Interreg
Danube Transnational Programme
EcoInn Danube

NATIONAL REPORT ON O&O – SLOVAKIA

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ACTIVITY 3.2	Analysing the environment for ecoinnovation in partner countries
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1. ABSTRACT

Eco-innovations are essential to address not only environmental but also wider economic challenges in Slovakia and thus establishing a circular economy is of prime importance for the country's development.

Growing manufacturing sector and consumption of material resources and a rather scarce sub-soil reserves is characteristic for the Slovak economy. The demand for natural resources exceeds the capacity of ecosystems to supply these resources almost by 50% (Global Footprint Network, 2017).

The most important sectors are automotive industry and the manufacturing of basic metals and fabricated metal products. The country is highly dependent on external markets for both imports of raw materials and exports of manufactured goods. Industry generates more than a third of the country's value added and thus Slovakia still remains more industrial than other OECD countries. (OECD, 2011)

Despite of the fact that Slovakia generates comparable amounts of waste per capita than similar economies, waste management remains a great challenge. The annual generation of waste is below the EU average with 1,17 versus 1,67 tonne per capita and 83,22 versus 67,87 g/EUR. In 2015 up to 69% of municipal waste ended up in the landfills and only about 20% was recycled. Almost 80% of landfilled municipal waste was mixed municipal waste of non-defined content. (OECD 2017)

Energy efficiency is improving but the energy intensity of the economy still ranks among the highest in the EU (221kg of oil equivalent per 1 000 EUR of GDP in 2014 compared to the EU average of 122 kg of oil equivalent per 1 000 EUR) according to Eurostat.

Progress in the areas of air and water quality over the past ten years has resulted in improved score of Slovakia in the EPI by 10% (Hsu, 2016). The country has substantially reduced its greenhouse gas emissions and the share of the population exposed to the worst level of air pollution is lower than the OECD average. At the same time air pollution still remains a problem due to heavy use of brown coal in power generation. (European Commission, 2017), (OECD, 2017)

A number of companies in Slovakia claim the dedication to responsible business and the consumption or use of waste as a source. However, most of the companies implement only partial measures that save costs, but they are far away from the transition to the circular economy. Multinational companies comply mostly with policies of their parent organizations and as far as Slovak companies and startups are concerned, it is often a matter of their environmental beliefs. Still, weak demand for eco-innovation products and services is significant for Slovakia as well as low public awareness on this topic.

One of the main barriers in further uptake and support of eco-innovation are ineffective policies and fragmented administrative framework, very slow progress in implementing measures supporting research and development, insufficient financial backing in this area and lack of public awareness resulting in weak market demand for eco-innovation.

In April 2016 the Government of the Slovak Republic adopted a new manifesto which recognizes a resource efficient low carbon economy as one of the priorities in the environmental agenda. However, strong policy framework with coherent approach towards circular economy and eco-innovation as well as adequate financial allocations for this purpose stays one of the main challenges.

Much of the environment-related government research and development goes to areas with low potential for inventive activities, such as air, water, waste. In order to strengthen basic innovation

capacity, there are challenges which need to be addressed such as fostering international cooperation on science and technology, more engagement of the private and financial sector but as well direct support for higher education focused on eco-innovation and research. Moreover, there is a need to focus government R&D on emerging environmental areas that could boost Slovakia´s long-term competitiveness.

An attempt to strengthen R&D in Slovakia was the adoption of the Research and Innovation Strategy for Smart Specialization (RIS3 SK) in November 2013 and its Action plan for years 2014 – 2016. It resulted in couple of changes since 2013, but the process in general has been hindered by other priorities and new action plan including complex monitoring and evaluation process have not been set up yet. However, government currently works on the Implementation Plan to the RIS3 SK which comprises procedures a processes to meet the criteria in relation to the ex-ante conditionality and the thematic objective related to strengthening research, technological development and innovation, relevant investment priorities funded in the 2014 – 2020 programming period as well as the measures to which the Slovak Republic committed in Research and Innovation Operational Program.

One of the existing initiatives “The National Green Home Project” was launched under the EU Structural Funds and is managed by the Ministry of the Environment of the Slovak Republic. Within this initiative households can apply for vouchers to co-fund the installation of renewable energy technologies. The first phase of the project called Green for Households (Zelená domácnostiam) should help revitalize the market environment with facilities for the use of renewable energy in households. At the same time, it should contribute to improving the awareness and practice of PLT installers and to increasing their interest in study in related disciplines. Since the beginning of the project in December 2015, the Slovak Innovation and Energy Agency (SIEA) has paid over 9,700 bills worth more than 21,6 million EUR from a project funded through the Environmental Quality Operational Program. More vouchers for more than 4,7 million EUR are already available to households. Currently, the SIEA is preparing the continuation of the Green House project so that other resources earmarked to support the use of renewable energy in households can be used from 2019 onwards.

Another policy which contributes to the improvement of the circular economy is a legal Act on Waste (Act. No. 79/2015) which entered into force on January 1, 2016. It covers critical aspects of waste management including operation of the Recycling Fund and tackles problems such as producer responsibility, management of municipal waste or waste prevention. E.g. extended producers responsibility scheme, makes producers of specified products obliged to bear all the financial costs associated with the collection, transport, preparing for reuse, recovery, recycling, processing and disposal of separately collected waste.

2. OVERALL NATIONAL RANKING

This chapter describes eco-innovation performance of Slovakia compared to the EU average and Danube region countries through two composite indices The Eco-Innovation Scoreboard (Eco-IS) and the Eco-Innovation Index. Eco-innovation Index and Scoreboard capture 16 different indicators of eco-innovation in order to provide comparative analysis of innovation performance in EU countries, other European countries, and regional neighbours. It covers five dimensions of eco-innovations, particularly, eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency and socio-economic outcomes complement other measurement approaches of innovativeness of EU countries.

2.1 Eco-Innovation Scoreboard

For innovation index, the national rankings are calculated and presented within the European Innovation Scoreboard 2017 database, where are shown relative performances as compared to EU in 2010. Slovakia´s score lies 32% below the EU average.

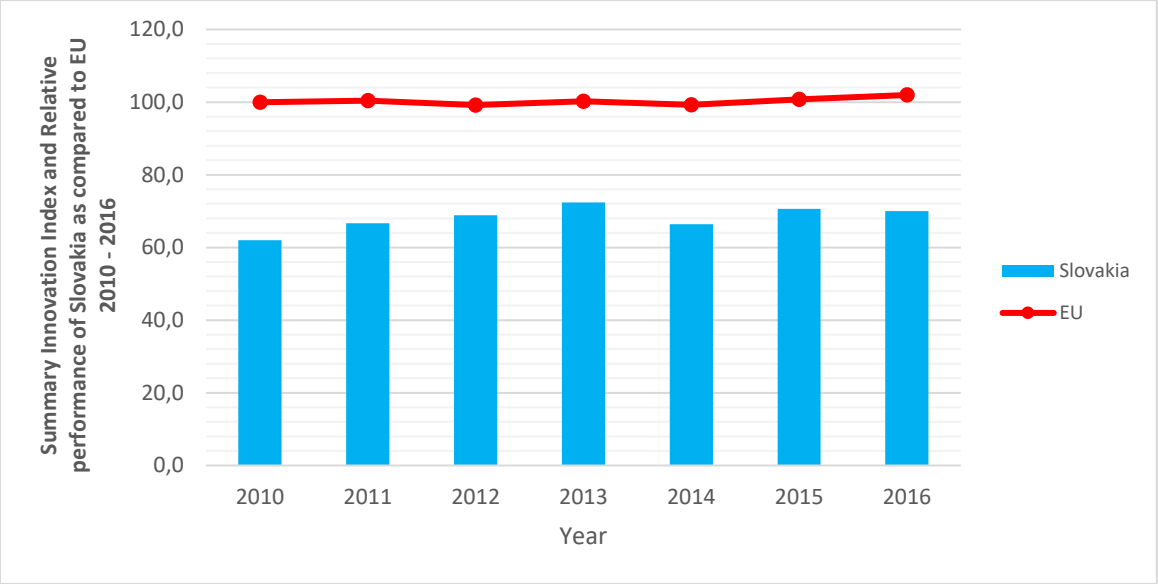

Figure 1: Summary Innovation Index and Relative performance of Slovakia as compared to the EU in the period 2009 – 2016 (Source: European Innovation Scoreboard 2017)

Therefore, Slovakia ranks among the Moderate Innovators. Country´s performance between 2010 and 2016 increased by 8,0% relative to that of the EU in 2010. Over the time the performance has been volatile between 62% and 72,4% to that of the EU in 2010, it increased strongly until 2013, but has declined between 2013 and 2016.

Figure 2: Summary innovation index and its sub-indexes for Slovakia compared to the EU-28 in 2010, for 2016 (Source: European Innovation Scoreboard Interactive Tool (EIS-IT))

Among the main assets in the innovations are Employment impacts, Sales impacts and Human resources while Innovators, Intellectual assets and Attractive research systems remain rather weak.

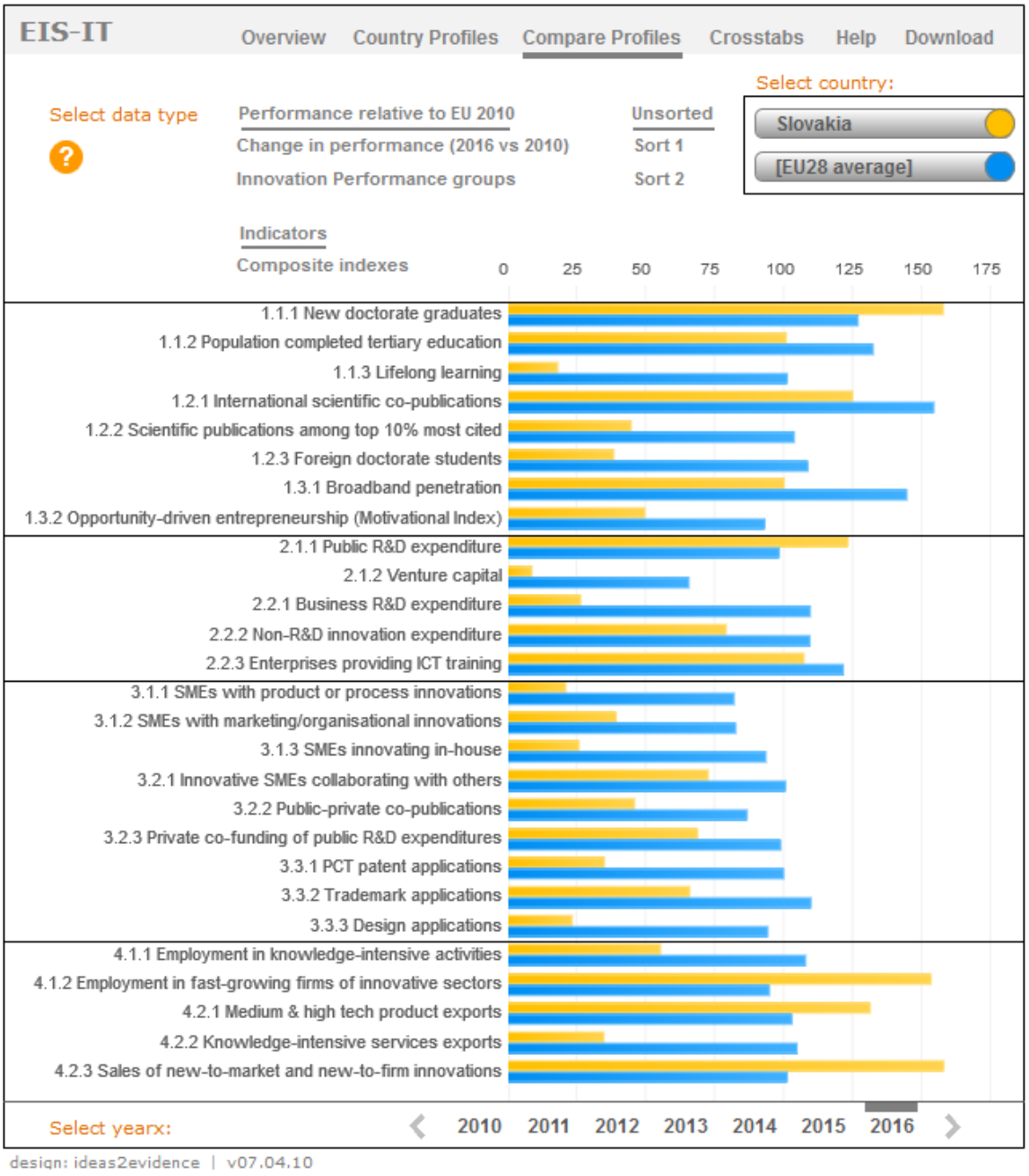

Figure 3: Summary of innovation indicators for Slovakia compared to the EU-28 in 2010, for 2016 (Source: European Innovation Scoreboard Interactive Tool (EIS-IT))

However, present are structural differences such as smaller share of employment in Agriculture and Mining industry, a larger share of employment in Manufacturing, Utilities and Construction and Public administration. Smaller share of foreign controlled enterprises, and a larger share of enterprise births, lower buyer sophistication, lower GDP per capita, a higher growth rate of GDP, and a lower growth rate of population are typical for Slovakia´s eco-innovative industry.

2.2 Eco-Innovation Index

The Eco-Innovation Index for Slovakia shows how well the country perform in different dimensions of eco-innovation compared to the EU average and presents its strengths and weaknesses.

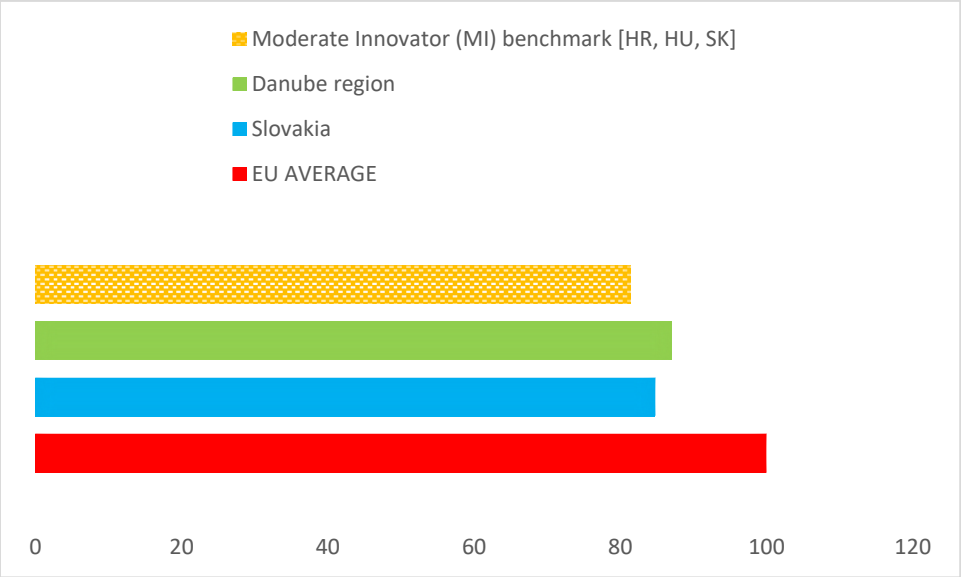

Figure 4: Eco-innovation index for Slovakia compared to the EU and Danube region (Source: Eurostat)

When looking at Slovakia`s performance with respect to the eco-innovation it is only slightly below the Danube region average, however it is still 25% below the EU average. The composite indicator for Slovakia is only about 4% above the average of the Moderate innovator benchmark represented by Croatia or Hungary as for the Danube region countries.

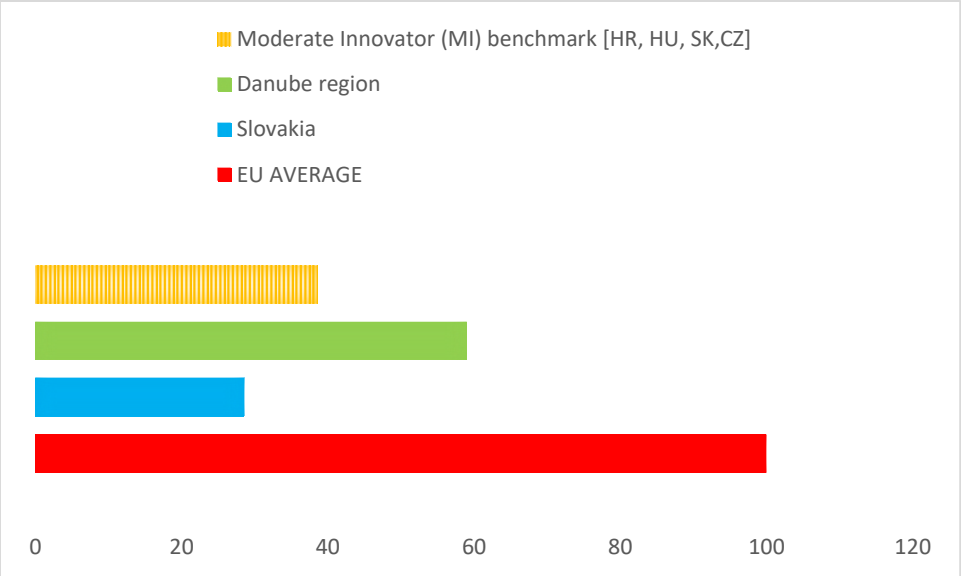

Figure 5: Eco-innovation inputs index for Slovakia compared to the EU and Danube region (Source: Eurostat)

Slovakia´s eco-innovation input has a score of 29 compared to the index score 59 average of Danube region. The difference between Slovakia and moderate innovators such as Czech Republic, Hungary or Croatia makes 10%.

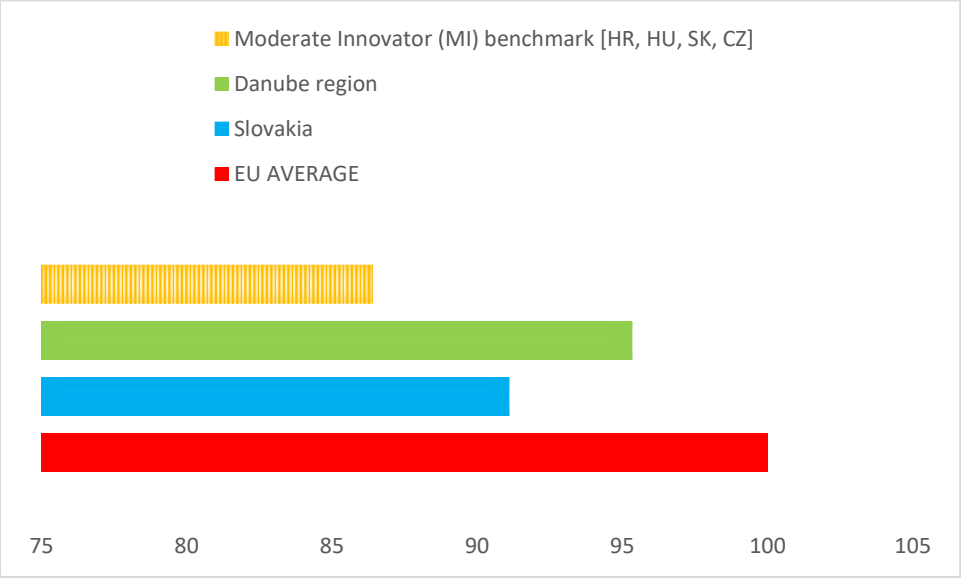

Figure 6: Eco-innovation activities index for Slovakia compared to the EU and Danube region (Source: Eurostat)

Slovakia has a comparably similar value of the composite indicator focused on eco-innovation activities to that of the average of the countries in Danube region. It shows a slightly better performance also in comparison to the Moderate innovation benchmark in 5%.

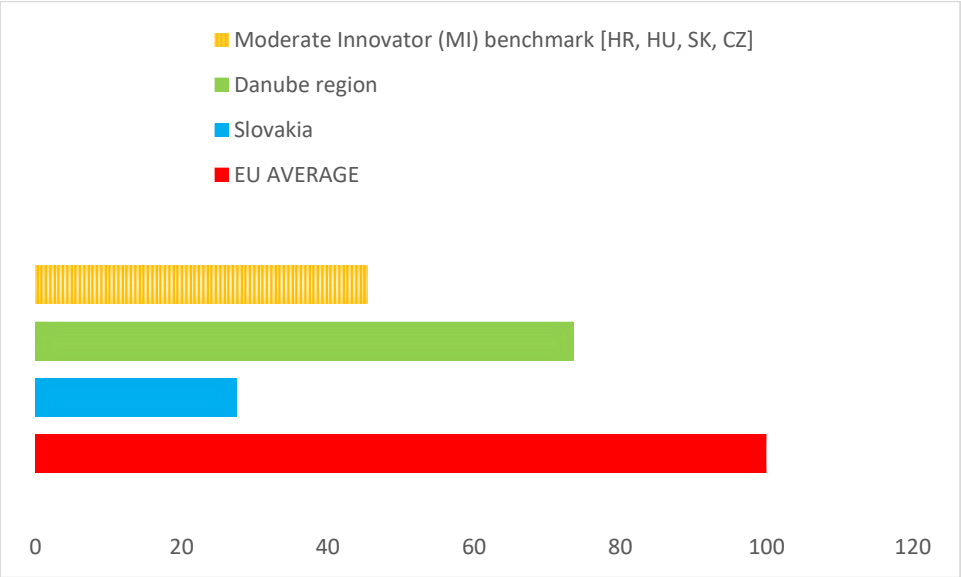

Figure 7: Eco-innovation outputs index for Slovakia compared to the EU and Danube region (Source: Eurostat)

Slovakia is significantly below the Danube region average in the eco-innovation output index with the value of 28 and it is lagging behind the Moderate innovators represented by Croatia, Hungary. Slovakia and Czech Republic that have a composite indicator with average the value of 45. Furthermore the

indicator value for Hungary remained on the same level, while indicator for Czech Republic and Slovakia rose little more than 4% between 2011 and 2014.

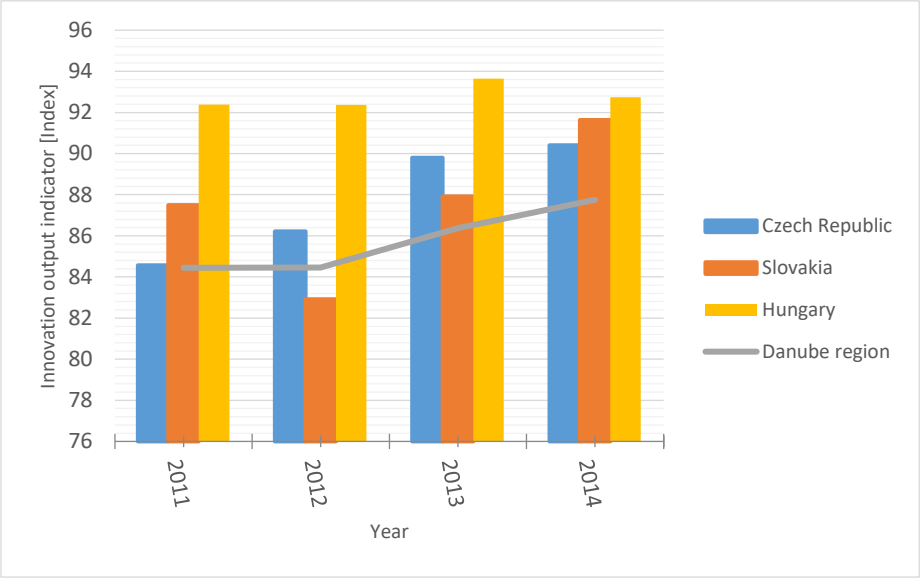

Figure 8: Innovation output indicator for Czech Republic, Slovakia, Hungary and Danube region (2011 - 2014) (Source: European Commission)

These scores show clearly stronger performance and progress in eco-innovations of Slovakia, Czech Republic and Hungary in comparison to the Danube region average. Volatile performance, with the sharper decline in 2012 shows, that Slovakia still faces challenges especially in terms of coherent eco-innovation policy framework as well as low investments and lack of human capacities in R&D.

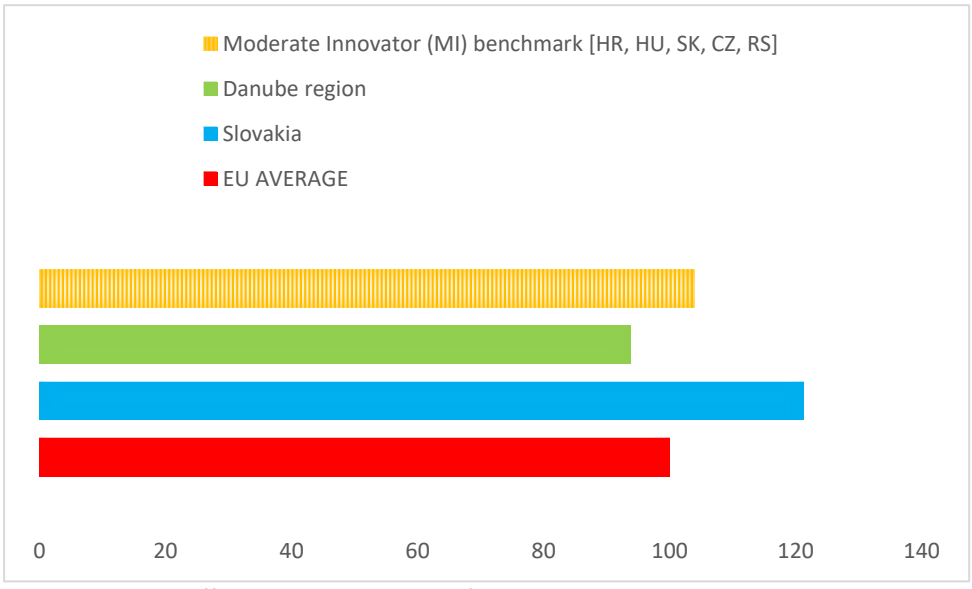

Figure 9: Resource efficiency outcome index for Slovakia compared to the EU and Danube region (Source: Eurostat)

On the other hand, Slovakia scores significantly well in Resource efficiency outcome index with the value 121 compared to the Danube region average with the score 94 and Moderate innovators such as Croatia, Hungary or Czech Republic with the score 104.

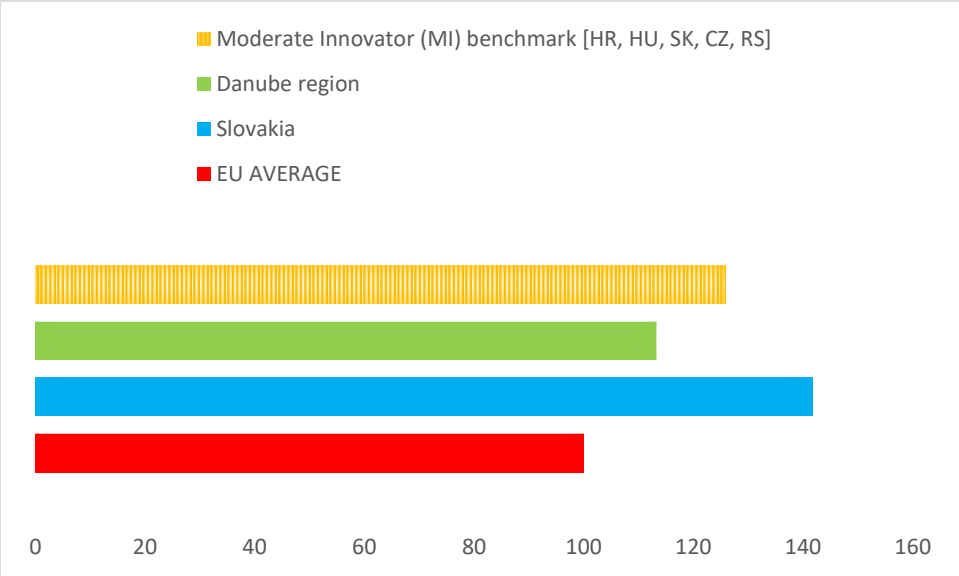

Figure 10: Socioeconomic outcomes for Slovakia compared to the EU and Danube region (Source: Eurostat)

The overall component score in socioeconomic outcomes for Slovakia is 142 which is much above the Danube region average with the value of 113,2 and benchmark innovators such as Croatia, Hungary, Czech Republic that score value of 125,8.

3. INNOVATION

Indicator: New doctorate graduates per 1000 population aged 25-34

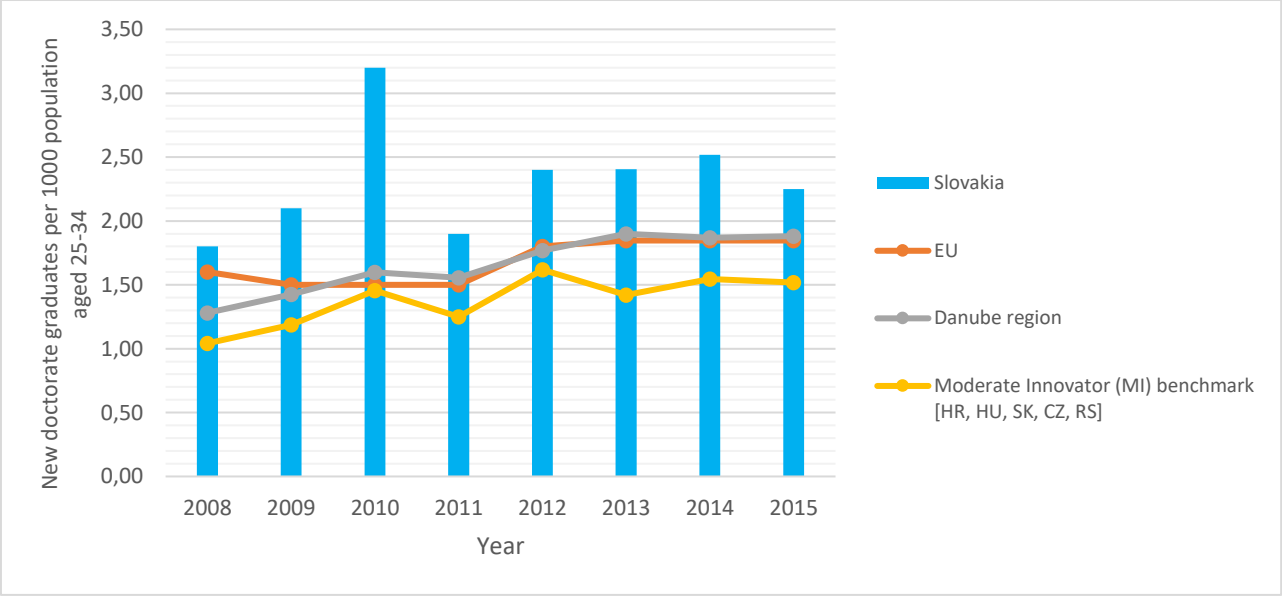

Figure 11: New doctorate graduates per 1000 population aged 25-34 indicator in Slovakia compared to MI benchmark, and the average of the EU and Danube region
(Source: Eurostat)

Students with the advanced research degrees are considered to be key players for research and innovation since they are trained to conduct research, create and disseminate scientific knowledge. The situation is getting better over the past years in Slovakia and exceeds the average of the Danube region and the EU average. While there was only small proportion of the doctoral graduates in 2008 at the level of 1,8% there is a volatile upward trend till 2015 up to 2,25% with the exception of the increase in 1,1% between 2009 and 2010 followed by sharper decline of 1,3% between years 2010 and 2011. Still Slovakia is still above the Moderate Innovator benchmark where the graduation rates were relatively the same varying only slightly between 1,04% and 1,65% in the observed period.

Indicator: Public R&D expenditure as % of GDP

In 2015, Slovakia allocated 0,85% of its GDP to fund research and development activities in the public sector, including the government and higher education.

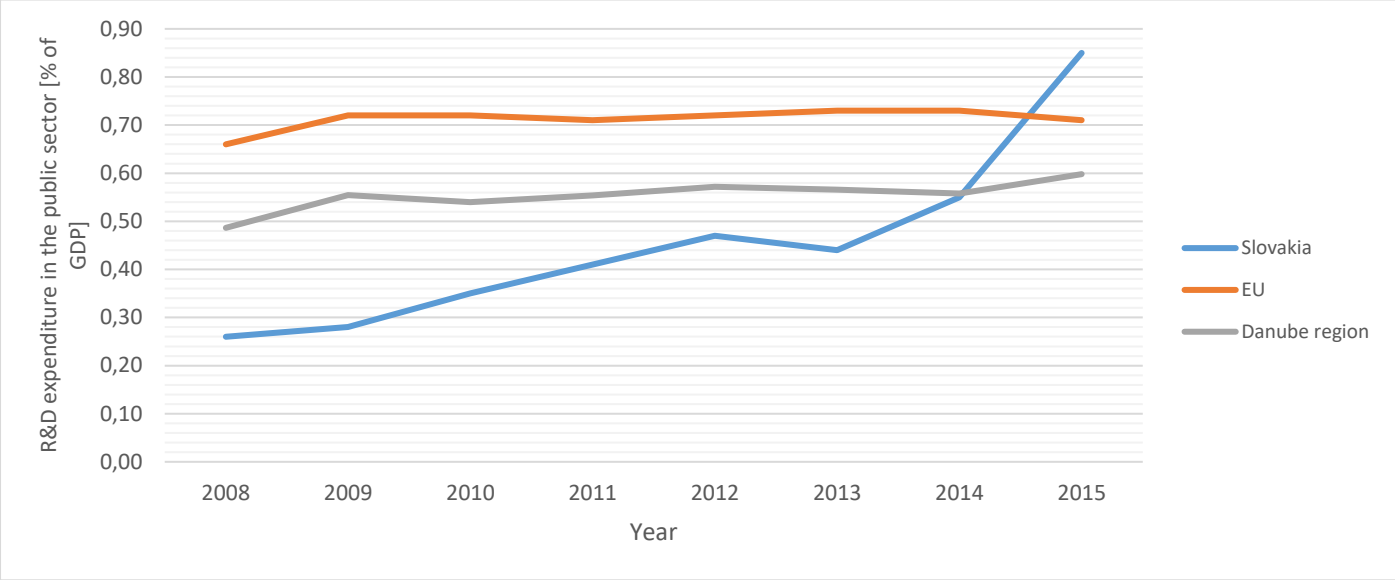

Figure 12: Public R&D expenditure as % of GDP for Slovakia, the European Union and the Danube region (Source: Eurostat)

Figure represents the R&D expenditure in the period from 2007 to 2015. The trend for the European Union has stagnated from 2009 with about 0,7% of GDP, rising only a modest 12,7% in 8 years, while the Danube region is demonstrating a trend of substantial growth with an increase of over 24% from 2007. In the year 2015 Slovakia surpassed the average of countries in the Danube region in about 14% and the EU average in 25% difference noted in 2015.

Figure 13: Real GDP growth (%) in Slovakia, the EU and the Danube region

(Source: Eurostat)

Real GDP growth in Slovakia has been significantly overinflated before the financial crisis with reference to the Danube region and the European Union and was followed by a comparable decline in 2009. In terms of the long-term trend, the inflation in Slovakia exceeds the average of both the European Union as well as the Danube region.

OPPORTUNITY: In comparison to both the EU-28, as well as the Danube region, considering a GDP share of public spending for research and innovation, it`s clear that Slovakia improved investments in such activities and the trend is still on rise.

Indicator: Private sector R&D expenditure as % of GDP

The indicator of R&D expenditure within the private sector as a share of national GDP is inclusive of the business sector (BES) as well as the private non-profit (PNP) sector. This indicator is could also be titled Business enterprise R&D expenditure (BERD) financed by all sectors (including business enterprise, higher education, private non-profit, government and foreign).

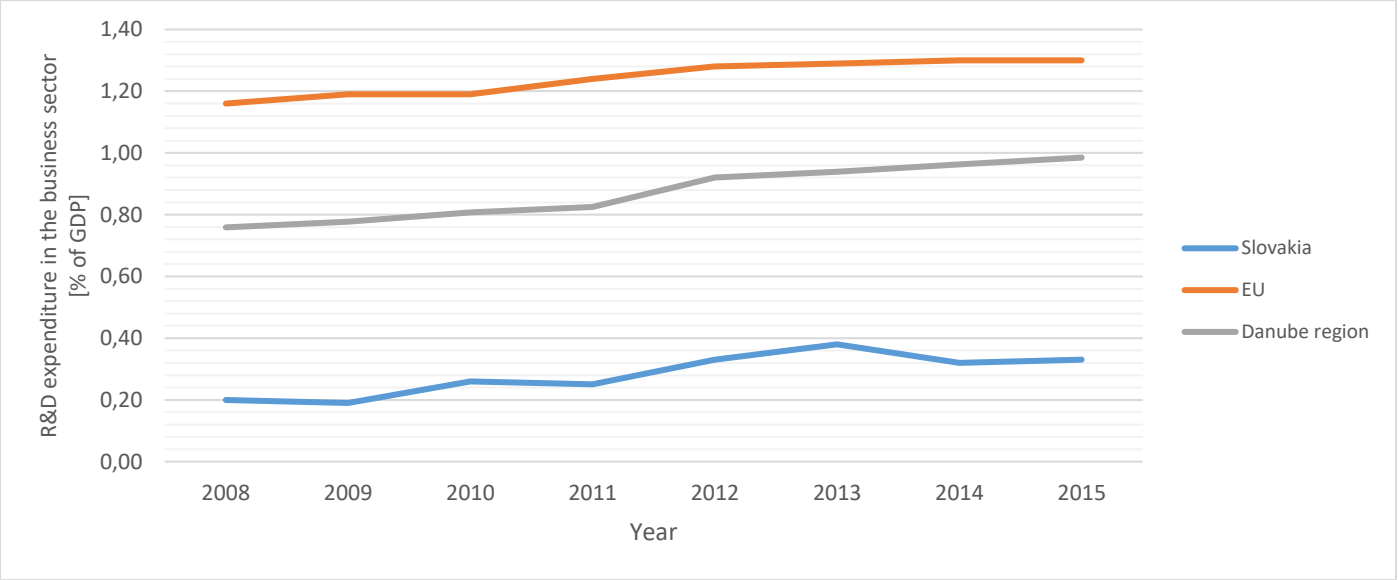

Figure 14: R&D expenditure of the private sector as % of GDP
(Source: Eurostat)

Slovakia encounters very slow increase in business sector investments in R&D but is deeply below the European Union's average, which has remained stable within the observed time period. The private sector from countries within the Danube region have on average allocated much larger share of the national GDP to R&D expenditure, which can be described as a modest linear trend in the observed period.

OBSTACLE: Slovakia`s private sector has been investing poorly in research and development, however it encounters a very slight increase between 2008 and 2015. Compared to the EU and the DR countries

average, Slovakia scores deeply bellow with the 0,33% of GDP compared to 0,99% of GDP in DR countries and 1,30 in the EU countries.

Indicator: Business enterprise R&D expenditure financed by all sectors in million EUR

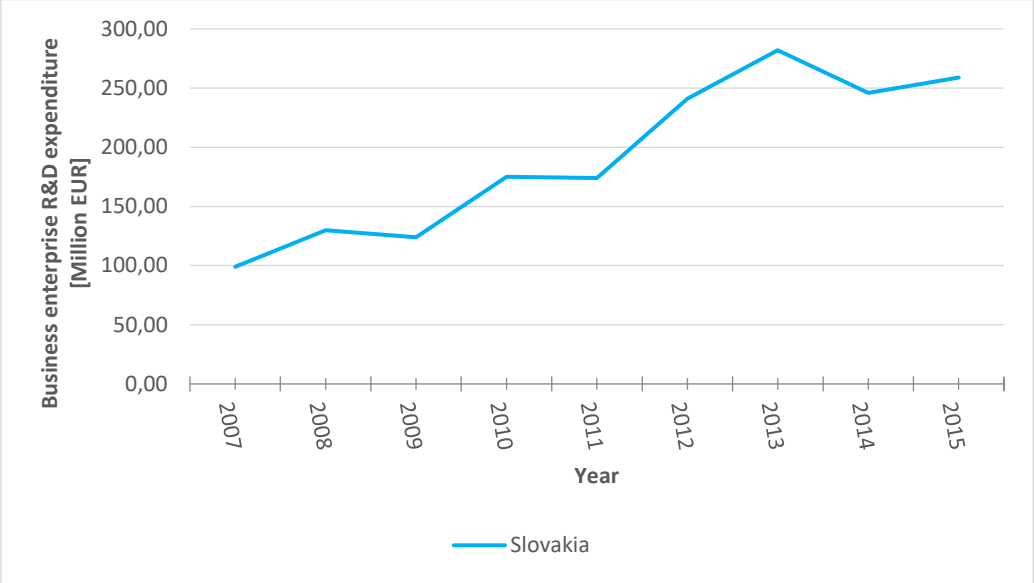

Figure 15: Business enterprise by all sectors
(Source: Eurostat)

Slovakia has increased the BERD expenditure (all sectors) in absolute terms to almost 217% of the initial expenditure in 2007 (130 million EUR) to 282 million EUR in 2013. In 2015 BERD expenditure reached 259 million (more than a 150% increase compared to the reference value in 2007). The most notable growth was documented from 2011 until 2013 while there was only a steady growth of the national economy. The indicator includes funding from the business enterprise sector, the government sector, the higher education sector, the private non-profit sector as well as contributions from abroad. One of the main problems of Slovak research and innovation is the poor involvement in international initiatives and projects. Qualitative as well as qualitative comparisons prove that Slovakia is still lagging behind other EU countries in participating in framework programs.

OPORTUNITY: Total BERD expenditure has encountered increased within the observed period. Further boost to BERD expenditure, especially increased involvement in international initiatives would provide additional opportunities for knowledge sharing and new products and services development.

Indicator: Business enterprise R&D expenditure financed by public funding as % of GDP

Business enterprise R&D expenditure (BERD) includes financing through public funds (by the government) but disregards other sources of public funds such as from higher education and EU funding.

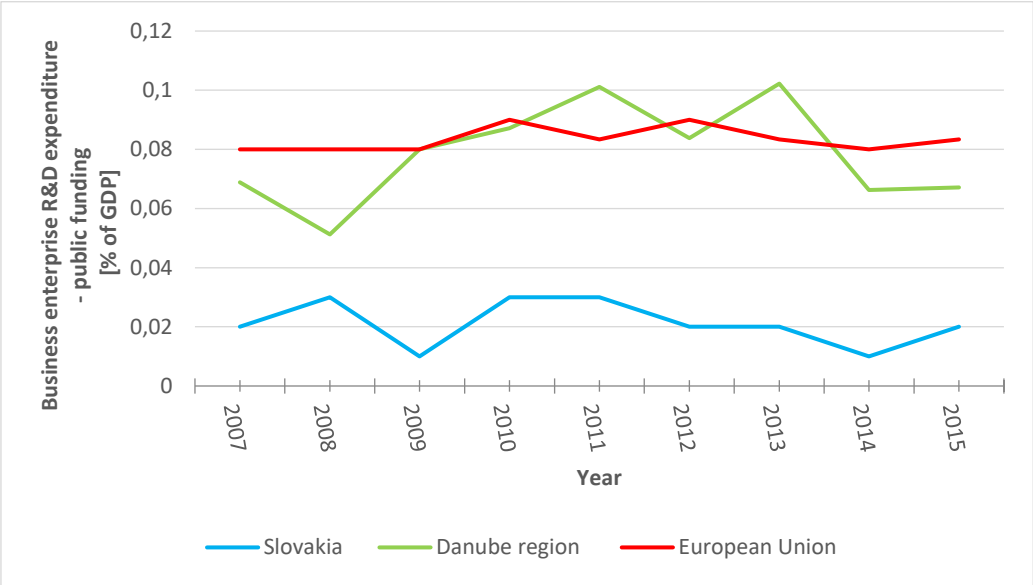

Figure 16: Business enterprise expenditure financed by public funding as % of GDP (Source: Eurostat)

Slovakia is far below the averages of both the European Union and countries within the Danube region which follow comparable values and patterns. From the end of the first quarter of 2008 until 2015 it alternate slight increases and decreases. Business expenditure in R&D in terms of GDP share has slightly increased between 2010 and 2011 a 0,27% and has been on a decline ever since.

OBSTACLE: Public funding of Business expenditure in research and development is very low, which is a clear obstacle hampering the support of eco-innovation.

Indicator: Government budget appropriations or outlays for R&D

The amount of government budget appropriations or outlays for R&D as a share of general governmental expenditure in countries within the Danube region is notably less than that of the European Union, on average about 20%. In 2007 this amounted to 25,5%. However, with a slight decrease within countries of the EU and a substantial increase of budget appropriations and outlays in the Danube region (+10% from 2007 to 2016), the trend has converged to achieve the smallest difference in 2016 (less than 15%).

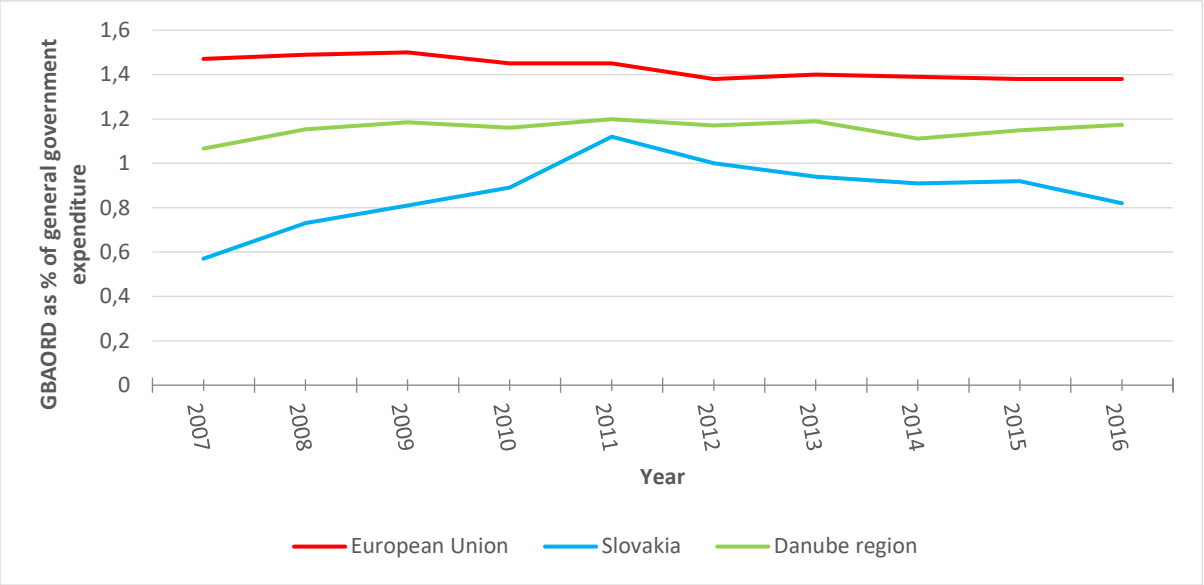

Figure 17: Government budget appropriations or outlays for R&D
(Source: Eurostat)

Slovakia in 2007 secured only 0,57% of general budget expenditure to R&D and also increased the spending to a peak value of 1,12% in 2011. The trend has been somewhat positive from between 2007 and 2010 followed by a slight negative trend from 2011 onwards. Thus the share of government appropriations and outlays reached a record decline in 2016 to only 0,82% and the share in 2016 achieved only 70% of the Danube regions average, and slightly more than 59 % to that of the European Union.

OBSTACLE: Government budget appropriations or outlays for R&D as is the case in general for public funding in Slovakia, has lagged far behind the EUs and Danube regions average during the whole observed period. Low government budget appropriations and outlays for R&D are a major obstacle in further development and application of Eco-innovations.

Indicator: Total Intramural R&D expenditure (GERD) by sectors of performance

The amount of total intramural R&D expenditure (GERD – Gross domestic expenditure on R&D) from all sectors (inclusive of funding from the business enterprise sector, the government sector, the higher education sector and the private non-profit sector) measured as a share of GDP has been on average almost 25% lower in the countries of the Danube region compared to the European Union.
However, the countries of the Danube region have steadily decreased the divergence from a maximum of 32% in 2009 to just 18,5% in 2015, as the European Union's share has stagnated at around 2%, while the Danube region increased the share to 1,66% from a modest 1,32% (a more than 26% increase).

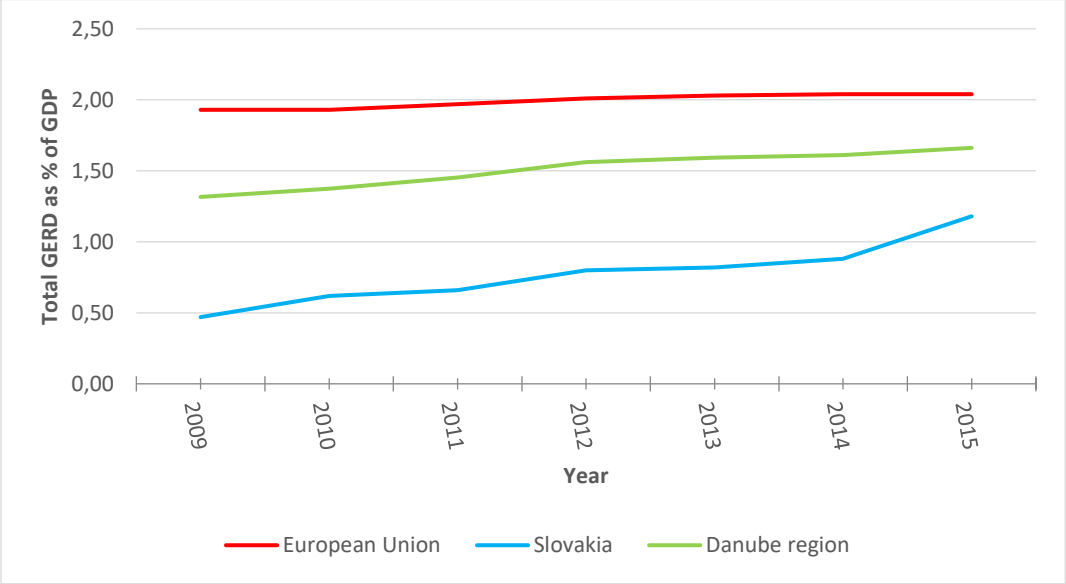

Figure 18: Total Intramural R&D expenditure as % of GDP (all sectors)
(Source: Eurostat)

During the observed period, Slovakia kept significantly below the average of the European Union and the countries of the Danube region. From Intramural R&D expenditure 0,47% of GDP in 2009 the share increased to 0,88% of GDP in 2014 and 1,18% of GDP in 2015.

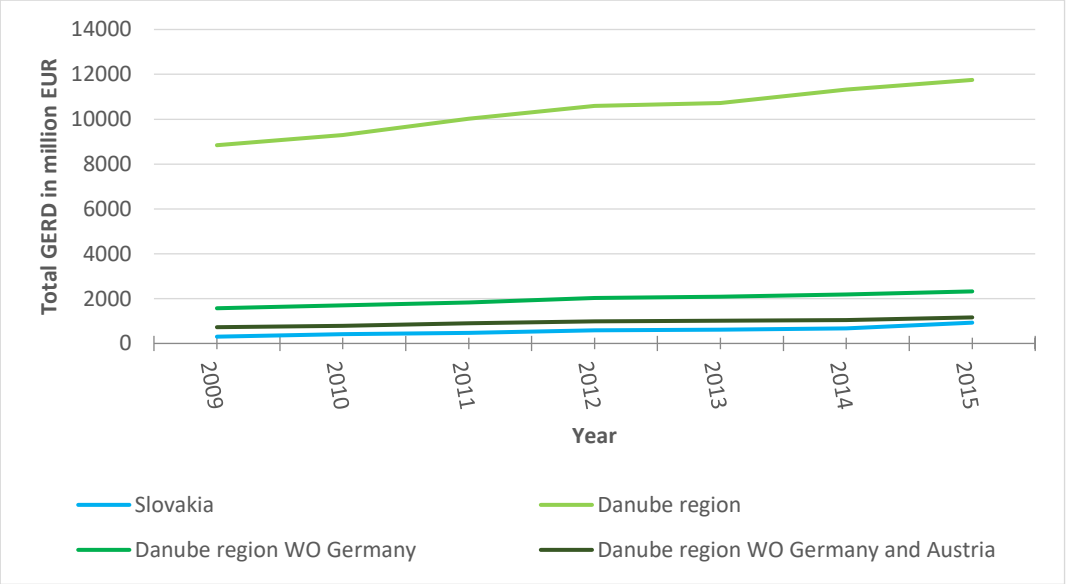

Figure 19: Total Intramural R&D expenditure in million EUR (all sectors)
(Source: Eurostat)

In absolute terms Slovakia is falling behind even compared to the Danube regions average excluding Germany and Austria. The graphical representation of the Danube regions as a whole was excluded due to the large size of the German expenditure – also on the level of states Baden Württemberg and Bavaria). The values in absolute terms have slightly converged in 2015, when the difference was very

low 927,27 million compared to more than 1,16 billion in 2015).

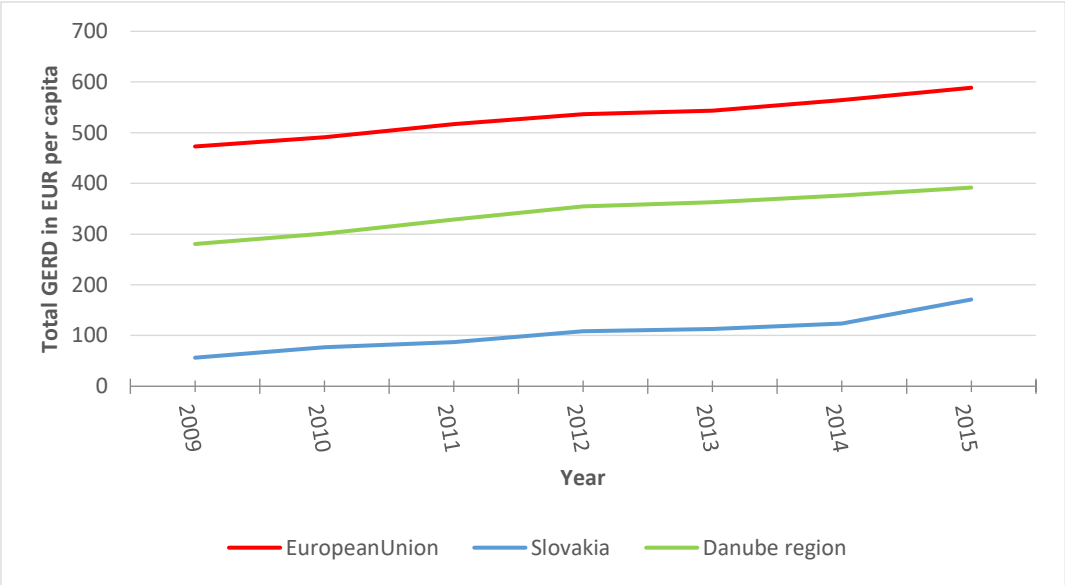

Figure 20: Total Intramural R&D expenditure in EUR per capita (all sectors)
(Source: Eurostat)

Within the observed period, the average total intramural R&D expenditure in countries of the European Union was 530 EUR per capita and 342 EUR (-35%) in countries of the Danube region. Expenditure of Slovakia changed within the range of 56 EUR per capita in 2009 and reached a level of 171 EUR in 2015. The average expenditure was only little above 105 EUR, which is more than 30% below the average of countries in the Danube region.

OBSTACLE: Total Intramural R&D expenditure is extremely low even in comparison to the Danube region average. Total Intramural R&D expenditure per capita in Slovakia was only 20% of that of the European Union's average and was less than half of the average for comparable developed countries. There is a clear lack of intramural expenditure for R&D across all sectors, which can be seen as an obstacle of further development of eco-innovations.

Indicator: Turnover from innovation (% of total turnover)

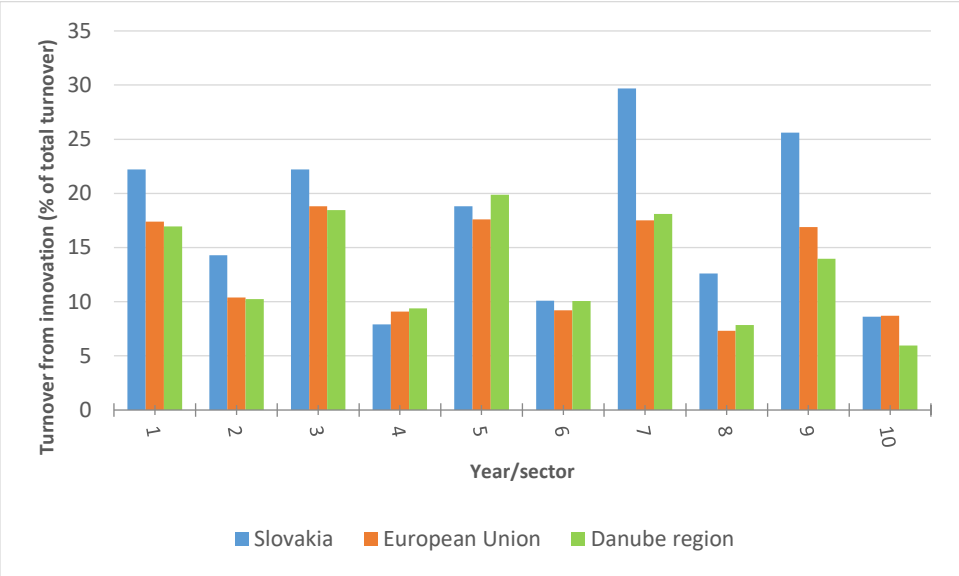

Figure 21: Turnover from innovation (% of total turnover)
(Source: Eurostat)

The actual turnover from innovation as a share of total turnover has varied significantly in the observed time period (from 2004 to 2012 on a biennial basis). The average share of turnover from innovation in the European Union was 15,32% in the industry sector and 7,88% in the service sector respectively. The average is calculated with values for EU-27 including for the year 2010 with the values for EU-28 included for the year 2012. Comparably the average for countries from the Danube region have documented very similar results at 17,47% for industry and 8,7% for services. The average for Slovakia is calculated to be 36% more for industry and 23% more for services.

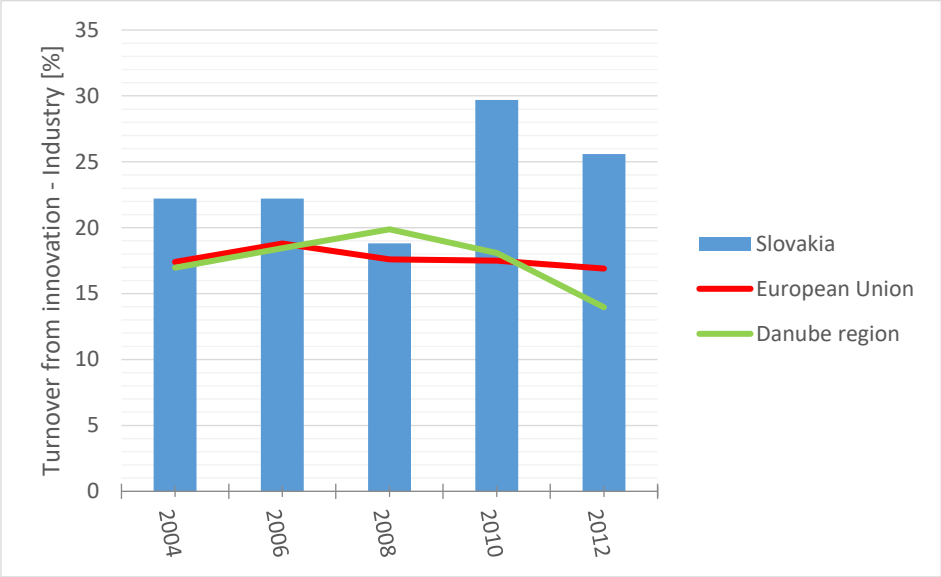

Figure 22: Turnover from innovation in industry (% of total turnover)
(Source: Eurostat)

The turnover from innovation in the industry sector in comparison to the total turnover has increased in Slovakia from 22,2% in 2004 to 29,7% in 2012. The average share in the period from 2004 to 2012 was 23,7%, which was 34% more than the average of countries in the European union and 36% more than countries in the Danube region respectively. Unlike the average of the Danube region, the share peaked in 2010 at 29,7% (18,09% in the Danube region) and was followed by a decline in 2012, in which the share was only 25,6% (13,97% in the Danube region).

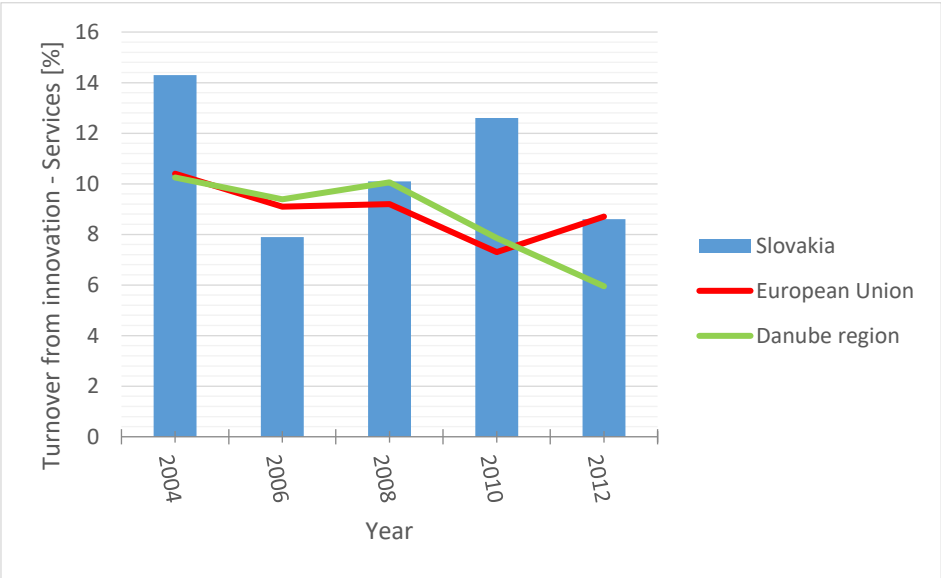

Figure 23: Turnover from innovation in services (% of total turnover)
(Source: Eurostat)

The turnover from innovation in the service sector in comparison to the total turnover has also been volatile in the observed period. In the service sector the share reached peaked value in 2004 at 14,3%

and it was followed by sharp decline in 2006 at 7,9%. Slight increase has been marked between 2006 and 2010 from 7,9% to 12,6% and a correction back to the 8,6% in 2012. In comparison the share of analysed countries in the Danube region has been on almost a steady decline from 10,25% in 2004 to only 5,95% in 2012.

OPPORTUNITY: The shares of turnover from innovation in both the industry and service sectors have been volatile, despite of that in 2004 and 2010 largely exceeded the average of the EU 28 and the DR region average. In spite of the certain inconsistency in the turnover from products new to the enterprise and the market in both the industry and service sectors in Slovakia, overall high shares of total turnover indicate an opportunity for Slovakia for further uptake of innovation. With reference to the total national expenditure on R&D across all sectors points there might be a conclusion drawn, there is an efficient use of said funds in Slovakia.

Indicator: Value added by knowledge intensity (in services and manufacturing)

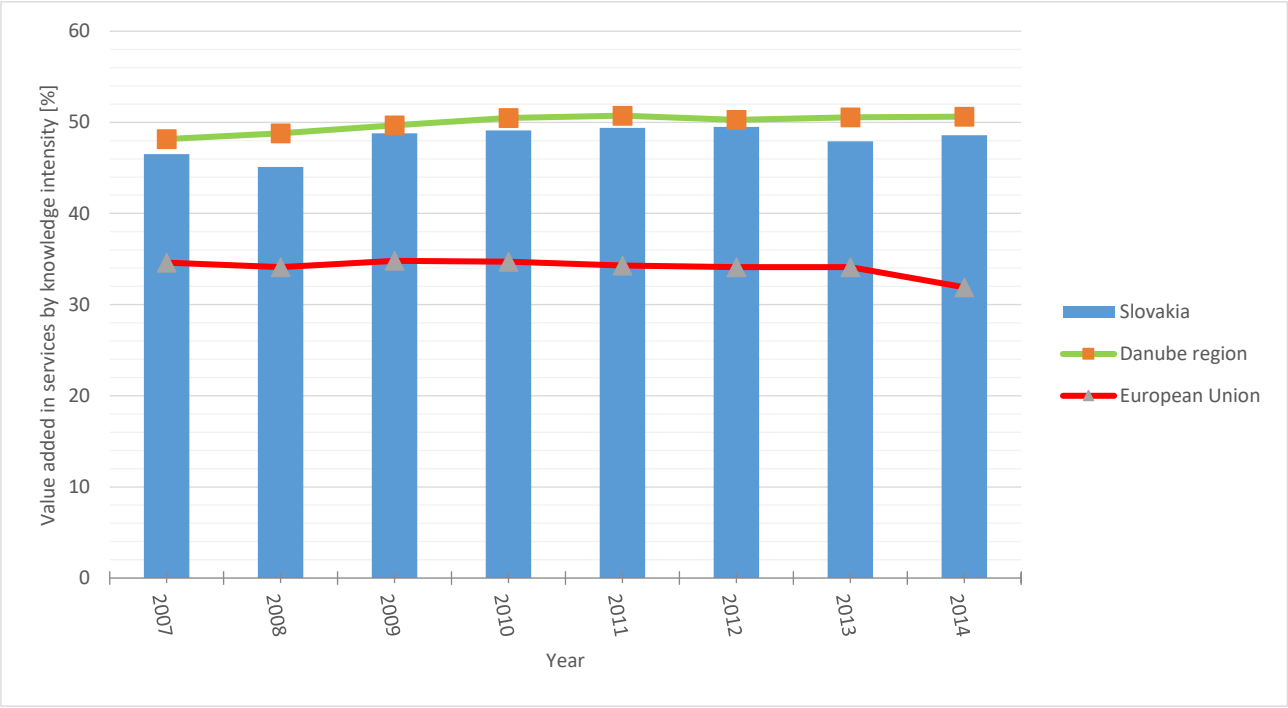

Figure 24: Value added in services by knowledge intensity (%)
(Source: Eurostat)

Value added at factor cost for knowledge-intensive services (KIS) and less knowledge-intensive services (LKIS) expressed as a share of the total value added and as a share of the value added from services has been rather stable in Slovakia in the period from 2007 to 2014 with a little decline in 2008, raising a modest 2% in observed period. Slovakia is slightly below the Danube region average (4%) in the share of value added at factor cost for KIS and LKIS and 29% above the average of the European Union.

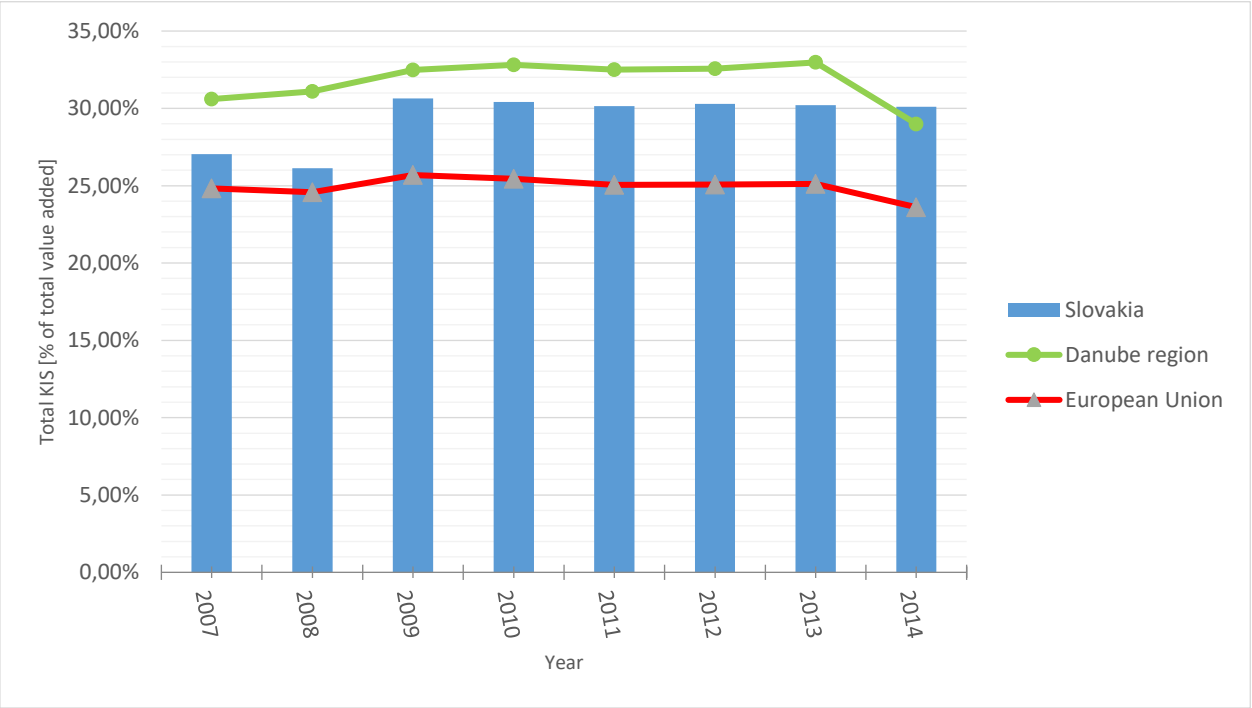

Figure 25: Total knowledge intensive services in Slovenia [% of total value added] (Source: Eurostat)

With respect to knowledge intensive services the trend is very similar. The share of knowledge intensive services compared to total value added has been stable with a rise of roughly 2% (maximum change 4,4% between 2008 and 2012) and on average 18% above the European Union and 7,5% below the Danube region.

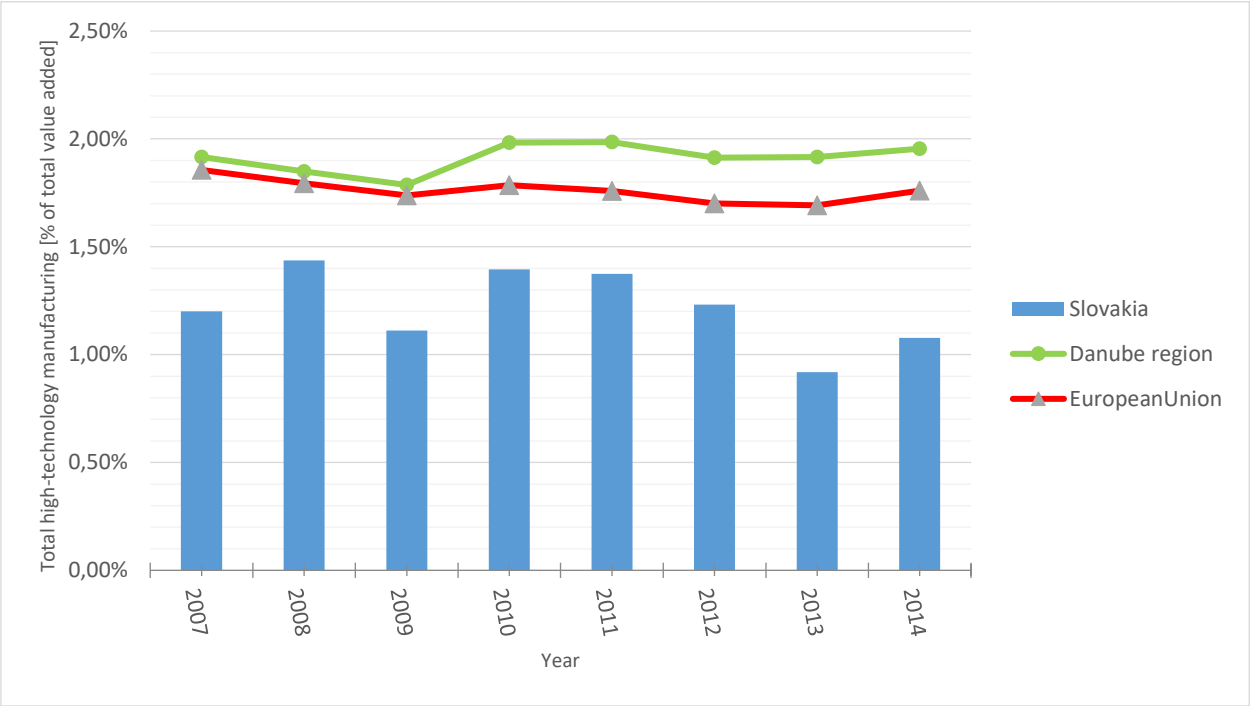

Figure 26: Total high-technology manufacturing [% of total value added]
(Source: Eurostat)

High-technology manufacturing as a share of total value added has been volatile in observed period. The peak value at about 1,5% was reached in 2008 following by the decline between 2010 and 2013 from 1,4 % to 0,92%, which was also the lowest documented value. In 2014 Slovakia has documented again a slight increase up to 1,1%. Compared to the countries in the Danube region and the EU average the total high-technology manufacturing has been about 36% and 44% less for Slovakia.

OBSTACLE: Value added at factor cost for knowledge-intensive services (KIS) and less knowledge-intensive services (LKIS), total knowledge intensive services and high technology manufacturing have been constantly far below the averages of both the countries in the European Union and the Danube region.

Indicator: Scientists and engineers as % of active population

The share of scientists and engineers within the Slovakia's total population has only a very slight increase over the observed period. The national growth is far below the trend of countries in the European Union with the value 50% lower than the average. Compared to the average of countries in the Danube region, Slovenia has about 37% less of scientists and engineers as a share of active population, and is in this regards it is ranked as the last country in the list.

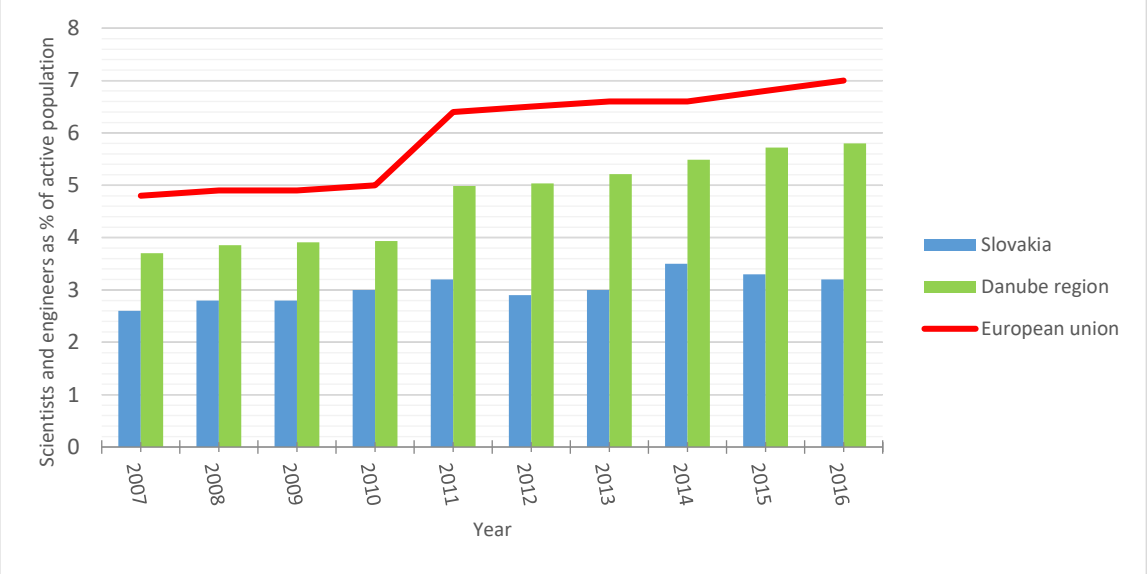

Figure 27: Scientists and engineers as % of active population in Slovakia (Source: Eurostat)

OBSTACLE: Highly educated persons in the field of engineering and science present a very low share of the population active in the national workforce. This indicates that Slovakia has a poor representation in the highest fields of knowledge, technical development and specialization. This presents an obstacle in further development in Slovakia, results in brain-drain. There is an urgent need to provide better conditions for scientists and researchers, and create opportunities for international exposure and more competitive environment.

Indicator: Employment in Knowledge Intensive Activities (KIA) and medium/high-tech manufacturing

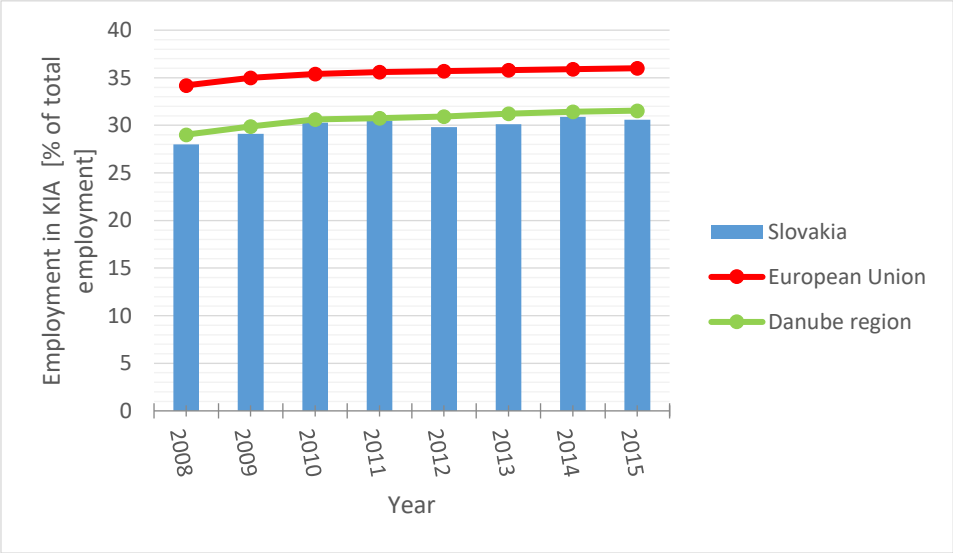

Figure 28: Employment in Knowledge Intensive Activities (KIA) as a share of total employment in Slovakia (Source: Eurostat)

In Slovakia, employment in knowledge intensive activities in both manufacturing and services is below the EU average but comparable to the Danube region average.

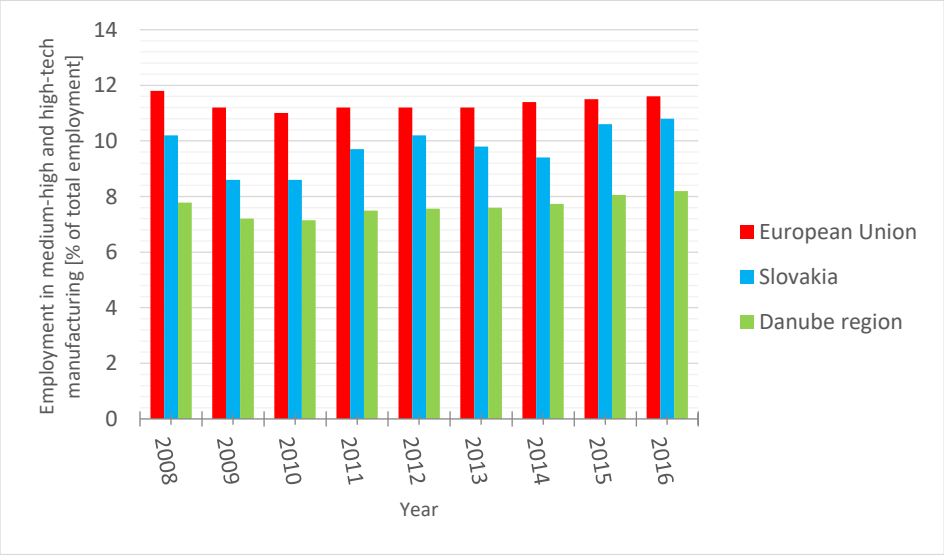

Figure 29: Employment in medium-high and high-tech manufacturing as share in total employment in Slovakia (Source: Eurostat)

Employment in medium-high and high-tech manufacturing as a share of total employment in Slovakia

is also well below the European Union, on average 14%. Slovakia´s share compared to the Danube region average is above about 28%.

OPPORTUNITY: Rather stable comparable to the average of the Danube region employment in knowledge intensive activities in both manufacturing and services and higher share of employment in medium-high and high-tech manufacturing (as a share of total national employment) creates an opportunity for Slovakia in future development in eco-innovative products and services.

4. ENERGY

Slovakia, like other post-soviet countries, has been largely dependent on energy imports from Russia which was given by the existing oil and gas infrastructure. However, in last years, several measures such as construction of more south-north interconnections and reverse gas flow have been taken to decrease this dependence. Thus the energy mix is beginning to diversify, with balanced representation of coal, nuclear, natural gas and a slowly rising share of renewable sources energy sources. (Jurcova, 2016)
The primary energy sources for electricity generation in Slovakia is nuclear energy covering 65% of the overall production. (Eurostat, 2017)
Energy consumption is gradually increasing (in 2016 it amounted to 30,103 GWh) while the overall electricity production is decreasing (Slovakia generated 27,452 GWh). It is mainly due to huge differences in prices of the electricity on the market and the operational costs of unsubsidized electricity. Deficit is then compensated by increase in imports which was 8,8% percent of its electricity consumption in 2016. (Liptakova, 2017) However, the long-term strategy is to cover the electricity consumption in Slovakia by total production. Finalisation of two new reactors in Mochovce nuclear power plant should contribute to it prospectively in following two years.
Slovakia shows good performance in the Internal Energy Market and due to successful day-ahead market-coupling the Czech Republic, Slovakia, Hungary and Romania price stability in the region has significantly improved. However, end-user prices for all households and SMEs remain high compared to the other countries in the region due to the regulation in the electricity and gas retail markets.
Slovakia has committed itself to a 14% share of electricity production by 2020 renewable resources. EU target is 27 % of final energy consumption from renewable sources by 2030. Nevertheless, political debates on renewable resources have been often associated with instability, high costs and intermittency. Currently the share of the renewable energy comes close to 17,65% and it is based mostly on hydropower plants and part of it comes from wood biomass in heat production. However, ministry of environment sees a large so-far unused potential in geothermal energy too.

4.1 General overview of energy sector

In 2016 large proportion (53,8%) of electricity in Slovakia came from nuclear power plants. Fossil fuels made up 19,4%. Hydropower stations generated 17,65%.

"Green electricity", i.e. electricity generated from renewable sources, amounted to 2,430 GWh. Compared with the previous year this was an increase by less than 2%. Thus RES accounted for 8,85% of electricity produced in Slovakia.

Indicator: Energy dependence

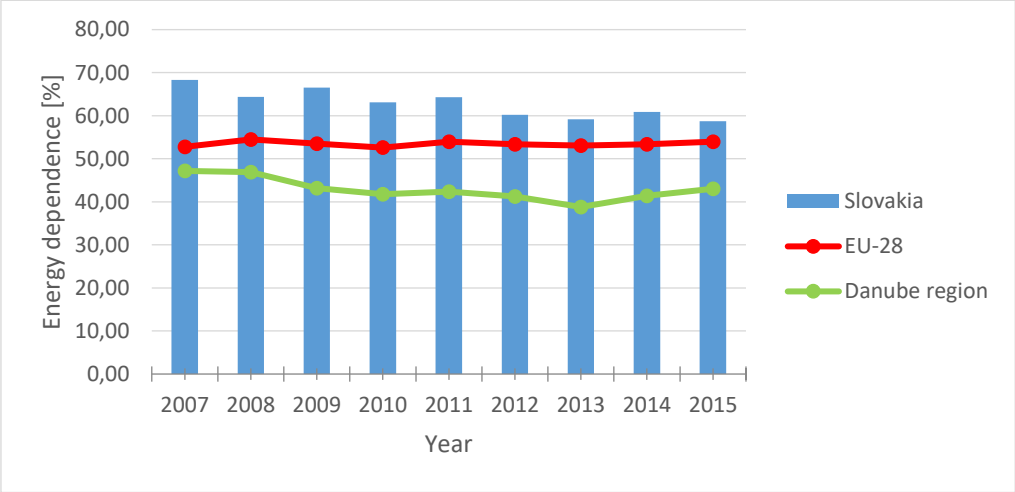

Figure 30: Energy dependence of Slovakia compared to EU-28 and the Danube region (Source: Eurostat)

To a major extent Slovakia's dependency was 58,7%, which was above the European Union average. From the point of view of import dependence of fossil fuels alone, the share of imports shifted to 90%, with Russia playing a major role. Slovakia thus belongs to a Member state with medium dependency considering that the average for the European Union member states (EU-28) was 54,0% in 2015.

Indicator: Energy intensity of the economy

The metal processing and electricity production sectors generate more than 20% of the Slovakia´s industrial waste. Half of this waste (i.e. 11% of the total) comes from the manufacture of basic iron and steel and ferro-alloys. Some of these wastes are harmful. Despite of that they end up at the landfills. Coal and biomass power stations produce around 10% of the country's electricity supply (Slovenské elektrárne, 2017). They generate more than 90% of all waste from electricity supply. Moreover, the waste from mining of lignite is about 1,5% of total waste generation. Thus increasing the efficiency of metal processing and of electricity generation from lignite could significantly increase the overall resource efficiency of the economy. (OECD 2017)

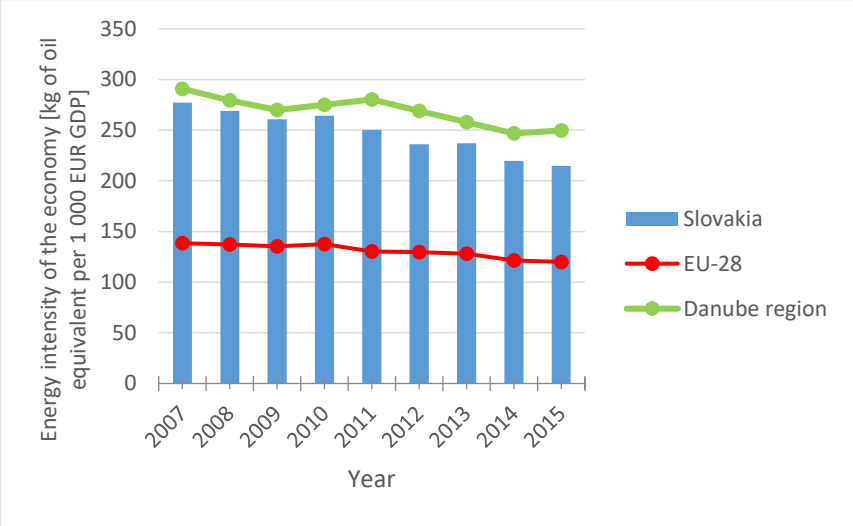

Figure 31: Energy intensity of the Slovak economy
(Source: Eurostat)

Slovakia has substantially decreased the energy intensity of its economy from the value 277,3 kg of oil per 1000 EUR GDP in 2007 to the value of 214,7 in 2015.

Indicator: Share of renewable energy in gross final energy consumption

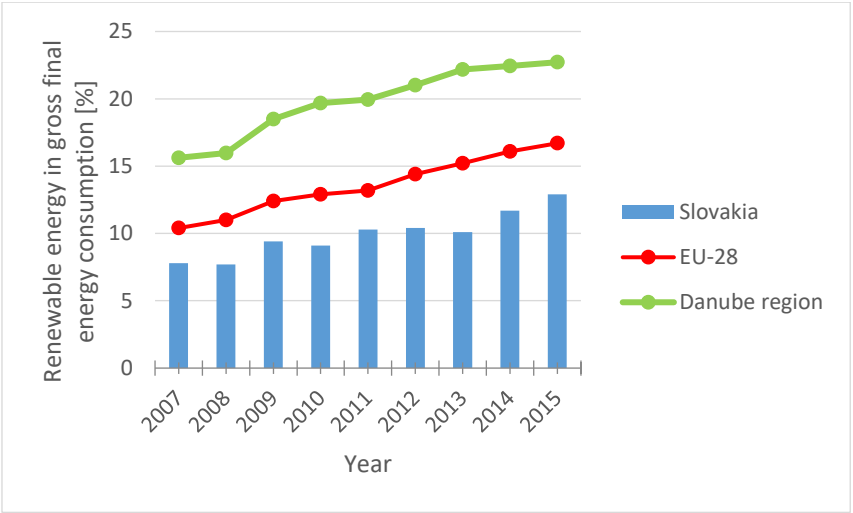

Figure 31: Share of RES in final energy consumption in Slovakia
(Source: Eurostat)

In 2015, renewable energy accounted for 12,9 % of total final energy consumption in Slovakia, compared with 16,7 % in the EU and 22,72 in the Danube region countries. However, Slovakia has made a progress in the observed period, since in 2007 when the renewable energy consumption accounted only for 7,8% of the total final energy consumption.

Indicator: Electricity generated from renewable sources

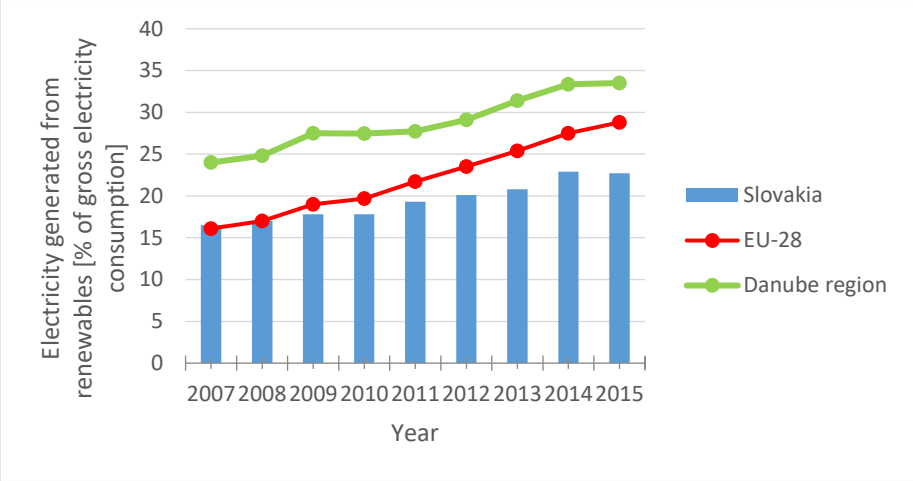

Figure 32: Share of electricity generated from RES in Slovakia (Source: Eurostat)

In 2015 22,7% of the total electricity consumption has been generated from renewable resources which means a significant increase since 2007 when the share of the electricity generated from renewable resources made 16,5 of the total energy consumption. However, compared to the 28,8% RES of the EU and to the 33,51% of the Danube region average in 2015, Slovakia is lagging significantly behind.

Obstacle: Key challenges are the independence of national regulatory authority and its accountability. Promotion of a regulatory framework conducive to investment in and integration of the electricity and gas markets, including by reviewing the impact of price regulation and changes in network charges. May help to decrease network distribution and transmission charges in Slovakia which belong currently among the highest in the EU.

Opportunities: Successful regional integration and strong interconnections with neighbouring countries in both gas and electricity networks create a huge advantage for the Slovak energy sector. Market coupling with the Hungarian, the Czech and Romanian day-ahead electricity markets is a positive development which contribute largely to the stability of the industry. Efforts to diversify gas imports in order to foster security of supply and in order to address the concentration on the wholesale market help to address energy dependency.

4.2 National energy policy

The main objective of the energy policy, according to the Energy Policy of the Slovak Republic

document, sets the main objectives and priorities of the energy sector by 2035 with a view to 2050. Main aim is to ensure reliability and stability of energy supply, efficient use of energy for optimum cost and environmental protection. At the same time Slovakia bound on to the EU 2030 Agenda targets and to the 2020 climate and energy package. However, energy policy in Slovakia is prone to politically strategic and ideological rather than market-oriented considerations. Worrying factor is the interference of state and private interests since major energy companies are largely publicly owned.

Nevertheless, one of the major concerns of the Slovak government is energy security thus the country continues to focus on gas imports and further development of its nuclear power. To ensure the stability of energy supplies, it is necessary to diversify transport routes, especially for natural gas and oil, as the risk of supply disruptions for these commodities is higher than for coal and nuclear fuel.

In the case of gas transmission in 2015, Slovakia accomplished the project of connecting the Veľké Zlievce-Vecsés networks, which strategic importance in the future lies in diversification and supply stability but also in the possibility of access of the Slovak Republic to the planned southern corridor or to the LNG terminal in Croatia. Slovakia has built reverse gas flows with Austria and the Czech Republic, but the government priority is to support the east-west direction of natural gas flow as well, so that SR is not supplied only in the reverse direction. Oil security was reinforced also by the reconstruction of the Adria oil pipeline accomplished in 2015 as well. From the point of view of energy security, the concept operates with nuclear fuel as least dependent on supply outages as uranium supplies are diversified from stable regions. The Slovak Republic therefore continues to plan to use nuclear energy within its energy mix which shall be fulfilled by the completion of the 3rd and 4th blocks of the Mochovce nuclear power plant.

As the use of indigenous renewable energy sources (RES) increases energy security, the SR's energy policy envisages an increase in their share in the energy mix by 2020 at 14% required by the European Union.

The goal of RES support is to reduce redemption prices so that no support for the purchase price scheme is needed after 2020.

The greatest potential for RES use in the production of heat with 10% is biomass. In the case of electricity production, hydroelectric power has the greatest potential, which already covers up to 19% of the consumption. The concept also envisages the construction of a new power plant in Sereď to take advantage of the potential of the Váh River and the Ipeľ pumping station.

Support will also be given to the construction of wind power plants, which are currently suspended. The use of wind potential will be possible on the basis of the reverse auction principle, with the approval given to those investors who offer the lowest redemption price.

5. ENVIRONMENTAL PROTECTION

5.1 Environmental challenges

According to the Summary report on the environmental situation in the Slovak republic 2015 key challenges are related to the air pollution, quality of water resources, acidity of the agricultural land, significant degradation of the ecosystems and unhealthy state of the forests. (MŽP SR, 2016)

In the long-term perspective pollutant emissions in the air have fallen down but the rate of decline has significantly slowed down after year 2000. Moreover statistics on some pollutants are rather volatile. For example, there was an increase of pollutant in emissions in 2014 compared to 2013 recorded namely in the case of NOx, CO, for heavy metals it was lead, cadmium, mercury as well as for polychlorinated dibenzo-p-dioxins (PCDD), dibenzofurans (PCDF) and polychlorinated biphenyls (PCB) emissions. However, the limit values of air pollutants for protection of the vegetation have not been exceeded. Ground ozone remains a serious problem since the limit values for the protection of vegetation and the protection of forests are regularly exceeded.

Slovakia possesses enough water resources to meet current and prospective water needs. However, water resources are unevenly distributed and it concerns both their quantity and quality. Major challenge is the ecological state of the surface water where more than a half of the total length belongs to the average, bad or very bad category and the state. However, when assessing the chemical status of surface water bodies only about three percent of the length is in the bad chemical category on the contrary in the case of the chemical status of bodies of groundwater, about a fifth of their area has a poor chemical status.

The share of the total area of agricultural land in Slovakia was almost half in 2015 and it has slightly fallen compared to the previous years. Agricultural land is of high quality in terms of its contamination. More than 99% is hygienically satisfying. However, the acidity of soils is increasing. Average values of organic carbon content in arable land are significantly lower than on permanent grasslands.

Another problem is the degradation of ecosystems. Nearly half of the species of higher plants of European significance are in an unfavorable state and in case of the habitat of the European significance i tis more than a half. An even worse situation is in the case of animals of European significance where it is more than three quarters.

The area of forests is growing steadily in the long run. The largest percentage increase in the long run was recorded for built-up areas and courtyards. The health state of forests has been stabilized in recent years, but is still considered unfavorable. However, in 2015 there was a significant improvement in the health status of deciduous trees, recorded the stabilization of spice and pine health status and improvement in the case of fir.

5.2 Environmental legislation

Slovak environmental policy has been based on several cross-cutting and partial conceptual documents,

in particular the Strategy, Principles and Priorities of the State Environmental Policy adopted in 1993, the National Strategy for Sustainable Development adopted in 2002, Integrated Approach Strategy in the Environment Chapter approved by the government in 2001 and the Operational Program Environment 2007 - 2013.

Based on the Program Statement of the Government of the Slovak Republic for 2012-2016 a new concept of state environmental policy of the Slovak Republic has been established. This concept, entitled "Orientation, Principles, Priorities and Main Responsibilities of the Slovak Environmental Protection for 2014-2020", is based on the analysis of the environmental situation in the Slovak Republic and relevant international contexts (Europe 2020 Strategy, EU Strategy for the Danube Region, the EU's 6th and 7th Action Plans, the OECD Recommendations on the Environmental Performance Assessment of the Slovak Republic in 2011, the Agenda 21 with the relevant Implementation Plan, and the RIO + 20 "The Future WE Want" conventions to which the Slovak Republic has acceded), as well as the current objectives of 7 cross-cutting and 26 adopted and 15 prepared sectoral strategies, concepts, programs and plans for environmental protection, including 36 adopted and 7 prepared such supporting economic pillars and the Social Pillar of Sustainable development of the SR. It basically forms the basis for the creation of the Environmental Quality Operational Program for the years 2014-2020.

A new document “Strategic Environmental Policy of the Slovak Republic until 2030” is currently being prepares, the document has an ambition to respond to the new challenges and measures should aim at improving the quality of life and health of people. The new strategy should contain clear vision of Slovakia's environmental policy so that it is acceptable to experts, legislators and the general public.

The overall policy framework regarding climate change in the Slovak Republic is in line with EU strategies and Slovakia also complies with international treaties. In September 2016, the Slovak parliament ratified the Paris Agreement within the United Nations Framework Convention on Climate Change, making the country the fourth to do so. The ratification by the end of 2016 of the agreement by all crucial states, including the EU itself, featured prominently among Slovakia’s priorities for its EU presidency in the second half of 2016.

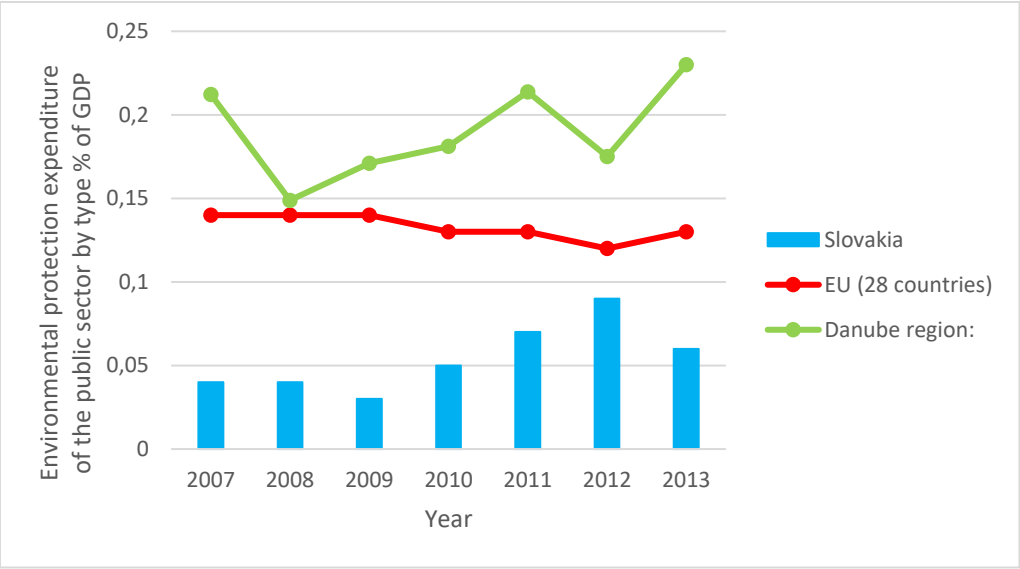

Figure 33: Environmental protection expenditure of the public sector by type [% of GDP] (Source: Eurostat)

Expenditures on environmental protection in the Slovak Republic were volatile in the observed period. The share of total expenditures on environmental protection in GDP amounted to 0,09% in 2012 and 0,6% in 2013. According to the Ministry of Environment (MŽP SR, 2016), the share of total expenditures on environmental protection in GDP amounted to 1,12% in 2016. Hence, Slovakia belongs among the EU countries with the lowest share of public sector's expenditures in GDP.

5.3 Environmental taxes

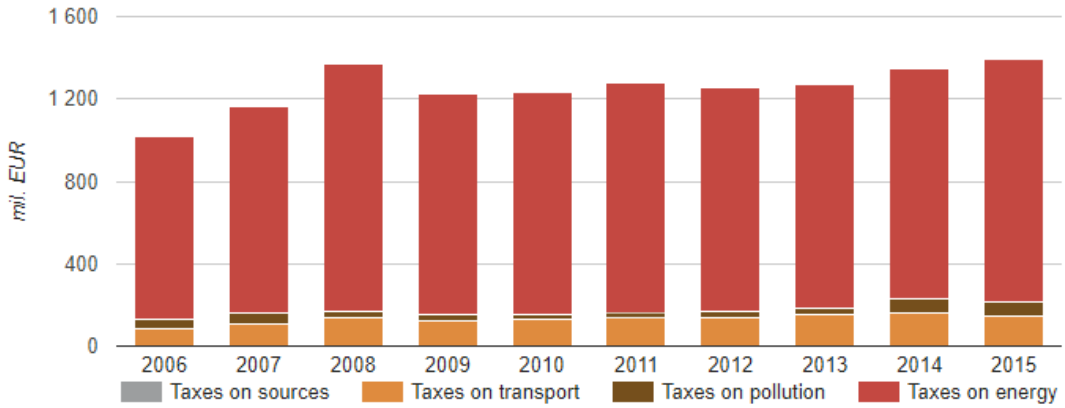

Figure 34: Development of taxes with environmental aspects
(Source: SO SR, Eurostat)

Energy tax increased by 33% between 2006 and 2015 while in 2015 it amounted to 1 181,25 mil. EUR in 2015. The energy tax compared to the previous year increased by 5,6%.
Transport tax reached 142,34 mil. EUR in 2015, and compared to 2006 it increased by 65,1%. Transport tax decreased by 9,4% when compared to the previous year.
Total taxes with environmental aspects amounted to 1 392,45 mil. EUR in 2015, and compared to 2006 they increased by 37,3%. Taxes with environmental aspects compared to the previous year increased by 3,2%.
The share of energy taxes in GDP reached 1,5% of GDP in 2015, and compared to 2006 it decreased by 0,45%. Compared to the previous year it increased by 0,03%. The share of transport taxes in GDP reached 0,18% of GDP in 2015, and compared to 2006 it increased by 0,01%. Compared to the previous year it decreased by 0,03%.
The overall share of taxes with environmental aspects in GDP reached 1,77% of GDP in 2015, and compared to 2006 it decreased by 0,46%. Compared to the previous year it decreased by 0,01%. Within the taxes with environmental aspects the energy tax contributes the most in GDP.
The share of energy tax in total tax revenues reached 4,67% in 2015, and compared to 2006 it decreased by 1,99%. Compared to the previous year, it was a decrease by 0,07%.
The share of transport tax in total tax revenues reached 0,56% in 2015, and compared to 2006 it decreased by 0,09%. Compared to the previous year it decreased by 0,11%.

The overall share of taxes with environmental aspects in total tax revenues reached 5,5% in 2015, and compared to 2006 it decreased by 2,12. Compared to the previous year, it decreased by 0,22%.
Within the taxes with environmental aspects the energy tax contributes the most in total tax revenues**.** (MŽP SR, 2016)

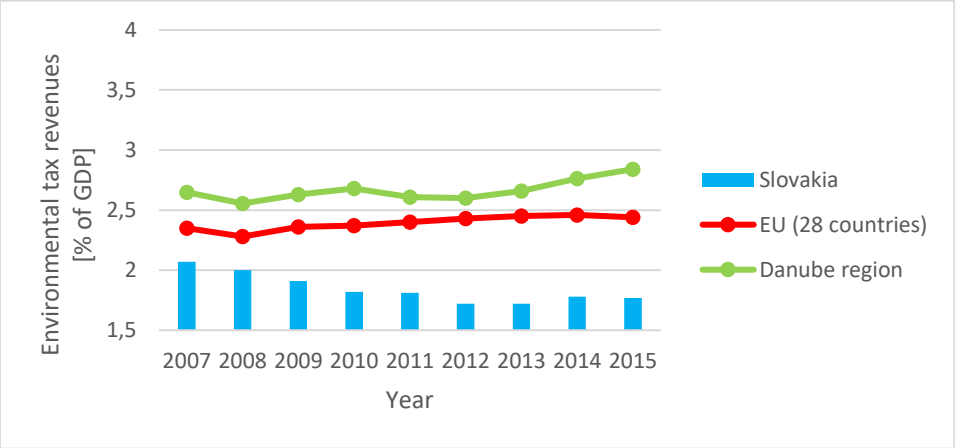

Figure 35: Environmental tax revenues [% of GDP]
(Source: Eurostat)

In the Slovak Republic the share of taxes with environmental aspects in GDP has been decreasing since 2007, in 2015 it reached 1,77%. The energy tax contributed the most on GDP, in 2015 it was 1,5%. The Slovak Republic is deeply below the EU and Danube region countries average with significantly low share of taxes with environmental aspects in GDP.

Obstacle: Low share of taxes with environmental aspects in GDP and extremely low public sector expenditures on environmental protection create a serious problem in sustainable development and the preservation of the natural ecosystem in Slovakia.

6. ECONOMY AND DEMOGRAPHY

In March 2013, the research team Branislav Bleha, Branislav Šprocha and Boris Vaňo issued a detailed INFOSTAT study on demographic trends in Slovakia. The conclusions of the study show that the transformation of the Slovak society after 1989 also influenced the reproductive behavior of women in the Slovak Republic. This trend is typical of the whole of Eastern Europe, which can limit regional solutions such as migratory flows, and also creates a competitive environment in which we need to respond quickly and efficiently. A large proportion of the female population decided to postpone the date of family formation due to the extension of the study period, housing security, and for this reason Slovakia had the lowest fertility rate in Europe between 2000 and 2007. The high rate of emigration of high-quality people and the absence of an active immigration policy only exacerbates the demographic trend by 2060. According to the Eurobarometer of October last year, Slovakia is one of the least tolerant countries among the 28 member states of the European Union. The consequences of an economic crisis like globalization will affect the structure of our population and functioning in a diverse environment will be one of the common parts of our lives.

The decisive impact on population growth in the Slovak Republic over the next thirty years will have support for childbearing and migration, and the state must play a key role in both setting the legislative, socio-economic and labour law arrangements and creating a pleasant environment for family and child care, the living conditions in Slovakia to prevent the departure of young people from Slovakia and to encourage the return of those who have already travelled abroad. An essential part of this strategy is to make the conditions for migrants more attractive so that they can be fully integrated into society.

Indicator: Gross domestic product at market prices in PPS per capita

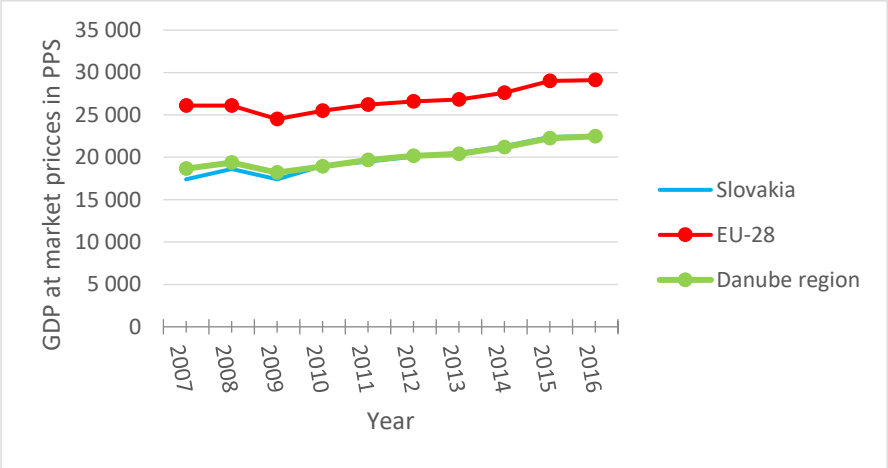

Figure 36: Gross domestic product at market prices in PPS per capita in Slovakia, the EU and the Danube region (Source: Eurostat)

The Gross Domestic Product of the Slovak Republic since 2007, with the exception of 2009, is year after year on a stable increase. According to observers, the increase of Slovakia's gross domestic product in the second quarter of 2017 came as a positive surprise.

Indicator: Employment rate as a share of total population of age group 20-64

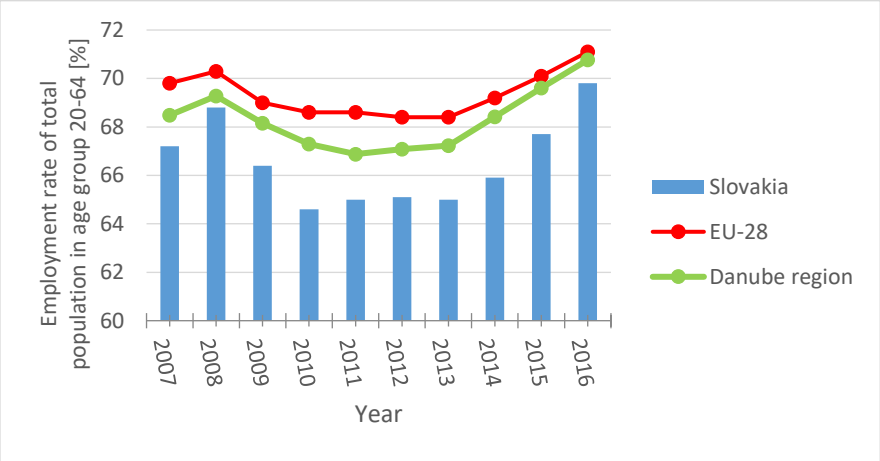

Figure 37: Employment rate as a share of population age 20-64 in Slovakia (Source: Eurostat)

Slovakia encountered increase in domestic consumption which resulted in the increase in employment and real wages. While employment rate of the total population aged between 20 – 64 has been 64,6% in 2016 the rate grew to 69,8%. However it is still below the EU and Danube region average which both score above 70% employment rate of the total population in age group 20 – 64.

Indicator: Unemployment rate as a share of active population

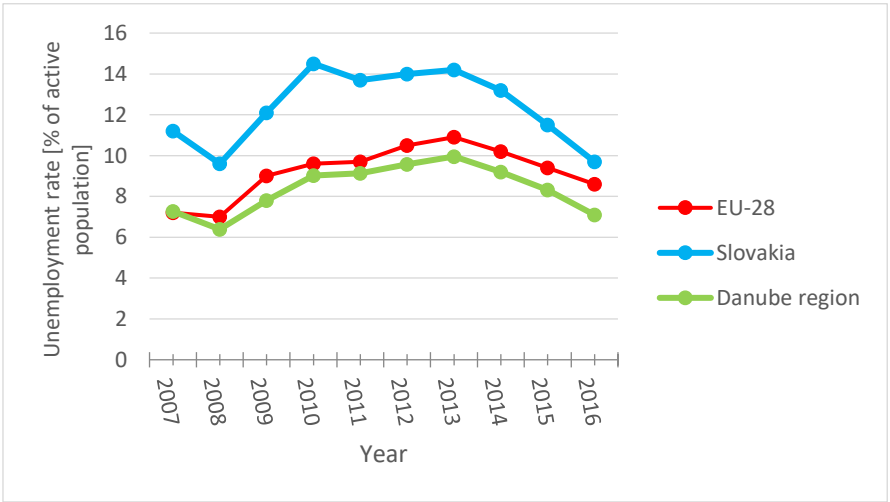

Figure 38: Unemployment rate as a share of active population in Slovakia (Source: Eurostat)

After the peak value in 2013 9,96% unemployment has been followed by the continuous decrease to the value of o 6,39% in 2016. Still, the decrease in unemployment was slower than expectations. One of the reasons might have been the higher number of people going to work abroad or the higher number of people becoming economically inactive.

7. CONCLUSION

Slovakia belongs to the group of economies whose eco-innovation index does not reach high level and it is still lagging behind the average of the EU. The only exception is the resource efficiency outcome index, where Slovakia scores high above the average of the EU and the Danube region countries. This represents a clear opportunity for Slovakia to ensure long-term benefits for all - the government, businesses and people. Lower production costs and a lower dependency on imports could stimulate further economic growth. Lower expenditure on the mitigation of environmental degradation and lower health-related costs due to improved environmental quality may save the public finance. Companies could increase their productivity and competitiveness thanks to lower dependency on virgin materials, more efficient production processes and lower input costs. However, the innovations do not produce the expected positive result, which should be the higher competitiveness of Slovak enterprises because the current innovation system fails in transforming new knowledge into advanced materials, products, processes, technologies and services. Further weaknesses in the development of eco-innovations in Slovakia include insufficient funding of research and science, low demand for the corporate sector after the results of domestic public research and science and a weak emphasis on innovation policy within the framework of economic policies and its coordination within individual sectors. Innovation activity in Slovakia is lower compared to economies in other European countries as well as the Danube region countries.

Unsatisfying conditions for scientists and researchers on one hand results in a low share of the highly educated persons in the field of engineering and science and a brain-drain. Better conditions, international exposure and creation of the more competitive environment could improve the representation in the highest fields of knowledge, technical development and specialization. On the other hand, rather stable employment in knowledge intensive activities in both manufacturing and services and higher share of employment in medium-high and high-tech manufacturing (as a share of total national employment) creates an opportunity for Slovakia in future development in eco-innovative products and services.

Energy sector in Slovakia requires long-term vision and strategy. Progress in terms of specific policies and projects need to be translated in its effective implementation. A combination of well-targeted policies that are reasonably using EU funds together with private investments could contribute fulfilment of the major goals of the energy policy - reliability and stability of energy supply, efficient use of energy for optimum cost and adequate environmental protection.

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