Future possible uses of renewable energy in the V4 countries

Róbert Magda
Szent István University
Institute of Economics, Law and Methodology, Department of Microeconomics
Páter Károly út 1.
H-2100 Gödöllő, Hungary
e-mail: magda.robert@gtk.szie.hu

Abstract
Nowadays the number of the population of the World is over 7.3 billion, which was less than 4 billion at the beginning of the 1970s. That was one of the reasons why in the last 40 years the utilisation of fossil minerals increased rapidly. The stocks of these resources are limited, so we need to find another way which helps us to substitute them in the future and also to increase our efficiency and sustain our natural environment. The use of the limited resources has also increased in Europe and it holds true in the V4 countries, too. That is the reason why this question is also important in the V4 countries, but the natural possibilities are different. The goal of the countries is to find those alternative or renewable energy sources which could be suitable for solving this problem, and boost the economy instead of destroying their natural environment. In this paper I compare the energy utilisation of V4 countries in the past, the structure of the fossil and renewable energy usage nowadays and examine those possibilities (wind energy, solar energy, geothermal energy, biomass), which can help them reduce their energy dependency from other countries. These countries need to increase the ratio of the utilisation of renewable- and alternative resources in the future if they want to satisfy their population demand.

Keywords: fossil minerals, renewable energy, V4 countries, sustainability, energy dependency

JEL Classification: Q42, Q43, Q35, Q01, P28, P18

1. Introduction
Within just a few years we need to generate more than one third of our power from renewable sources of electricity. A significant part of our heating and transport must be based on renewable fuels. It is not enough to tinker around the edges. We need huge practical and concrete initiatives involving society as a whole, and need to persuade international partners to follow the same way.

Despite the strong efforts of the European Union and its member state to promote higher use of renewable sources of energy, conventional energy sources as gas, oil or coal still hold the primacy in the energy mix of almost all the member states. The limited supplies, uneven distribution and rising costs of fossil fuels push the states intensively towards ensuring their national energy security.

The V4 countries are among those in the European Union, which are dependent on imports of strategic energy sources such as oil or gas, as their home production is far from being able to secure sufficient supplies for the consumers. Furthermore the V4 countries and especially Slovakia, but also Austria in the case of gas, relies on energy imports primarily from only one country, Russia.

This single-track dependency can lead to situations as those in January 2009 when the gas crisis caused by Russia’s suspension of supplies due to the conflict between the Russian gas company Gazprom and the Ukrainian company Naftohaz Ukrainy over supplies, prices and debts. In order to prevent similar situations the V4 countries are intensively trying to ensure diversification of both, transport routes for oil or gas and alternative suppliers.
2. Data and Methods

In the following sessions, the paper focuses on V4 countries pursuit of sustainable development, who has different opportunities, production, consumption of the fossil, and renewable energy sources, however, the motivation and the future goals have become the same for both. The methodological approach is mainly descriptive. The analysis will be based on relevant statistical data from secondary sources from national and international literature.

3. Results and Discussion

The primary energy production is based on the natural resources of the countries. In all of these countries the consumption of the primary energy sources is higher than the production, but the level of the difference is not the same. Comparing the V4 countries the best situation is in Poland whose stocks are the biggest in the region, but in the last 15 years the difference between the production and consumption increased by nearly 30 percent. In Hungary and Slovakia the consumption of the primary energy sources is more than 2.5 times exceeded the production which is not good. (Table 1)

Table 1: Total primary energy production and consumption in the V4 countries 2000-2012 (Quadrillion Btu)

|        | 2000  | 2005  | 2010  | 2012  |
|--------|-------|-------|-------|-------|
|        | P     | C     | P     | C     | P     | C     |
| Czech R. | 0.814 | 1.396 | 0.895 | 1.541 | 1.021 | 1.601 | 1.064 | 1.572 |
| Hungary | 0.453 | 1.022 | 0.399 | 1.157 | 0.402 | 1.053 | 0.370 | 0.951 |
| Poland | 3.057 | 3.624 | 2.966 | 3.673 | 2.501 | 4.049 | 2.694 | 3.905 |
| Slovakia | 0.284 | 0.785 | 0.146 | 0.819 | 0.250 | 0.769 | 0.255 | 0.698 |

Source: www.eig.gov, HSY 2015

Analysing the primary coal production of the V4 countries we can see that the stocks covered the consumption in Czech Republic (role in Total Primary Energy Sources TEPS reach 40.38%) and Poland (51.8% in TPES), but in the other two countries the consumption is higher than the production. In 2012 the Slovak consumption (18.67 in TPES) was more than 3 times bigger than production which means the high ratio of import coal. (Table 2)

Table 2: Total primary coal production and consumption in the V4 countries 2000-2012 (Thousand Short Tons)

|        | 2000   | 2005   | 2010   | 2012   |
|--------|--------|--------|--------|--------|
|        | P      | C      | P      | C      | P      | C      |
| Czech R. | 71829  | 67045  | 68372  | 62148  | 60858  | 56886  | 60597  | 54952  |
| Hungary | 15469  | 16579  | 10549  | 12925  | 10045  | 11822  | 10240  | 12021  |
| Poland | 179247 | 158488 | 174988 | 150166 | 146257 | 147871 | 158197 | 146661 |
| Slovakia | 4021   | 9897   | 2768   | 9290   | 2621   | 8415   | 2526   | 7701   |

Source: www.eig.gov, HSY 2015

Analyzing the primary coal production of the V4 countries we can see that the stocks covered the consumption in Czech Republic (role in Total Primary Energy Sources TEPS reach 40.38%) and Poland (51.8% in TPES), but in the other two countries the consumption is higher than the production. In 2012 the Slovak consumption (18.67 in TPES) was more than 3 times bigger than production which means the high ratio of import coal. (Table 2)

Table 2: Total primary coal production and consumption in the V4 countries 2000-2012 (Thousand Short Tons)

|        | 2000   | 2005   | 2010   | 2012   |
|--------|--------|--------|--------|--------|
|        | P      | C      | P      | C      | P      | C      |
| Czech R. | 71829  | 67045  | 68372  | 62148  | 60858  | 56886  | 60597  | 54952  |
| Hungary | 15469  | 16579  | 10549  | 12925  | 10045  | 11822  | 10240  | 12021  |
| Poland | 179247 | 158488 | 174988 | 150166 | 146257 | 147871 | 158197 | 146661 |
| Slovakia | 4021   | 9897   | 2768   | 9290   | 2621   | 8415   | 2526   | 7701   |

Source: www.eig.gov, HSY 2015

Analyzing the primary coal production of the V4 countries we can see that the stocks covered the consumption in Czech Republic (role in Total Primary Energy Sources TEPS reach 40.38%) and Poland (51.8% in TPES), but in the other two countries the consumption is higher than the production. In 2012 the Slovak consumption (18.67 in TPES) was more than 3 times bigger than production which means the high ratio of import coal. (Table 2)

Table 2: Total primary coal production and consumption in the V4 countries 2000-2012 (Thousand Short Tons)

|        | 2000   | 2005   | 2010   | 2012   |
|--------|--------|--------|--------|--------|
|        | P      | C      | P      | C      | P      | C      |
| Czech R. | 71829  | 67045  | 68372  | 62148  | 60858  | 56886  | 60597  | 54952  |
| Hungary | 15469  | 16579  | 10549  | 12925  | 10045  | 11822  | 10240  | 12021  |
| Poland | 179247 | 158488 | 174988 | 150166 | 146257 | 147871 | 158197 | 146661 |
| Slovakia | 4021   | 9897   | 2768   | 9290   | 2621   | 8415   | 2526   | 7701   |

Source: www.eig.gov, HSY 2015

Natural gas role varies amongst V4 states, with its portion in the energy-mix being the lowest in Poland, 13.88% in 2012, whilst the highest in Hungary, reaching 35.27%. (Eurostat 2014)

A relatively low level of domestic natural gas production is a common feature of V4 states, resulting in high-dependency upon imports. (BP 2014)
As the Czech Republic is a landlocked country, natural gas is transported there via pipelines; it has two main suppliers: historically Russia, and after signing the deal to diversify imports – Norway. (Kalan 2013)

Three pipelines deliver Russian gas to the region, thus transport-related risks can be significantly reduced if the individual markets are integrated into one complex entity.

Figure 1: Major existing and planned natural gas pipelines

![Diagram of natural gas pipelines](image_url)

Source: (BDEW & Eurogas 2012), (IEA 2014) and (Gazprom 2014b)

In 2013, total imports amounted to 11 bcm, of which 7.2 bcm (65.45%) originated from Russia, whilst 3.8 bcm (32.54%) from Norway. (BP 2014) Importation is executed through the Yamal-Europe and the Nord Stream/OPAL/Gazelle pipeline systems. (IEA 2010) The Czech Republic has one of the largest natural gas storage capacities in the region, with 10 facilities capable of storing a total of 3.2 bcm. (Kalan 2013)

The consumption of natural gas in Hungary amounted to 8.6 bcm in 2013, which was 37.75% of TPES. Consumption has shown a declining trend in recent years and according to the estimates of the government domestic consumption will stabilize between 8-9 bcm/year. (IEA 2011a) As domestic production is relatively low (approximately 2 bcm/year), dependency on imports is high, with Russian supplies amounting to 5.9 bcm (68.6% of total gas consumption) in 2013. (Eurostat 2014) (BP 2014) Hungary’s storage capacities totalling 4.4 bcm. (IEA 2011a)

Poland, as the largest economy by GDP of the V4, also consumes the most energy. TPES reached 97 974.4 TOE in 2012. Petroleum products are the second most important source of energy in the country, whilst natural gas is third. (Eurostat 2014) Consumption of the latter amounted to 16.7 bcm in 2013, and with domestic production only reaching 4.2 bcm, the economy is heavily reliant on imports. It imported 11.4 bcm in 2013, of which 9.6 bcm
originated from Russia, whilst the remaining 1.8 bcm from European countries other than the Netherlands, Norway and the UK. (BP 2014) Gas consumption within the country is projected to increase by 28% between 2009-2020 and 52% by 2030. (IEA 2011b)

Slovakia’s gross inland consumption in 2013 amounted to 16.6 MtOE, of which the largest portion was produced with the use of natural gas (29.52%), play major roles in TPES. Domestic production of natural gas is nearly non-existent, 0.2 bcm in 2012 (IEA 2014b), thus the economy has been heavily reliant on Russian imports, with 2013 figures reaching 5.3 bcm. (BP 2014) The Brotherhood pipeline running through Slovakia is of key importance in transiting Russian gas to Western Europe. Its full capacity amounts to 90 bcm/a; however its utilization varies.

Table 3: Natural gas production and consumption in the V4 countries 2000-2014 (Million Cubic Feet)

|        | 2000  | 2005  | 2010  | 2012  |
|--------|-------|-------|-------|-------|
|        | P C  | P C  | P C  | P C  |
| Czech R. | 7.7 326 | 7.1 335 | 7.2 328 | 8.7 265 |
| Hungary  | 113 425 | 107 529 | 102 428 | 65 295 |
| Poland  | 184 473 | 214 573 | 215 606 | 215 631 |
| Slovakia | 6.1 252 | 5.2 255 | 3.7 215 | 3.5 142 |

Source: www.eig.gov, HSY 2015  \( ^{a} \) P=Production, C=Consumption

The situation is the worst in the oil sector where the consumption is 6-13 times higher than production in the V4 countries. That was the same in the past and nowadays too. The reason of this is the bad natural circumstances. So both of the V4 countries decided to build up an additional transport capacity for oil for the case of problems at then the only one route – oil pipeline Brotherhood.

Table 4: Oil production and consumption in the V4 countries 2000-2014 (Thousand Barrels/day)

|        | 2000  | 2005  | 2010  | 2012  |
|--------|-------|-------|-------|-------|
|        | P C  | P C  | P C  | P C  |
| Czech R. | 9.4 170 | 18 213 | 10 201 | 11 200 |
| Hungary  | 49 143 | 42 155 | 34 149 | 25 139 |
| Poland  | 23 411 | 39 471 | 29 568 | 39 514 |
| Slovakia | 3.2 67 | 13 78 | 7.7 84 | 9.1 73 |

Source: www.eig.gov, HSY 2015  \( ^{a} \) P=Production, C=Consumption

**What would be the solution?**

One of the biggest task for the European countries – included V4 – how will they substitute the fossil minerals.

The EU Renewables Directive is a unique creation which addresses two of the biggest challenges of our time – energy security and climate change. The 20% renewables target for 2020 is now firmly embedded in the psyche of Europe’s decision makers.

What would be these resources?

Wind power is the harnessing of wind energy by wind turbines and the conversion to useful forms such as electricity or mechanical energy. We are all aware of the large-scale wind farms and have probably seen them from the highway at some point. These large scale wind farms are typically connected to the local network with smaller turbines used to provide electricity.
to more isolated areas. Wind farms installed on agricultural land or grazing areas, have one of the lowest environmental impacts of all energy sources. The number of the produced energy increased in a rapid way in the last 10 years and now it is 5100 MW in Poland, 329 MW in Hungary, 282 in Czech Republic and the role of this energy is very low in Slovakia – 3 MW.

Solar power harnesses the sun’s direct energy to produce electricity. This is by far the most advanced of our renewable energy efforts with new technologies developing at a rapid rate. Photovoltaic (PV) solar cells are becoming more efficient, lightweight, flexible and cheaper to manufacture. Germany is by far the world leader when it comes to solar energy production. In 2012 Czech Republic had a solar energy production of 2149GWh, Hungary had 8GWh, Poland had 1GWh and Slovakia had 424GWh.

Hydroelectricity is the production of power through use of the gravitational force of falling or flowing water. It is the most widely used form of renewable energy. There is no direct waste once a hydroelectric complex has been constructed. Small scale hydro power systems can be installed in small rivers or streams with little or no environmental effect or disruption to fish migration. This has become a popular alternative energy source, especially in remote areas where other power sources are not viable.

The majority of small-scale hydro power systems make use of water wheels to generate energy, skipping the need for a dam or major water diversion. Many hydroelectric projects are plugged into the national grid; however, some are created to serve specific industrial enterprises. Dedicated hydroelectric projects are often built to provide the substantial amounts of electricity needed for aluminium, electrolytic plants.

In 2012 Czech Republic had a hydro energy production of 2108GWh, Hungary had 211GWh, Poland had 2017GWh and Slovakia had 4062GWh.

Biomass is the harnessing of dead biological matter that can be used as fuel or for industrial production. In this context biomass refers to plants or produce such as trash, dead trees and branches, wood chips and even plant or animal matter. Biomass can also include biodegradable wastes that can be burnt as fuel.

Biomass reduces environmental pollution as it uses organic garbage. Biomass is an essential energy form for developing nations, for its potential as a low-cost, indigenous supply of power and environmental benefits.

In 2012 Czech Republic had a biomass and waste energy production of 3343GWh, Hungary had 1655GWh, Poland had 10103GWh and Slovakia had 928GWh.

In the last 15 years the ratio of the renewables increased in every V4 countries which I summarize in the Table 5.

Table 5: Total Electricity Generation from renewables in the V4 countries 2000-2012 (Billion Kilowatt hours)

|        | 2000 | 2005 | 2010 | 2012 |
|--------|------|------|------|------|
| Czech R. | 2.5  | 3.1  | 5.9  | 8.0  |
| Hungary | 0.3  | 1.9  | 3.2  | 2.6  |
| Poland  | 2.6  | 4.1  | 11   | 17   |
| Slovakia| 4.6  | 4.7  | 5.9  | 5.4  |

Source: www.eig.gov, HSY 2015
4. Conclusion

V4 Member States have been, and will remain to be, vulnerable to energy-supply disruptions in the near future. The prominent role of natural gas in TPES, paired with the low domestic production has led to strong import-dependency, which, due to the lack of alternative energy sources, leaves Russia as the primary regional supplier. V4 cooperation has helped subduing the risks related to dependency; however the region is far from being fully interconnected. Further actions are necessary and they must be backed by political motivation. The aforementioned developments have helped each state on a national level; however, to achieve real interconnectivity, the North-South Corridor must be constructed and the HU-SK interconnector must be put to use without further delay. This would strengthen the V4’s integration with the western European market and it would also allow LNG to be both a form of security during in case of disruptions and a form of leverage against the non-market-based pricing of Russian gas.

References

[1] **BDEW & Eurogas**, 2012. Natural gas pipelines and LNG terminals in Europe. Retrieved February 12, 2016, from http://hro.ceu.hu/vacancies/student-affairs-coordinator

[2] **BP**, 2014. Statistical review of World Energy 2014, Retrieved February 12, 2016, from http://www.bp.com/content/dam/bp/pdf/Energy-economics/statistical-review-2014/BP-statistical-review-of-world-energy-2014-full-report.pdf.

[3] **Eurostat**, 2014. Database. Retrieved February 12, 2016, from http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database [Accessed October 8, 2014]

[4] **Energy Information Administration** 2014 Retrieved February 12, 2016, from https://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=53&aid=1&cid=CG1,&syid=2000&eyid=2014&unit=TBPD

[5] **Gazprom**, 2014b. Gazprom Transportation. Retrieved February 12, 2016, from http://www.gazpromexport.ru/en/projects/transportation/

[6] **Hungarian Statistical Yearbook** 2015, Budapest

[7] **IEA**, 2014. Gas Trade Flows in Europe, in MCM. Retrieved February 12, 2016, from http://www.iea.org/gtf/# [Accessed November 10, 2014].

[8] **IEA**, 2010. Energy Policies of IEA Countries The Czech Republic, International Energy Agency. Retrieved February 12, 2016, from http://www.iea.org/publications/freepublications/publication/CzechRep2010_free.pdf

[9] **IEA**, 2011a. Energy Policies of IEA Countries, Hungary 2011 review, International Energy Agency. Retrieved February 12, 2016, from http://www.iea.org/publications/freepublications/publication/hungary2011_web.pdf

[10] **IEA**, 2011b. Energy Policies of IEA Countries Poland Review, International Energy Agency. Retrieved February 12, 2016, from http://www.iea.org/publications/freepublications/publication/Poland2011_web.pdf

[11] **Kalan, D.**, 2013. Window to the West: The importance of the Czech Natural Gas market for V4. The Polish Institute of International Affairs, (No. 25), p.2.

* Online full-text paper availability: doi:http://dx.doi.org/10.15414/isd2016.s2.03