvia and Lithuania) are dependent on one external operator for the operation and balancing of their electricity network.

The EU external energy bill represents more than €1 billion per day (around €400 billion in 2013) and more than a fifth of total EU imports. The EU imports more than €300 billion of crude oil and oil products, of which one third from Russia. EU energy security has also to be seen in the context of growing energy demand worldwide, which is expected to increase by 27% by 2030, with important changes to energy supply and trade flows (European, 2014).

The Strategy sets out areas where decisions need to be taken or concrete actions implemented in the short, medium and longer term to respond to energy security concerns. It is based on eight key pillars that together promote closer cooperation beneficial for all Member States while respecting national energy choices, and are underpinned by the principle of solidarity:

1. Immediate actions aimed at increasing the EU's capacity to overcome a major disruption during the winter 2014/2015.
2. Strengthening emergency/solidarity mechanisms including coordination of risk assessments and contingency plans; and protecting strategic infrastructure.
3. Moderating energy demand.
4. Building a well-functioning and fully integrated internal market.
5. Increasing energy production in the European Union.
6. Further developing energy technologies.
7. Diversifying external supplies and related infra-structure.
8. Improving coordination of national energy policies and speaking with one voice in external energy policy (European, 2014).

To succesfully implement the EU Energy Security Startegy 27 projects in gas and 6 in electricity have been identified as critical in the short and medium terms (Table 1) because their implementation is expected to enhance diversification of supply possibilities and solidarity in the most vulnerable parts of Europe.

Though much progress has been done in the sphere of energy security strategy formation in the EU, still much is to be done to strengthen Europe's resilience and reduce its energy import dependency. As mentioned in (Sotnyk, 2015) "the restructuring of the national economy based on energy and resource efficiency, development of renewable energy sector, environmental entrepreneurship, the use of innovations, and the solution of social problems must be of high priority for the new Government".

4 Energy security strategies for Ukraine

Ukraine has to step up its efforts to create a comprehensive framework for the promotion of energy from renewable sources and to regain investor confidence, which was significantly affected in the last years due to the retroactive measures imposed. The introduction of a market-based process for granting operational or investment support to renewable energy producers will ensure not only compliance with the competition acquis and internal market principles, but also bring the country towards its trajectory to 2020 in a cost-effective way (Ukraine, 2016).

Ukraine has a strong potential for renewable energy sources. The International Renewable Energy Agency (IRENA) suggests the Renewable Energy Prospects for Ukraine – The REmap 2030. Ukrainian Government together with international organizations and civil society are on the road to develop a renewable-energy policy and form its future energy system. The progress in solving energy security issues is quite great.

A revised and complete NREAP in accordance with the required template and adequate policy measures in compliance with the State aid guidelines should be considered to ensure that Ukraine is on track to meet the 11% target in 2020. An energy consumption survey addressing especially biomass used for heating has to be conducted by the country's statistical office to ensure reliability of the energy data. By the year 2030, the increased use of renewable energy will reduce Ukraine's overall energy system costs (Figure 1) (IRENA, 2015).

Ukraine's mid-term energy security strategy targets a level of 10% of renewables until 2030, the potential for renewables being much higher. According to Inogate (the international energy co-operation program between the European Union and Ukraine and other Central and Eastern European countries), Ukraine has enormous potential for energy efficiency as its "energy intensity" is inordinately high. The energy saving potential has been determined at almost 50% of the volumes of used fuel and energy resources (Great, 2016).

To reach the set goal of energy security a number of very important economic measures must be taken. Here belongs:

– preferential bank loans for green projects: biogas plants, solar panels, wind generators, waste treatment plants, etc.;

– international banks (e.g. European Bank for Reconstruction and Development supports only green projects);

– governmental support of international investment to green projects;

– subsidy for energy saving;

– subsidy to associations of co-owners of apartment buildings;

– Governmental support (subsidy) for poor people: municipal payments for gas, water, electricity;

– monetization of subsidies;

– decentralization of budget for regions;

– green energy tariffs.

Based on the current state of the energy sector a set of practical recommendations (economic, technological, financial, political, and environmental), organizational and economic measures to reform the energy sector for sustainable functioning was suggested (Сабадаш, 2015).

5 Conclusions

The best European practices that Ukraine could implement in the light of reducing its energy import dependency include the following measures: strengthening emergency/solidarity mechanisms; coordination of risk assessments; formation of strategic energy infrastructure; building a well-functioning and fully integrated internal market; increasing alternative energy production in Ukraine; further development and research of innovative energy technologies; diversifying external supplies and related infrastructures as well as improving coordination of national energy policies and speaking with one voice in external energy policy.

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