STUDY ON THE FEASIBILITY OF PROMOTING V4-KOREA COOPERATION IN THE CONTEXT OF IMPLEMENTING THE EURASIA INITIATIVE

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1 Brief profiles

1.1 Korea

South Korea, officially the Republic of Korea (ROK), is a highly urbanized sovereign state in East Asia, constituting the southern part of the Korean Peninsula.

Today, it is the eleventh country in the world when compared by GDP (GDP (current US$), WB data 2015), the world's sixth largest exporter (merchandise exports (current US$), WB, 2015) and ninth largest importer (merchandise imports (current US$), WB, 2015) with the highest credit rating of any country in East Asia. It is the only G20 nation having free trade agreement with China, the US and EU simultaneously.

KEY FACTS	
Capital:	Seoul
Geographical size:	100,210 km^2
Population:	50,617,045 (2015) (http://kosis.kr/eng/)
Gross domestic product (GDP) :	1,377,873.11 (2015, current mil. US$)
Official language(s) :	Korean
Political system:	presidential republic
Currency:	South Korean won
Key sectors:	Services, textile, steel, shipbuilding, car manufacturing, electronics, R&D
Rating:	S&P/Moody's/Fitch AA/Aa2/AA-

1.2 V4

The Visegrad Group was formed on 15th February 1991 at a meeting of the President of the Czechoslovak Republic, Vaclav Havel, the President of the Republic of Poland, Lech Wałęsa, and the Prime Minister of the Republic of Hungary, József Antall. The central motif of the meeting was the desire to intensify mutual cooperation and friendship among the three Central European states. After disintegration of Czechoslovakia in 1993, both successor countries, the Czech Republic and the Slovak Republic, became members of the Visegrad Group. Since then the Visegrad Group has been formed by four countries and marked as the V4 Group.

The formation of the Visegrad Group was motivated by four factors:

- the desire to eliminate the remnants of the communist bloc in Central Europe;
- the desire to overcome historic animosities between Central European countries;
- the belief that through joint efforts it will be easier to achieve the set goals, i.e. to successfully accomplish social transformation and join in the European integration process; and
- the proximity of ideas of the then ruling political elites (*Source: http://www.visegradgroup.eu/about/history*).

All four nations in the Visegrád Group, which became members of NATO (1999, Slovakia 2004) and European Union (2004), are high income countries with high Human Development Index and more or less steady economic growth for over a century. Slovakia adopted the euro as its official currency in 2009.

In 2000, the Visegrad Group (V4) countries founded the International Visegrad Fund. The purpose of the fund is to facilitate and promote the development of closer cooperation among citizens and institutions in the region as well as between the V4 region and other countries, especially in the Western Balkan and Eastern Partnership regions. The fund operates several grant programs, and also awards individual scholarships, fellowships and artist residencies. Grant support is given to original projects namely in the areas of culture, science and research, youth

exchanges, cross-border cooperation and tourism promotion, as well as in other priority areas defined in calls for proposals published on the fund's website. The fund's annual budget (€8 million as of 2014) consists of equal contributions of V4 governments. The fund also utilizes (in the form of subgranting or co-financing) contributions from other governments/governmental organizations from the following countries: Canada, Germany, the Netherlands, South Korea, Sweden, Switzerland, the United States. Any natural person or legal entity is eligible to apply for grant support with the exception of organizations of state (central) administration institutions. Preference is generally given to those projects submitted by not-for-profit entities (NGOs/CSOs, foundations) and public institutions (schools and universities, research institutes, etc.). Applicants from outside of the V4 region can win support provided that their proposed projects deal with the V4 region and meet all formal requirements, such as having V4 project partners. (Source: http://visegradfund.org/home/)

1.2.1 Poland

With a population of about 38 million and GNI per capita of US$13,400 (2015), Poland has the largest economy in Central Europe. Poland is a country in central Europe, bordered by Germany to the west, the Czech Republic and Slovakia to the south, Ukraine and Belarus to the east and, to the north, Lithuania and the Russian exclave of Kaliningrad. Poland has a long coast on the Baltic Sea and is largely dominated by low-lying rolling plains in the north. To the south, the Carpathian Mountains form a watershed and natural border with Slovakia.

The most important sectors of Poland's economy in 2015 were industry (26.1 %), wholesale and retail trade, transport, accommodation and food services (25.4 %), and public administration, defence, education, human health and social work activities (14.7 %).

Poland's main export partners are Germany, UK and the Czech Republic while its main import partners are Germany, Russia and China. (Source: EU website)

KEY FACTS	
Capital:	Warsaw
Geographical size:	312,679 km^2
Population:	38,005,614 (2015)
Population as % of total EU:	7.5 % (2015)
Gross domestic product (GDP):	474,783.39 (2015, current mil. US$)
Official EU language(s):	Polish
Political system:	parliamentary republic
EU member country since:	1 May 2004
Seats in the European Parliament:	51
Currency:	Polish Zloty PLN
Schengen area member:	since 21 December 2007
Key sectors:	Machine building, iron and steel, mining coal, chemicals, ship building, food processing, glass
Rating:	S&P/Moody's/Fitch BBB+/A2/A-

1.2.2 Czech Republic

The Czech Republic is a landlocked country in Central Europe and became a separate state in 1993 after Czechoslovakia split into two countries.

The most important sectors of the Czech Republic's economy in 2015 were industry (32.1 %), wholesale and retail trade, transport, accommodation and food services (18.4 %) and public administration, defence, education, human health and social work activities (14.9 %).

The Czech Republic's main export partners are Germany, Slovakia and Poland, while its main import partners are Germany, Poland and China. (Source: EU website)

KEY FACTS	
Capital:	Prague
Geographical size:	78,868 km²
Population:	10,538,275 (2015)
Population as % of total EU:	2.1 % (2015)
Gross domestic product (GDP) :	181,811.03 (2015, current mil. US$)
Official EU language(s) :	Czech
Political system:	parliamentary republic
EU member country since:	1 May 2004
Seats in the European Parliament:	21
Currency:	Czech koruna (CZK)
Schengen area member:	since 21 December 2007
Key sectors:	Motor vehicles, metallurgy, machinery and equipment, glass, armaments
Rating:	S&P/Moody's/Fitch AA-/A1/A+

1.2.3 Slovak Republic

Slovakia is a country in eastern central Europe and is bordered by the Czech Republic and Austria to the west, Poland to the north, Ukraine to the east and Hungary to the south. The Carpathian Mountains extend across the northern half of the country and include the High Tatras, which provide a natural watershed between Slovakia and Poland. In the southern half of the country are the lowlands of the Danube plain.

The most important sectors of Slovakia's economy in 2015 were industry (25.2 %), wholesale and retail trade, transport, accommodation and food services (22.0 %) and public administration, defence, education, human health and social work activities (13.6 %).

Slovakia's main export partners are Germany, the Czech Republic and Poland, while its main import partners are Germany, the Czech Republic and Austria. (Source: EU website)

KEY FACTS	
Capital:	Bratislava
Geographical size:	49,035 km²
Population:	5,421,349 (2015)
Population as % of total EU:	1.1 % (2015)
Gross domestic product (GDP):	86,581.79 (2015, current mil. US$)
Official EU language(s):	Slovak
Political system:	parliamentary republic
EU member country since:	1 May 2004
Seats in the European Parliament:	13
Currency:	Euro. Member of the eurozone since 1 January 2009
Schengen area member:	since 21 December 2007
Key sectors:	Metal and metal products; food and beverages; chemicals and manmade fibers; machinery; paper and printing; earthenware and ceramics; transport vehicles; textiles; electrical and optical apparatus; rubber products
Rating:	S&P/Moody's/Fitch A+/A2/A+

1.2.4 Hungary

Hungary is a landlocked country in central Europe, which borders with no fewer than seven countries: Slovakia, Ukraine, Romania, Serbia, Croatia, Slovenia and Austria. The country is mostly flat, with low mountains in the north.

The most important sectors of Hungary's economy in 2015 were industry (27.4 %), wholesale and retail trade, transport, accommodation and food services (18.3 %) and public administration, defence, education, human health and social work activities (17.6 %).

Hungary's main export partners are Germany, Romania and Slovakia, while its main import partners are Germany, China and Austria. (Source: EU website)

KEY FACTS	
Capital:	Budapest
Geographical size:	93,011 km^2
Population:	9,855,571 (2015)
Population as % of total EU:	1.9 % (2015)
Gross domestic product (GDP):	120,687.14 (2015, current mil. US$)
Official EU language(s):	Hungarian
Political system:	parliamentary republic
EU member country since:	1 May 2004
Seats in the European Parliament:	21
Currency:	Hungarian Forint HUF
Schengen area member:	since 21 December 2007
Key industries:	Mining, metallurgy, construction materials, food processing, electronics, textiles, chemicals, pharmaceuticals, motor vehicles, information technology
Rating:	S&P/Moody's/Fitch BBB-/Baa3/BBB-

1.3 Economic indicators and structure by value added

Following tables briefly summarizes key economic indicators of V4 countries and those ones of RoK. As it will be illustrated bellow, some features are common for all analyzed economies, some different based on diverse level of economic development (V4 versus RoK). Nevertheless, even the differences can bring potential of increased cooperation.

Table 1: Key socio-economic facts about V4 and RoK

	Poland		Czech Republic		Slovak Republic		Hungary		*RoK*	
Indicator	2000	2015	2000	2015	2000	2015	2000	2015	*2000*	*2015*
Population, mil. total	38.3	38	10.3	10.6	5.4	5.4	10.2	9.8	*47*	*50.6*
Population growth (annual %)	-1.04	-0.03	-0.28	0.25	-0.14	0.10	-0.26	-0.22	*0.84*	*0.38*
Surface area (sq. km)	312,690	312,680	78,870	78,870	49,030	49,036	93,030	93,030	*99,260*	*100,266*
Population density (people per sq. km)	124.91	124.10	132.72	136.62	112.03	112.79	113.94	108.75	*487.33*	*519.33*
Urban population growth (annual %)	-0.97	-0.08	-0.46	0.21	-0.24	-0.20	-0.46	0.42	*1.13*	*0.52*
GNI per capita, Atlas meth. (cur. US$)	4,690	13,370	6,320	18,050	5,520	17,310	4,660	12,990	*10,750*	*27,440*
GNI per capita, PPP (cur. internat. $)	10,700	25,400	15,980	30,420	11,100	28,200	11,500	24,630	*17,950*	*34,700*
GDP per capita (cur. US$)	4,493	12,495	5,995	17,231	5,403	15,963	4,620	12,259	*11,948*	*27,222*
GDP growth (annual %)	4.26	3.65	4.29	4.20	1.21	3.60	4.23	2.94	*8.83*	*2.61*
Inflation, GDP deflator (annual %)	7.36	0.44	1.68	0.73	9.37	-0.26	9.83	1.77	*0.95*	*2.21*
Unemployment, total (% of total labour force) (modelled ILO estimate)	16.1	9.2*	8.8	6.2*	18.8	13.3*	6.4	7.8	*4.4*	*3.5*
Exports of goods & serv. (% of GDP)	27.21	49.36	48.33	84.49	54.07	93.80	66.81	89.3*	*35.01*	*45.90*
Imports of goods & serv. (% of GDP)	33.58	46.57	50.18	78.06	56.63	91.37	70.49	82.0*	*32.94*	*38.94*
Trade (% of GDP)	60.8	95.9	98.5	162.5	110.7	185.2	137.3	171.2*	*67.9*	*84.8*
FDI, net inflows (BoP, cur. mil. US$)	9,335	7,353	4,987	2,479	2,183	2,150	2,748	-967	*11,509,*	*5,042*

Gross capital formation (% of GDP)	24.59	20.50	31.50	26.66	27.60	22.91	28.34	22.2*	*32.94*	*28.49*
Life expectancy at birth, total (years)	73.75	77.25*	74.97	78.28*	73.05	76.71*	71.25	75.87*	*75.84*	*82.16**
Energy use (kg of oil equiv. per cap.)	2,320	2,496*	3,988	3,945*	3,293	2,847*	2,448	2,292*	*4,003*	*5,262**
Time required to start a business (days)	..	37.00	..	15.00	..	11.50	..	7.00	..	*4.00*
High-technology exports (% of manufactured exports)	3.36	8.78	8.49	14.52	3.63	10.02	26.53	13.74	*35.07*	*26.9**

Source: World Bank
*Note: * data for 2014*

Concerning population, RoK is by far the most populous country out of the analyzed countries, followed by Poland with 75 % of RoK population. The less populated country of the whole group is Slovak Republic with 11 % of RoK population. However, when counted together, V4 forms interesting market at least from the size point of view. If we compare total population with the surface area it is obvious that RoK is the country with the highest population density. Besides, it is also the country with the fastest growth of urban population. Even if the numbers are lower for V4 countries, the trend is similar to that one in RoK as in all V4 countries the urban population either increased or decreased but in slower pace in 2000 - 2015.

The numbers about economy performance (GNI, GDP indicators) are obviously the most favourable for RoK. All countries are characterized by positive GDP growth leaving free space for higher cooperation between RoK and V4 Group.

The price levels are relatively stable with much better situation in Poland, Hungary and SR than in 2000. Unemployment is the lowest in RoK and the highest in Poland and SR, which may mean sufficient labour force in case of new projects realized by RoK in V4.

As the V4 countries are small and open economies, it is not surprising that these countries are more opened than RoK, even though there was some increase in the share of trade as % of GDP from 68 % to 85 % in RoK between 2000 and 2015. The most opened economy in 2015 (and 2000 as well) was SR (that got ahead of Hungary), Hungary and CR. While in 2000 imports of V4 Group exceeded exports, in 2015 the opposite held. RoK exported more than imported in both years.

Table 2: Structure of V4 and RoK economy

	Poland		Czech Republic		Slovak Republic		Hungary		***RoK***	
Indicator	**2000**	**2015**	**2000**	**2015**	**2000**	**2015**	**2000**	**2015**	***2000***	***2015***
Agriculture, value added (% of GDP)	3.30	2.78	3.42	2.38	4.42	4.05	5.74	4.5*	*4.39*	*2.31*
Industry, value added (% of GDP)	32.81	33.54	37.18	38.09	36.07	34.38	31.77	31.2*	*38.09*	*37.98*
out of which Manufacturing	*18.1*	*19.3*	*25.9*	*27.1*	*23.9*	*20.8*	*22.4*	*23.5**	*29.0*	*29.5*
Services, etc., value added (% of GDP)	63.89	63.68	59.40	59.53	59.52	61.57	62.49	64.4*	*57.51*	*59.71*

Source: World Bank
*Note: * data for 2014*

Table 2 illustrates the current structure of V4 members´ and RoK´s economies. Primary sector (agriculture, hunting, forestry, and fishing) forms only a minor part of the total value added in all the countries with the highest share of 4.5 % in Hungary and the lowest share of 2.31 % in RoK. In all analyzed countries, the share of agriculture decreased since 2000, in RoK almost to one half of original number. This decrease was compensated by shifts towards industrial production and services. Concerning manufacturing, RoK has the highest share of this sector in the value added followed by the Czech Republic with 267.1 % and Poland has the lowest share of 19.3 %. The service sector is the most important sector for all countries ranging from 59.7 % in RoK to 64.4 % in Hungary. Therefore looking at particular industries, there are no significant differences between the analyzed economies.

Table 3: Global Competitiveness Index 2015 - 2016 - comparison of V4 countries and RoK

			Poland	Czech Republic	Slovak Republic	Hungary	*RoK*
BASIC REQUIREMENTS	1. Institutions	Rank	58	57	104	97	*69*
		Score	4,07	4,90	3,43	3,52	*3,90*
	2. Infrastructure	Rank	56	41	57	48	*13*
		Score	4,30	4,70	4,28	4,51	*5,82*
	3. Macroeconomic environment	Rank	46	21	41	52	*5*
		Score	5,11	5,97	5,21	4,94	*6,58*
	4. Health and primary education	Rank	40	27	50	72	*23*
		Score	6,15	6,31	6,01	5,71	*6,34*
EFFICIENCY ENHANCERS	5. Higher education and training	Rank	31	29	53	57	*23*
		Score	5,05	5,10	4,62	4,56	*5,36*
	6. Goods market efficiency	Rank	46	37	54	72	*26*
		Score	4,51	4,63	4,43	4,29	*4,81*
	7. Labour market efficiency	Rank	81	47	100	77	*83*
		Score	4,11	4,44	3,90	4,15	*4,08*
	8. Financial market development	Rank	43	24	35	65	*87*
		Score	4,26	4,62	4,41	3,93	*3,60*
	9. Technological readiness	Rank	41	29	44	48	*27*
		Score	4,78	5,43	4,64	4,60	*5,50*
	10. Market size	Rank	21	47	62	51	*13*
		Score	5,16	4,47	4,03	4,32	*5,56*
INNOVATION AND SOPHISTICATION FACTORS	11. Business sophistication	Rank	55	30	57	90	*26*
		Score	4,09	4,49	4,07	3,70	*4,80*
	12. Innovation	Rank	64	35	66	51	*19*
		Score	3,32	3,79	3,29	3,44	*4,83*

Source: The Global Competitiveness Report 2015–2016

The table above shows that by far most competitive, based on comparison by GCI, is RoK (in 9 pillars out of 12). Only in the field of institutions, Poland and CR ranked better, in the field of labour market efficiency V4 Group except for SR ranked better and in case of financial market development the whole V4 reached higher performance.

Among the most problematic issues for doing business in particular countries the report mentions tax regulations, restrictive labour regulations, policy instability, tax rates and inefficient government bureaucracy in Poland, similarly inefficient government bureaucracy, tax regulations, corruption, policy instability and tax rates in CR, corruption, tax rates, inefficient government bureaucracy, tax regulations and restrictive labour regulations in SR and policy instability, corruption, tax regulations, inadequately educated workforce or inefficient government bureaucracy in Hungary. **Improvement may increase potential for investors even from RoK.**

For RoK, the worst performing parameter (together with policy instability, inefficient government bureaucracy, restrictive labour regulations and access to financing) was insufficient capacity to innovate. **In case of insufficient capacities V4 potential might be used. For particular opportunities see chapters below.**

Table 4: Doing Business Index - comparison of V4 countries and RoK

Indi-cator	Country	Overall	Starting a Business	Dealing with Construction Permits	Getting Electricity	Registering Property	Getting Credit
DB 2017 Rank	Poland	24	107	46	46	38	20
	Czech Republic	27	81	130	13	31	32
	Slovak Republic	33	68	103	53	7	44
	Hungary	41	75	69	121	28	20
	RoK	*5*	*11*	*31*	*1*	*39*	*44*
DB 2016 Rank	Poland	25	102	52	48	36	19
	Czech Republic	26	88	126	13	31	29
	Slovak Republic	30	64	102	47	5	42
	Hungary	40	71	66	118	28	19
	RoK	*4*	*17*	*28*	*1*	*41*	*42*
DB 2017 DTF (% points)	Poland	77,81	84,22	75,15	81,35	76,49	75
	Czech Republic	76,71	86,86	62,76	90,32	79,68	70
	Slovak Republic	75,61	88,62	67,82	80,31	91	65
	Hungary	73,07	87,28	71,7	60,13	80,08	75
	RoK	*84,07*	*95,83*	*77,84*	*99,88*	*76,34*	*65*
DB 2016 DTF (% points)	Poland	77,04	84,18	74,24	80,15	76,9	75
	Czech Republic	76,43	85,23	62,73	89,99	79,32	70
	Slovak Republic	75,44	88,54	67,81	80,3	90,99	65
	Hungary	72,74	87,1	71,69	60,11	80,2	75
	RoK	*83,86*	*94,36*	*77,83*	*99,88*	*76,22*	*65*

Source: World Bank

Table 5: Doing Business Index - comparison of V4 countries and RoK - continuation

Indi-cator	Country	Protecting Minority Investors	Paying Taxes	Trading Across Borders	Enforcing Contracts	Resolving Insolvency
DB 2017 Rank	Poland	42	47	1	55	27
	Czech Republic	53	53	1	68	26
	Slovak Republic	87	56	1	82	35
	Hungary	81	77	1	8	63
	RoK	*13*	*23*	*32*	*1*	*4*
DB 2016 Rank	Poland	40	44	1	56	33
	Czech Republic	51	53	1	67	22
	Slovak Republic	85	58	1	81	34
	Hungary	78	79	1	13	63
	RoK	*10*	*25*	*32*	*1*	*6*
DB 2017 DTF (% points)	Poland	63,33	82,73	100	63,44	76,37
	Czech Republic	60	80,69	100	60,36	76,42
	Slovak Republic	53,33	80,57	100	58,92	70,53
	Hungary	55	74,46	100	75,79	51,25
	RoK	*73,33*	*86,56*	*92,52*	*84,15*	*89,22*
DB 2016 DTF (% points)	Poland	63,33	82,77	100	63,44	70,43
	Czech Republic	60	80,5	100	60,36	76,17
	Slovak Republic	53,33	79,46	100	58,92	70,04
	Hungary	55	73,74	100	73,94	50,58
	RoK	*73,33*	*86,54*	*92,52*	*84,15*	*88,75*

Source: World Bank

Another view presents Doing Business Index. Here again RoK has much better performance than V4 states except for registering property, getting credit or trading across borders. Problematic fields: starting business – Poland, CR, dealing with construction permits – CR, SR, getting electricity – Hungary, protecting minority investors – SR, Hungary, enforcing contracts – SR, resolving insolvency – Hungary. Improvement may again increase potential for investors even from RoK.

Even if particular economies are relatively small when compared to the Korean one, cumulated numbers for V4 are much more interesting:

- The size of the market: RoK accounts for 51 million inhabitants, V4 countries for even more – 64 million inhabitants.
- The cumulated size of economies of V4 almost 1 trillion USD in 2015 (GDP (current US$), in case of RoK 1.4 trillion USD. When counting with PPP calculations V4 and RoK almost equal. The cumulated V4 economy is the 6th largest in the EU (behind Germany, United Kingdom, France, Italy and Spain).
- In GNI per capita in PPP (2015) V4 Group and RoK are very much close. V4 countries reach between 71 % and 88 % of GNI per capita in PPP of RoK. (*Source: World Bank*)
- V4 Group ranks as second behind Germany in terms of overall trade volume with RoK. It is the largest export market for Korean goods in EU. V4 countries are the 3rd largest FDI recipient of Korean invest FDI in EU after United Kingdom and Netherlands (*Source: Welcoming speech of H.E. Milan Lajčiak, Ambassador of the Slovak Republic to the Republic of Korea, International Scientific Conference and Workshop Mutual Relations between the Republic of Korea and V4 Countries in Trade and Investment, 2015*)

These numbers shows that V4 as one market may offer interesting business opportunities for RoK and vice versa.

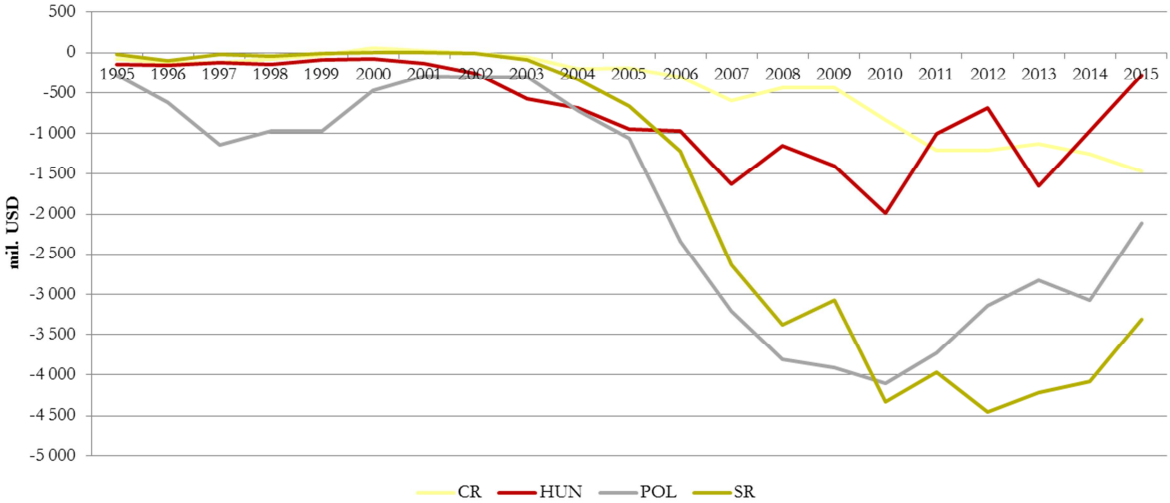
1.4 Mutual relations – V4 - RoK

1.4.1 Trade relations

This chapter analyzes mutual trade relations between the RoK and the V4 Group.

Figure 1 captures total trade flows between the RoK and the V4 members as the trade balance. The figure shows that until app. 2001, CR, Hungary and SR recorded relatively stable trade balances. The only exception was Poland with negative trade balance for the whole observed period. It is not surprising since import and export flows were very low and trade between V4 and RoK marginal. After the trade expansion in 2001, the situation significantly changed. From 2004 all V4 members record trade deficits with RoK, exporting to RoK less than importing. Currently, the highest deficit is recorded by SR, the lowest then by Hungary.

Figure 1: V4 countries and their trade balance with the RoK



Source: Comtrade

Table 6 shows total volumes RoK exports to world and share of V4 members on these volumes. As can be seen in the table, RoK exports constantly grow. Minor decreases were only recorded

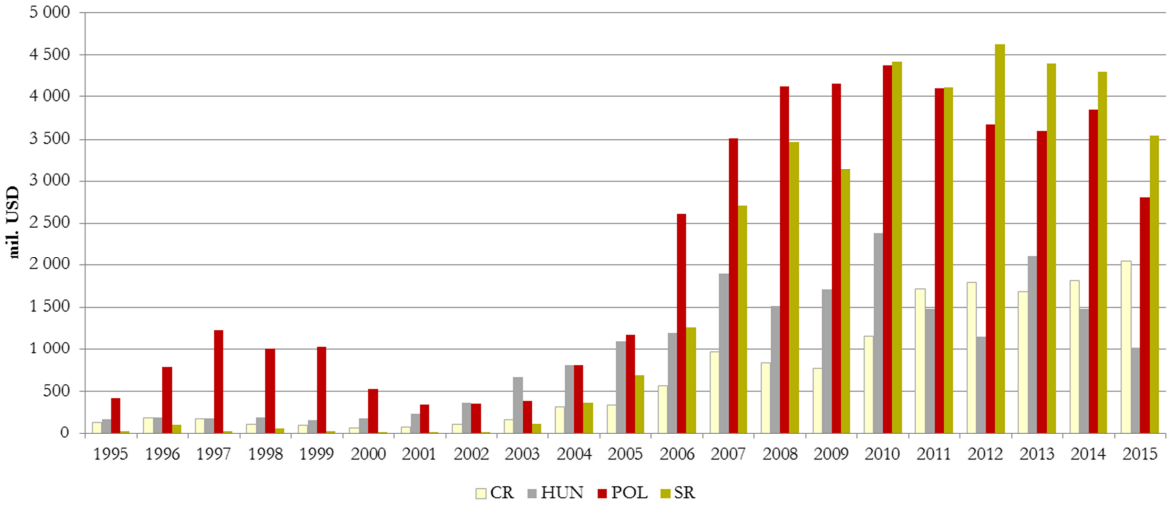
during crisis (2009 - global financial and economic crisis). Similarly, the share of V4 countries on RoK´s export gradually increases. During the 90's, the share of these countries was marginal with two outliers – Poland on one side and SR on the other side. Then total share of the V4 countries on total exports from the RoK increased from 0.57 % in 1995 to 1.78 % in 2013. Importance of V4 members for RoK went up especially after CR, SR, Poland and Hungary joined the EU in 2004.

Table 6: RoK exports to world and share of V4 Group

Year	World (bn USD)	CR (%)	HUN (%)	POL (%)	SR (%)
1995	125.06	0.11	0.13	0.33	0.02
2000	172.27	0.04	0.10	0.31	0.01
2005	284.42	0.12	0.39	0.41	0.24
2006	325.46	0.17	0.37	0.80	0.39
2007	371.48	0.26	0.51	0.94	0.73
2008	422.00	0.20	0.36	0.98	0.82
2009	363.53	0.21	0.47	1.14	0.86
2010	466.38	0.25	0.51	0.94	0.95
2011	555.21	0.31	0.27	0.74	0.74
2012	547.85	0.33	0.21	0.67	0.84
2013	559.62	0.30	0.38	0.64	0.79
2014	573.07	0.32	0.26	0.67	0.75
2015	526.90	0.39	0.19	0.53	0.67

Source: Comtrade

Figure 2: RoK exports to V4 Group



Source: Comtrade

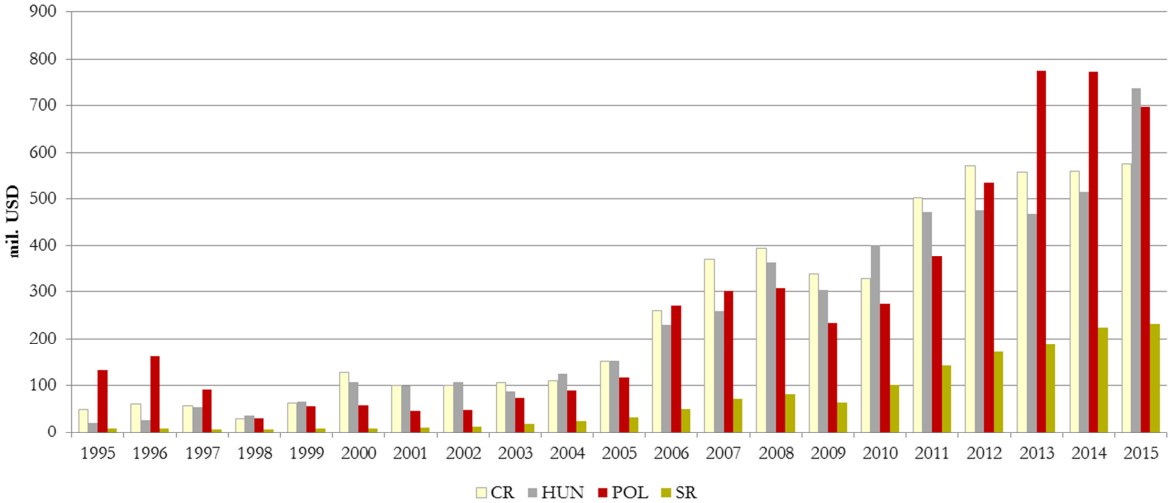
Next table illustrates volumes RoK imports from the world and shares of V4 members on these imports. Development of total RoK´s imports follows that one of exports with gradual increase and decreases only in the times of crisis in 1998 and 2009. Concerning the share of the V4 Group on the imports to RoK, these shares are significantly lower than it was the case for exports. While the average share of the V4 Group on exports from the RoK in 1995 and 2015 was 0.57 %, 1.78 % respectively, average share on RoK imports in 1995 and 2015 was 0.162 %, 0.511 % respectively. In 1995, the most visible outlier was SR (0.006 %). The same situation was in 2015 (0.053 %). The best performer was Hungary with the share growing from 0.016 % in 1995 to 0.168 % in 2015. CR had a stable position. **Relatively low percentage indicates there is enough space for further strengthening of trade relations.**

Table 7: RoK imports from world and share of V4 Group

Year	World (bn USD)	CR (%)	HUN (%)	POL (%)	SR (%)
1995	135.11	0.04	0.016	0.10	0.006
2000	160.48	0.08	0.067	0.04	0.005
2005	261.24	0.06	0.058	0.04	0.012
2006	309.38	0.08	0.074	0.09	0.016
2007	356.84	0.10	0.072	0.08	0.020
2008	435.27	0.09	0.083	0.07	0.019
2009	323.08	0.10	0.094	0.07	0.020
2010	425.21	0.08	0.094	0.06	0.023
2011	524.41	0.10	0.090	0.07	0.027
2012	519.58	0.11	0.091	0.10	0.033
2013	515.57	0.11	0.091	0.15	0.036
2014	525.56	0.11	0.098	0.15	0.043
2015	436.54	0.13	0.168	0.16	0.053

Source: Comtrade

Figure 3: RoK imports from V4 Group



Source: Comtrade

Table 8 shows absolute numbers for exports from V4 Group to world together with the share of V4 exports to RoK on exports to world and shares of particular V4 members on total V4 exports to RoK. In general, the significance of V4 exports to RoK increases with slight differences in patterns of particular countries. The share is the lowest in SR. CR, Hungary and Poland have relatively the same position with the development also depending on economic situation of particular country. This development was in the observed period rather volatile. For instance in 90's, Poland recorded the highest share exceeding 50 % in 1995. From 2000 however, there was an increase in exports from CR and Hungary reducing thus importance of Polish exports. For development of absolute numbers see Figure 3.

Table 8: V4 exports to world and share of RoK and particular countries

Year	V4 exports to world (bn USD)	Share of V4 exports to RoK on exports to world	Share of V4 members on exports to RoK			
			CR (%)	HUN (%)	POL (%)	SR (%)
1995	65.374	0.17%	34.81%	7.91%	50.84%	6.44%
2000	99.985	0.14%	38.70%	34.56%	22.11%	4.63%
2005	261.711	0.14%	26.05%	34.13%	31.84%	7.98%
2006	320.467	0.19%	20.12%	33.69%	37.00%	9.19%
2007	412.312	0.20%	27.84%	30.92%	34.57%	6.66%
2008	496.347	0.21%	26.17%	35.32%	29.95%	8.56%
2009	387.650	0.20%	34.82%	23.35%	32.08%	9.75%
2010	447.953	0.22%	28.00%	30.66%	28.61%	12.73%
2011	540.201	0.25%	32.87%	26.16%	30.81%	10.17%
2012	518.899	0.28%	38.57%	16.32%	36.93%	8.18%
2013	558.286	0.31%	33.73%	17.47%	42.31%	6.49%
2014	586.929	0.27%	37.84%	21.27%	31.82%	9.07%
2015	526.873	0.29%	32.91%	31.47%	27.70%	7.91%

Source: Comtrade

Next table shows reversibly absolute numbers for imports to V4 Group from world together with the share of V4 imports from RoK on imports from world and shares of particular V4 members on total V4 imports from RoK. Total imports from RoK to V4 countries in absolute value rose from 566 million USD in 1995 to almost 13 billion USD in 2015, which indicates growing significance of the V4 countries for RoK. When looking at particular countries, the highest share had again Poland in 90´s while SR recorded the lowest share of all V4 countries. Concerning CR and Hungary, even though their shares were at almost the same level in 1995, there was visible change in following years. The picture changed radically after these countries became part of the EU in 2004. After the accession we can see significant increase in case of SR strengthening even more after 2010. In 2015, SR ranked first with more than one thirds of all the imports coming to V4 Group from the RoK. Simultaneously, decline in Polish share can be noticed. Hungary also experienced went through different periods with quite low share in the 90's, rapid rise in years prior to the EU accession and gradual decline in 2005 - 2015. Growth in the weight of Hungary followed the trend of massive inflow of the RoK's FDI into Hungary in 2000 - 2004. Concerning the Czech Republic, its share was relatively stable throughout the whole observed period. For development of absolute numbers see Figure 2.

Table 9: V4 imports from world and share of RoK and particular countries

Year	V4 imports from world (bn USD)	Share of V4 imports from RoK on imports from world	Share of V4 members on imports from RoK			
			CR (%)	HUN (%)	POL (%)	SR (%)
1995	77.670	0.73%	21.19%	25.75%	46.43%	6.63%
2000	125.224	1.14%	9.50%	36.94%	51.22%	2.33%
2005	278.212	1.54%	13.79%	28.12%	37.03%	21.06%
2006	340.812	1.99%	10.63%	20.91%	42.77%	25.69%
2007	434.862	2.30%	10.56%	20.71%	38.48%	30.25%
2008	533.709	2.38%	11.71%	14.48%	40.60%	33.21%
2009	386.852	3.00%	11.68%	17.49%	38.62%	32.21%
2010	451.632	3.31%	13.90%	19.23%	32.44%	34.43%
2011	538.065	2.67%	18.74%	14.63%	32.30%	34.33%
2012	502.283	3.25%	18.98%	8.90%	27.25%	44.86%
2013	528.097	2.90%	19.61%	7.40%	27.33%	45.66%
2014	554.378	2.67%	21.05%	9.64%	29.25%	40.06%
2015	493.745	2.61%	26.04%	11.08%	25.46%	37.41%

Source: Comtrade

1.4.2 FDI

This chapter analyzes RoK FDI outflows to the world, EU and V4 countries.

Table 10 shows that before accession of V4 members to EU, RoK FDI outflows to these countries were negligible. Nevertheless, the situation has changed since 2005. The highest volume of the FDI was recorded by CR in 2007 amounting to 536 million USD. Years 2008 – 2010 meant steep decline with growth renewal in 2011. Best performers were SR and CR, weaker position was held by Hungary and Poland.

Total value of RoK FDI outflow in 2012 to V4 amounted to 1.2 bn USD, which accounted for 28% share out of RoK FDI outflow to EU and 4.4% share out of RoK FDI outflow to whole world. Trends in these shares were not clearly increasing and they do not always followed absolute numbers, which means that investors from RoK might have selected another country for implementation of their projects. Besides, there was a steep decline in 2008 - 2010 (global economic and financial crisis). After this period, V4 again witnessed sharp, more than 12-fold, increase in the FDI from RoK in 2010 and 2011 and more than 2-fold increase in 2011 - 2012. Massive FDI inflows in 2011 and 2012 experienced especially SR and CR.

Next rows in Table 10 illustrate importance of particular V4 states for RoK from the investment point of view. It is obvious that on EU level the importance of CR, Hungary, Poland and SR is higher than on the world level. The shares of particular countries were highest in 2007 for CR, in 2002 and 2006 in Hungary, in 2006 in Poland and in 2005 in SR. These conclusions are same either for share of RoK FDI outflows to V4 when compared to those ones to EU or to the whole world and the years correspond with the period just after accession of V4 countries to EU. It is worth mentioning that for instance in 2006, almost three fourths of all the FDI outflows from RoK to the EU were flowing to V4 Group. The greatest share was recorded by SR (reaching more than one third out of all RoK FDI inflows to EU in 2005). In 2006, more than one half of all the RoK FDI inflows to the EU went to SR and Poland. Although the share of these two countries declined sharply in the following years, in 2012 the share again went up to 12 % of all the RoK FDI inflows to the EU.

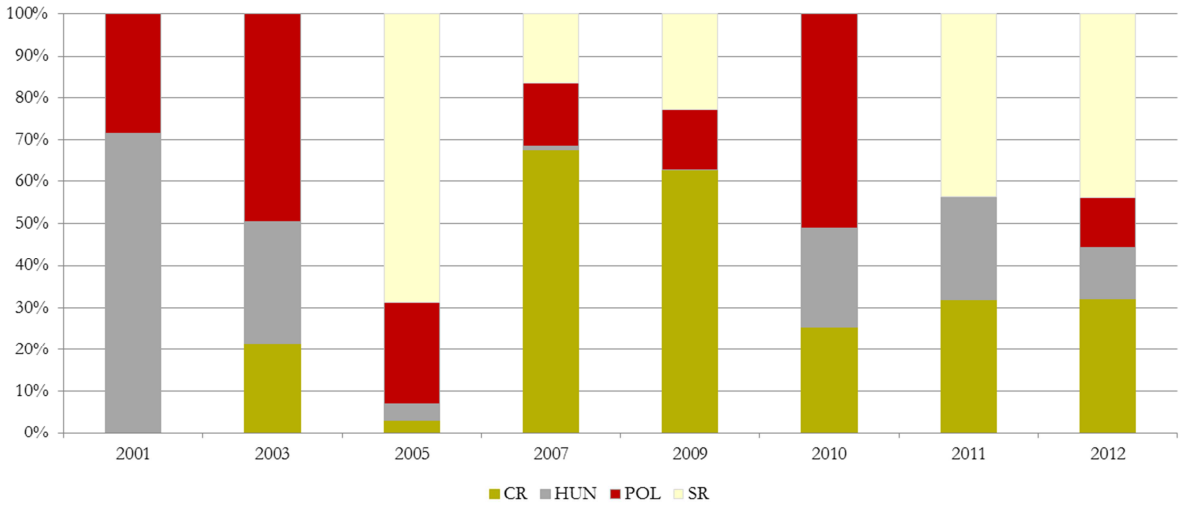
Share on the EU FDI inflows from the RoK is also reflected in the second part of Table 7. Even though Slovakia did not participate on the FDI inflow from the RoK in 2001- 2003, there was a rapid increase in 2004. Slovakia constituted 13.39% of the EU inflows and 76% of the V4 inflows. Its share on the V4 inflows declined in following years, reaching even 0% in 2010. In the second decade of the 21st century however, its share reached more than 43% on the V4 inflows in both 2011 and 2012.

Table 10: RoK FDI outflows, in millions of USD

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CR	-	-	5	-	10	111	536	227	94	13	211	391
HUN	33	79	7	- 6	13	73	7	- 23	-	12	162	148
POL	13	- 7	13	33	78	221	117	86	22	27	1	144
SR	-	-	-	84	223	286	132	104	34	-	290	532
V4	46	72	25	110	324	691	791	394	150	53	663	1 215
EU	1 929	593	124	625	519	929	3 189	1 773	4 151	5 438	3 945	4 417
% V4 out of EU	*2.36*	*12.13*	*20.48*	*17.60*	*62.31*	*74.33*	*24.81*	*22.21*	*3.60*	*0.97*	*16.80*	*27.51*
World	1 987	2 842	4 026	5 667	6 387	10 808	19 967	20 867	18 139	21 464	26 989	27 354
% V4 out of world	*2.30*	*2.53*	*0.63*	*1.94*	*5.07*	*6.39*	*3.96*	*1.89*	*0.82*	*0.25*	*2.46*	*4.44*
% CR out of EU	0.00	0.00	4.43	0.00	1.95	11.98	16.80	12.80	2.26	0.25	5.35	8.86
% HUN out of EU	1.69	13.35	5.91	-1.01	2.42	7.85	0.21	-1.32	0.00	0.23	4.09	3.35
% POL out of EU	0.67	-1.22	10.14	5.22	15.05	23.76	3.68	4.84	0.52	0.49	0.02	3.26
% SR out of EU	0.00	0.00	0.00	13.39	42.89	30.73	4.13	5.89	0.82	0.00	7.34	12.04
% CR out of world	0.00	0.00	0.14	0.00	0.16	1.03	2.68	1.09	0.52	0.06	0.78	1.43
% HUN out of world	1.64	2.79	0.18	-0.11	0.20	0.68	0.03	-0.11	0.00	0.06	0.60	0.54
% POL out of world	0.65	-0.25	0.31	0.58	1.22	2.04	0.59	0.41	0.12	0.13	0.00	0.53
% SR out of world	0.00	0.00	0.00	1.48	3.49	2.64	0.66	0.50	0.19	0.00	1.07	1.94

Source: UNCTAD Bilateral FDI Statistics[1].

Figure 4: RoK FDI outflows, share of particular V4 members



Source: UNCTAD Bilateral FDI Statistics.

Investment in reverse flow are negligible, the only exception is Hungary.

Table 11: FDI inflows to RoK, in millions of USD

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CR	-	-	-	-	-	-	-	-	-	-	- 1	-
HUN	-	6	5	5	1	77	2	10	129	143	159	122
POL	-	-	-	-	-	-	-	-	-	-	- 1	-
SR	-	-	-	-	-	-	-	-	-	-	-	-

Source: UNCTAD Bilateral FDI Statistics.

1.4.3 Comparative advantage of particular states

There have been many attempts to identify export opportunities in macroeconomic perspective in history of international trade. Beside the gravity models which rather focus on reliable parameters than searching the concrete opportunities, so called Export Decision Support Models

[1] UNCTAD Bilateral FDI Statistics includes data in such detail only till 2012. OECD database includes data in such detail only for 2013 and 2014, but it is not possible to verify continuity in methodology. We therefore use data only until 2012.

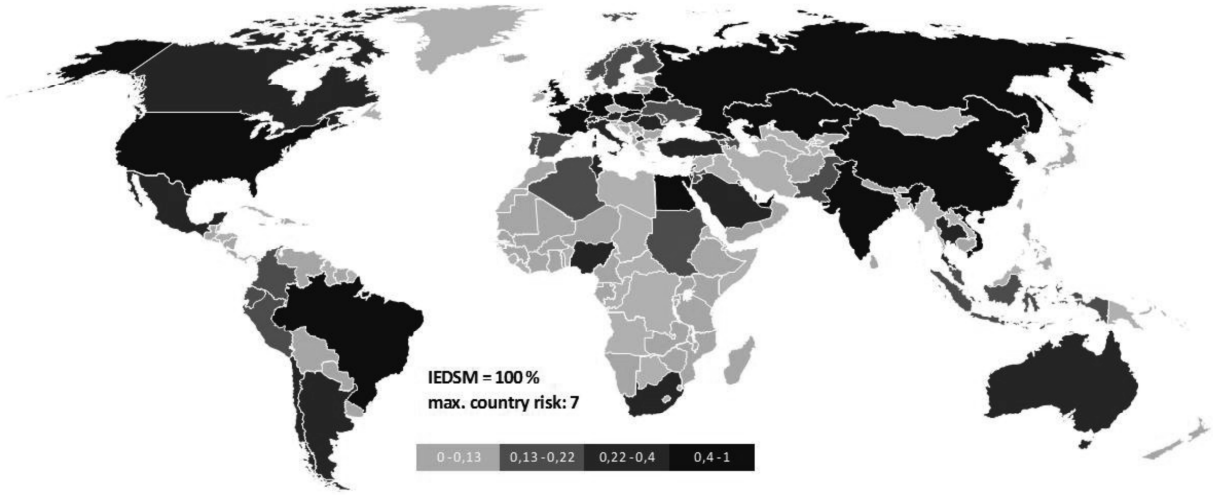
has been developed in order to identify export opportunities and being able to prioritize between them as an important tool for pro-export public policy. The involvement of governments in the designing of export promotion programs to promote specific domestic sectors has led to development of such tools. It is also case of the Czech Republic that uses various strategies for achieving its goals in export of goods and services.

Firstly Czech Republic defined so called priority territories which was the part of state Export strategy, however soon after that, the policy makers realized that export opportunities are both country specific and industry specific and therefore it is not possible to capture whole complexity in international trade by simple macroeconomic strategy. This lead to the development of map op opportunities where the ambassadors identified some opportunities in their respective territories. The other more sophisticated way of how to search for new opportunities is with the use of big data. The model for prioritizing export opportunities was developed with intention to prioritize between opportunities in economic diplomacy, but also for identifying sector or company specific opportunities. This model was developed by EEIP and therefore could be applied for identifying export opportunities of the Czech Republic in Korea.

The model basically search for opportunities, taking in account both sides – the demand side and supply side. It identifies in which sectors Czech Republic has comparative advantage or disadvantage in comparison with country, where might be the opportunity present. It identifies suitable export opportunities based on growth potential, absorption capacity and compatibility in relation to the Czech economy. It also takes into account barriers to trade, global value chains and enabling choice of the desired acceptable country risk and weights of indexes specific for the market and industry of interest. The methodology of the model can be found in Mejstřík et al. (2014)[2].

Korea belongs between the countries where we could identify many opportunities compared to other countries. This can support the illustration of opportunities in machinery/electrical products in 2010, where Korea belongs to the most promising territories

Figure 5: Map of export opportunities of machinery/electrical products (higher IEP means higher frequency of export opportunities)



[2] M.Urban, M.Mejstrik, J.G.Chvalkovska, "Application of the decision support model to Czech exports", Acta Oeconomica Pragensia, 2014

We identified export opportunities on new data till 2014. The model identified over 100 good opportunities (by the Harmonized system of classification – HS6) for Czech companies in Korea. Table below summarizes the most interesting opportunities.

Table 12: Example of export opportunities of theCzech Republic in RoK

HS6 classification	Product
320490	Synthetic organic products used as luminophores
120929	Seed, forage plants, for sowing nes
190520	Gingerbread and the like
540249	Yarn, synth filament, single untwisted nes, not retail
30622	Lobsters (Homarus), not frozen
730722	Threaded elbows, bends and sleeves of stainless steel
20610	Bovine edible offal, fresh or chilled
848050	Moulds for glass
410210	Sheep or lamb skins, raw, wool on, except Persian etc
842220	Machinery for cleaning/drying bottles/containers nes
843930	Machinery for finishing paper or paperboard
848140	Valves, safety or relief
848130	Valves, check
842839	Continuous action elevators or conveyors for goods nes
360100	Propellent powders
701990	Glass fibres, glass wool and articles thereof nes
860721	Air brakes, parts for railway rolling stock
870333	Automobiles, diesel engine of >2500 cc
930330	Rifles, sporting, hunting or target-shooting, nes
810530	Cobalt waste & scrap
841182	Gas turbine engines nes of a power > 5000 kW
292990	Compounds with other nitrogen function, nes
847910	Machines for public works, building etc, nes
780420	Lead powders and flakes
722511	Flat-rl p grain-oriented
701720	Low expansion laboratory, hygienic, pharmacy glassware
284330	Gold compounds
721691	Angles,shps&sec cold-for
711810	Coin (other than gold coin) not being legal tender
430180	Raw furskins of other animals, whole
847321	Parts and accessories of electronic calculators
854470	Optical fibres and cables
721069	Flat rld prod alum coate

Similarly we can identify opportunities of Korea in the Czech Republic and other V4 countries. The model itself takes a long time for calibration that takes into account special differences of the countries, therefore following opportunities were not subject to large investigation, but rather basic summary based on values of imports comparative advantages and barriers to trade.

Table 13: Example of export opportunities of RoK in the Czech Republic

HS6 classification	Product
271019	Light petroleum distillates nes
870323	Automobiles, spark ignition engine of 1500-3000 cc
851712	Telephones for cellular networks/for other wireless networks, other than Line telephone sets with cordless handsets
852990	Parts for radio/tv transmit/receive equipment, nes
870899	Motor vehicle parts nes
847330	Parts and accessories of data processing equipment nes
854231	Electronic integrated circuits, processors & controllers…
851770	Parts of telephone sets, incl, telephones for cellular networks/for other wireless networks;
721049	Flat rolled i/nas, coated with zinc, width >600mm, nes
300490	Medicaments nes, in dosage
840734	Engines, spark-ignition reciprocating, over 1000 cc
870840	Transmissions for motor vehicles
390230	Propylene copolymers in primary forms
390210	Polypropylene in primary forms
853400	Electronic printed circuits
870421	Diesel powered trucks weighing < 5 tonnes
740811	Wire of refined copper > 6mm wide
840820	Engines, diesel, for motor vehicles

870850	Drive axles with differential for motor vehicles
870120	Road tractors for semi-trailers (truck tractors)
390110	Polyethylene - specific gravity <0,94 in primary forms
841391	Parts of pumps for liquids
853890	Parts, electric switches, protectors & connectors nes
392690	Plastic articles nes

Table 14: Example of export opportunities of RoK in Poland

HS6 classification	Product
870323	Automobiles, spark ignition engine of 1500-3000 cc
271019	Light petroleum distillates nes
901380	Optical devices, appliances and instruments, nes
890120	Tankers
852990	Parts for radio/tv transmit/receive equipment, nes
870899	Motor vehicle parts nes
999999	Commodities not specified according to kind
851712	Telephones for cellular networks/for other wireless networks, other than Line telephone sets
890190	
847330	Parts and accessories of data processing equipment nes
851770	Parts of telephone sets, incl, telephones for cellular networks/for other wireless networks;
854231	Electronic integrated circuits, processors & controllers, converters, logic circuits, amplifiers, clock
721049	Flat rolled i/nas, coated with zinc, width >600mm, nes
847170	Storage units
390210	Polypropylene in primary forms
870840	Transmissions for motor vehicles
390110	Polyethylene - specific gravity <0,94 in primary forms
390230	Propylene copolymers in primary forms
853400	Electronic printed circuits
721070	Flat rolled i/nas, painted/plastic coated,width>600mm
870332	Automobiles, diesel engine of 1500-2500 cc
854370	Other machines & apparatus for electrical machines & apparatus,
390120	Polyethylene - specific gravity >0,94 in primary forms
840734	Engines, spark-ignition reciprocating, over 1000 cc
840999	Parts for diesel and semi-diesel engines
760612	Aluminium alloy rectangular plate/sheet/strip,t >0,2mm
852351	Semi-conductor media, solid-state non-volatile storage devices
390690	Acrylic polymers nes, in primary forms
230400	Soya-bean oil-cake and other solid residues
870190	Wheeled tractors nes

Table 15: Example of export opportunities of RoK in Hungary

HS6 classification	Products
271019	Light petroleum distillates nes
854232	Electronic integrated circuits, memories
870899	Motor vehicle parts nes
999999	Commodities not specified according to kind
851712	Telephones for cellular networks/for other wireless networks,
852990	Parts for radio/tv transmit/receive equipment, nes
851770	Parts of telephone sets, incl, telephones for cellular networks/for other wireless networks;
840991	Parts for spark-ignition engines except aircraft
847330	Parts and accessories of data processing equipment nes
854231	Electronic integrated circuits, processors & controllers,
853400	Electronic printed circuits
870840	Transmissions for motor vehicles
870421	Diesel powered trucks weighing < 5 tonnes
870829	Parts and accessories of bodies nes for motor vehicles
870190	Wheeled tractors nes
840999	Parts for diesel and semi-diesel engines
853690	Electrical switch, protector, connecter for < 1kV nes
851190	Parts of electrical ignition or starting equipment
841330	Fuel, lubricating and cooling pumps for motor engines
842139	Filtering or purifying machinery for gases nes

Table 16: Example of export opportunities of RoK in Slovakia

HS6 classification	Products
901380	Optical devices, appliances and instruments, nes
271019	Light petroleum distillates nes
870829	Parts and accessories of bodies nes for motor vehicles
851712	Telephones for cellular networks/for other wireless networks, other than Line telephone sets with cordless handsets
852990	Parts for radio/tv transmit/receive equipment, nes
870899	Motor vehicle parts nes
870840	Transmissions for motor vehicles
300490	Medicaments nes, in dosage
840734	Engines, spark-ignition reciprocating, over 1000 cc
854231	Electronic integrated circuits, processors & controllers, converters, logic circuits, amplifiers, clock & timing circuits,/other circuits
870323	Automobiles, spark ignition engine of 1500-3000 cc
870894	Steering wheels, columns & boxes for motor vehicles
870850	Drive axles with differential for motor vehicles
854449	Electric conductors, nes < 80 volts, no connectors
840999	Parts for diesel and semi-diesel engines
847170	Storage units
260112	Iron ore, concentrate, not iron pyrites, agglomerated
940190	Parts of seats
940540	Electric lamps, lighting fittings, nes
721049	Flat rolled i/nas, coated with zinc, width >600mm, nes

1.4.4 V4 – Korea - FDI largest projects, actual investment

V4 region in brief

Korean companies rank among TOP non-European investors in V4 region. The table below summarizes the number of South Korean investment in V4 countries. Based on the Financial Times database, Slovakia was the most successful in attracting the South Korean Investors. During 2003 – 2015, Korean companies invested nearly USD 5.5 bn in 45 projects in Slovakia.

Table 17: Comparison of South Korean investment activity in V4 countries over period 2003 - 2015

V4 Country	No. of South Korean Investments	Total amount of Korean Investments (USD mil.)
Czech Republic	29	4 057,95
Slovakia	45	5 490,43
Hungary	32	2 467,32
Poland	59	3 378,27

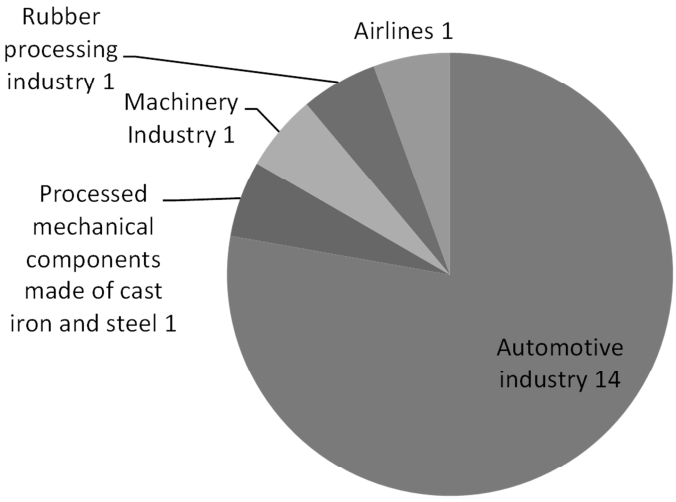
Source: Financial Times – fDi Intelligence

Czech Republic

The Korean companies rank among leading investors in the Czech Republic. According to information from agency CzechInvest, the value of South Korean investments in the Czech Republic reached CZK 76.4bn between the year 1993 and last year. These investments created 12,007 jobs.

Korean companies have invested mainly into automotive industry in the Czech Republic. As summarized in Figure 6, automotive industry represents 14 out of 18 major Korean investments made during 2003 - 2015.

Figure 6: Sector Overview of Korean Investments in the Czech Republic



Source: CzechInvest

The Korean car manufacturer Hyundai Motor Company invested into production plant that was opened in 2009 in Nošovice. The investment of Hyundai Motor Company (CZK 34 bn.) has been the largest foreign investment in the history of the Czech Republic. In connection with the presence of Hyundai, Korean auto parts manufacturers also invested in Czech Republic (e.g. Hyundai Mobis, Sungwoo Hitech, Sejong Industrial, PLAKOR etc.).

Apart from automotive industry, Korean companies also invested in the machinery industry (Doosan Škoda Power), processed mechanical components made of cast iron and steel (KOS WIRE) and Korean Air acquired a share in Czech Airlines. In 2014, Korean company Nexen Tire corporation announced the intent to invest over CZK 22bn. in a new tyre production plant, which would be the third biggest foreign investment in the Czech Republic. Construction of the plant started in summer 2016 with expected completion in June 2017.

In December 2016, Korean company Kiswire opened a plant for production of steel wires for tyres, investing around CZK 2.4bn. The plant will supply major tyre producers across Europe (Continental, Hankook, Michelin and Pirelli). Kiswire should become a supplier for a tyre producing plant of Nexen Tire, located in the same industry zone as Kiswire production plant.

The Czech company Gold of Prague was the first direct investor from the Czech Republic in Korea, investing a green-field microbrewery (Busan). Later on, another brewery will be built in the investment zone FOODPOLIS.

Slovakia

Korean is the second largest foreign investors in the Slovakia. During 2002 – 2015, 12% of all completed foreign investment projects in Slovakia were realized by Korean companies[3]. Similarly to the Czech Republic, automotive industry is the most important sector, however, not as dominant as in the Czech Republic. The reason is the presence of Samsung Electronics, the leading electronics equipment manufacturer.

Hence two main sectors of Korean investments in Slovakia can be identified: (i) automotive and (ii) electronics. The major investments in these sectors were realized by Kia Motors (Žilina) and Samsung Electronics (Galanta and Trnava). In October 2002, Samsung Electronics Slovakia

[3] SARIO (Slovak Investment and Trade Development Agency)

opened its production facility in Galanta. The production facility of Kia Motors in Žilina was opened in 2006. The Slovak plant is the only plant of Kia located in Europe. Further Korean investments were carried out mostly by Korean automotive suppliers, e.g. Mobis, Dongwon Metal Industrial Co., Donghee etc.); electronics (e.g. Dong Jin Precision, Woo One, Karam Tech Europe etc.).

In November 2016, Uni-Tech, an Asian producer of sealing cements used in car manufacturing, announced plans to invest EUR 4 m in a new plant in Povazska Bystrica. The company will supply Korean car makers - Kia Motors in Slovakia and Hyundai in the Czech Republic. The construction should start in May 2017 and the production should be launched in October 2017. Uni-Tech entered Slovak market in 2006 with opening a plant in Púchov.

Poland

Korea is the largest Asian investor and one of the largest non-European foreign investors in Poland. Poland is Korea's largest investment market in Central and Eastern Europe and the eighth-largest trade partner worldwide. The majority of Korean investment activity in Poland is focusing on automotive and electronic sectors. The largest Korean companies operating in Poland are LG and Samsung (production of electronic equipment and appliances) and Mando (production of braking systems and steering systems for automotive). The main investment sites for Korean companies in Poland include an LG cluster in Wrocław, Samsung's centre in Wronki, and a complex of five electronics companies in Mława.

In 2014, the world's fourth-largest pension fund, South Korea's National Pension Service (NPS), announced plans to invest about 820 billion Korean won ($800 million) in real estate assets in Poland. The fund already invested the money in two shopping malls and a power transmission tower in Poland.

The Polish Ministry of Development announced intent of Korean LG Chem to invest over PLN 1.3 billion by the end of 2018 to build a factory to produce batteries for electric vehicles. It will be the first factory to mass produce lithium batteries for the European automotive sector. The plant in Poland will be a part of LG Chem's global production system.

In November 2016, Korean firm Nifco Korea Poland (plastics product manufacturing) obtained necessary permits to operate in the Katowice Special Economic Zone. The estimated value of investment is PLN 90m.

Hungary

Korean companies are one of the leading foreign investors in Hungary and Korea is the third largest non-EU investor in Hungary. Korea Development Bank's regional headquarters is located in Budapest. In co-operation with Korea, there are six science research facilities in Hungary.

Samsung Electronics was the very first Korean investor in Hungary. The factory was opened in 1989, as the result of a project of USD 50 million in Jászfényszaru. Hungary has one of the largest electronics manufacturing industries in Central and Eastern Europe. Another important South Korean investment in Hungary was realized by Hankook Tire that operates a production facility in Racalmas. Samyang operates polycarbonate compounding plant in Jászberény.

Korea's Wooshin Medics will build a EUR 6 million pharmaceuticals plant and R&D laboratory in Székesfehérvár. The Seoul-based company opened its first European office in Budapest in 2013, which was the first step to establish its operations at the European market.

Samsung's Battery Manufacturing Business Unit (SDI) announced that it chose its Göd plant as a location for its battery production in Europe. The project worth KRW 400 billion is scheduled to start operations in the second half of 2018 and will produce 50,000 batteries for electric vehicles per year.

Summary

The majority of Korean investment activity in CEE region is focusing on automotive and electronic sectors. Korean investments in V4 region were often supported by investment incentives.

Opportunities for further development and investments include not only large projects with investment incentives but also SMEs sector. For example, Korean companies in Germany invested only 20% of the volume invested in the Czech Republic; however, they launched three times more projects.

We see a few opportunities in SMEs segment to invest, such as in energy and renewables sector (BRIKLIS, BIOMAC), machinery (Wikov Group), automotive (Kasko), nanotechnology (Nanovia, Nanoprotex).

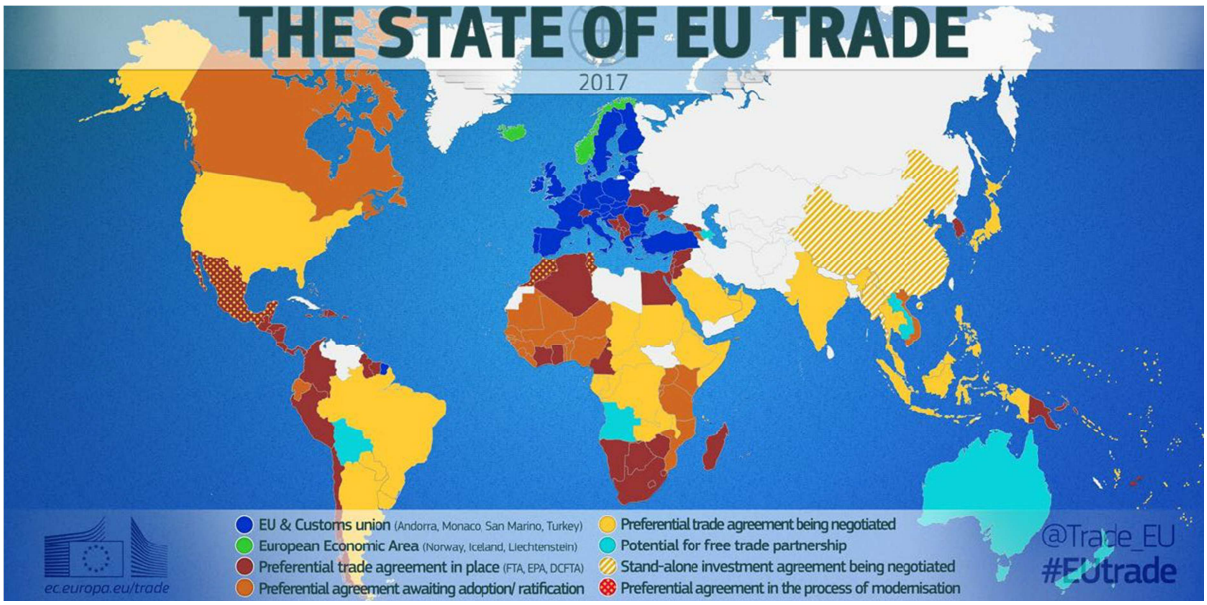
1.5 Institutional environment

As FTAs mean competitive advantage and create specific business opportunities in covered industries we provide brief overview of such contracts for V4 countries as well as for RoK, putting it together in the end.

1.5.1 V4

V4 relationships correspond with those ones of the EU. Therefore next picture maps trade relations of the EU with the rest of the world. The most important are brown fields marking countries with which the EU has concluded preferential free trade agreement.

Picture 1: Map of the EU's trade relations worldwide



Source: http://ec.europa.eu/trade/policy/countries-and-regions/agreements/index_en.htm

1.5.2 RoK

RoK has bilateral agreements with the following countries and blocs:

- ASEAN
- Chile
- Colombia
- EFTA
- India (Comprehensive Economic Partnership Agreement)
- Peru
- Singapore
- United States (US)
- European Union (European Union–South Korea Free Trade Agreement)
- Australia
- Canada

The most important from the V4 point of view is European Union–South Korea Free Trade Agreement, which took effect in July 2011. It went further than any previous agreements in lifting trade barriers and it was also the EU's first trade deal with an Asian country.

The agreement eliminates duties for industrial and agricultural goods in a progressive, step-by-step approach. The majority of import duties were removed already in 2011, the remaining ones – with exception of a limited number of agricultural products - by 1 July 2016.

The FTA also addresses non-tariff barriers to trade, specifically on the automotive, pharmaceutical, medical devices and electronics sectors.

The agreement creates new opportunities for market access in services and investments, and includes provisions in areas such as competition policy, government procurement, intellectual property rights, transparency in regulation and sustainable development.

The agreement marked a new era in EU-South Korea trade relations and has contributed to the expansion of bilateral trade. Full implementation of the agreement is important. The agreement established a significant number of specialised committees and working groups between the two parties to monitor its implementation. These bodies also provide an opportunity to seek resolutions to market access concerns and to engage in closer regulatory cooperation. The annual Trade Committee at the ministerial level plays a supervisory role and is designed to ensure that the agreement operates properly. (*Source: http://ec.europa.eu/trade/policy/countries-and-regions/countries/south-korea/*)

According to EC annual report FTA has worked well for both sides. EU exports of goods to Korea increased in 2014 by 35 %, compared to the 12-month period before the FTA took effect. While imports from Korea were roughly equal to the 12-month period before the FTA, they increased by 6 % in 2014, compared to the previous year. The weaker performance of Korean exports has to be seen in the context of the decreased demand in the EU following the financial crisis: EU imports from its 14 main suppliers decreased and in fact Korea was one of the few trade partners, along with Turkey and China, whose exports to the EU increased in 2014. It seems therefore that the FTA mitigated the impact of the crisis on Korean exports and that without the FTA, the Korean exports to the EU would have been hit much harder.

When looking at the development of bilateral trade of goods which has been fully or partially liberalised by the FTA, the situation looks brighter also for Korea, with an increase of 21 % in exports of fully liberalised goods and 26 % of partially liberalised goods to the EU.

On the EU-side, exports of fully and partially liberalised goods have also increased more than exports overall, with an increase of 46 % for fully liberalised goods and 37 % for partially liberalised goods.

While trade is prospering, full implementation of the FTA remains of key importance. Some implementation and bilateral trade issues persist. For example, in the automotive sector tackling the remaining non-tariff barriers remains a challenge. As regards Sanitary and Phytosanitary Measures, some of the issues encountered by EU exporters stem from the fact that Korea applies different import conditions for EU Member States for animal and plant products, although the legislation is fully harmonised in the EU. This delays access to the Korean market, as EU Member States have to undergo individual negotiations. However, there are also success stories, such as the conclusion of the agreement of equivalency of organic, agricultural processed products at the end of 2014. As a consequence, processed organic products processed and certified in the EU may be sold as organic in Korea as of 1 February 2015.

The FTA implementation structure, with its various specialised committees and working groups has proven an effective way to discuss and seek solutions to the implementation and market access issues. They also provide a regular forum to discuss current and future regulatory developments and any implications these may have on future exports. (*Source: Report from the Commission to the European Parliament and the Council, Annual Report on the Implementation of the EU-Korea Free Trade Agreement*)

1.5.3 Relevant competing associations - 16+1

1.5.3.1 16+1

The 16+1 format is a Chinese initiative aimed at intensifying and expanding cooperation with 11 EU Member States and 5 Balkan countries - Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia, Macedonia - in the fields of investments, transport, finance, science, education, and culture. The initiative was introduced on the first 16+1 summit held in Warsaw, Poland, in 2012 where the Prime Minister of China presented the content of framework document for the 16+1 format called China's Twelve Measures for Promoting Friendly Cooperation with Central and Eastern European Countries. Next summits then took place in in Bucharest, Romania (2013), Belgrade, Serbia (2014), Suzhou, China (2015) and Riga, Latvia (2016).

In the framework of the initiative, China has defined three potential priority areas for economic cooperation: ***infrastructure, high technologies, and green technologies.***

Key characteristics of the 16+1 Cooperation Framework are following:

1. Equal partnership.
2. Loose institutionalization.
3. Comprehensiveness of cooperation.
4. Multi-functional arrangement.
5. Well-planned framework.

The loose institutionalization means that the institutional arrangement in different mechanisms is not tight-knit - each country or entity can decide whether or not to join the relevant mechanism for cooperation on a voluntary basis. Institutionalization in different areas can have the form of an association, a forum, or a networking opportunity, which can facilitate contacts between China

and the CEEC (see Table 18). These different mechanisms should serve as a social network capital.

Next box and table summarize particular measures included in the Warsaw initiative and mechanisms, which were or are being prepared to capitalize intentions of the initiative.

BOX 1: MEASURES OF WARSAW INITIATIVE:

1. Establishment of a secretariat for cooperation between China and CEEC countries in China´s Ministry of Foreign Affairs.
2. Creation of a US$10 bn special credit line, a certain proportion of which will be concessional loans with a focus on cooperation projects in such areas as infrastructure, high and new technologies and green economy.
3. Setting up an investment cooperation fund between China and CEEC with the goal of raising US$500 mil. in the first stage.
4. Trade and investment promotion missions to be sent to CEEC countries.
5. Encouragement of Chinese enterprises to cooperate with relevant countries to establish one economic and technological zone in each country in the next five years. Encouragement of Chinese enterprises to take part in the development of existing economic and technological zones in the relevant countries.
6. Exploration of financial cooperation such as currency swap, local currency settlement for cross-border trade, and establishment of bank branches in each other´s countries.
7. Establishment of an expert advisory committee on the construction of transportation network between China and CEEC. Exploration of the building of regional highway or railway demonstration networks through joint venture, joint contracting and other means.
8. Proposal for holding a forum on cultural cooperation between China and CEEC.
9. 5,000 scholarships to the 16 CEEC in the next five years.
10. Proposal for setting up a tourism promotion alliance between China and CEEC.
11. Establishment of a research fund on relations between China and CEEC.
12. Hosting of the first young political leaders forum of China and CEEC.

Source: http://16plus1-thinktank.com/1/20151203/868.html

Table 18: Selected cooperation mechanisms in various areas between China and CEEC – established or in preparation

Mechanism	Host country
China - CEEC Association of Tourism Promotion Institutions and Travel Agencies	Hungary
China - CEEC Higher Education Institutes Consortium	Rotating (higher education institute)
Secretariat of China-CEEC Contact Mechanism for Investment Promotion Agencies	Poland and China
China - CEEC Joint Chamber of Commerce	Poland (Executive Office), China (Secretariat)
China - CEEC Federation of Transport and Infrastructure Cooperation	Serbia
China - CEEC Federation of Agriculture Cooperation	Bulgaria
China - CEEC Federation of Heads of Local Governments	Czech Republic
China - CEEC Federation of Logistics Cooperation	n.a.
China - CEEC Think Tanks Exchange and Cooperation Centre	China
China - CEEC Centre for Dialogue and Cooperation on Energy Projects	Romania

Source: http://16plus1-thinktank.com/1/20151203/868.html

Other initiatives include:

- China - CEEC Summit, i.e. the China-CEEC leaders' meeting at the prime minister level held yearly;
- China - CEEC Economic and Trade Forum held on an annual basis;

- national coordinators' meeting held before the summit, to coordinate positions and prepare for the summit;
- ministry-level conferences and other events devoted to issues such as tourism, education, agriculture, energy affairs, infrastructure development etc.;
- Polish "Go China" strategy aimed at encouraging Polish entrepreneurs to cooperate with Chinese business partners and explore the booming Chinese market;
- China Investment Forum held in the Czech Republic aimed to boost economic relations between China and the Czech Republic, etc.

Trade and investment relations within 16+1

The last decade has seen rapid growth in trade between China and CEEC: the trade volume between China and the CEEC in 2014 reached 60.2 bn USD, five times more than in 2004. During the Bucharest Meeting, China and the CEEC set the goal of doubling trade volume over the next five years.

According to the 2013 Statistical Bulletin of China's Outward Foreign Direct Investment (FDI), China's outward FDI stock in the CEEC amounted to 1.4 bn USD (compare with China's outward FDI stock in the EU-15 reaching 38.5 bn USD). This shows that China's investment in the CEEC is relatively insignificant.

The activity of acquisitions by China's enterprises is concentrated in the VisegradV4 Group while the main infrastructure projects are located in West Balkan states.

Bigger investment cases:

- Wanhua Industrial Group acquired full control over the Hungarian chemical company BorsodChem in a transaction of 1.69 bn USD in February 2011.
- LiuGong Machinery Corporation finalized its agreement to acquire Poland's Huta Stalowa Wola (HSWS) and its distribution subsidiary Dressta Co, Ltd. in January 2012.
- China Railway Signal & Communication Corporation has signed a deal to buy a majority stake of 51 % in the Inekon Group, a Czech tram producer.
- Rizhao Jin He Biochemical Group (RZBC) announced in Budapest in 2014 that it had chosen Borsod County in Hungary as the site of a new citric acid factory, with sales planned for the European market.
- The Zemun-Borca Bridge in Belgrade, valued at 260 mil. USD and built by China Road and Bridge Corporation, has already been completed.
- Section of the Corridor 11 Highway (valued at 334 mil. USD) being built by Shandong Highway Corporation is underway.

Other important mutual projects:

- Launch of a thermal power plant in Stanari, 180 km northwest of Sarajevo, Bosnia and Herzegovina(BIH), in September 2016. The power plant is built by a Chinese company with the help of a 350-million-EUR (386.94 million USD) loan from China Development Bank. It is the first project to utilize the 10-billion-USD Special Credit Line under the 16+1 mechanism (see BOX 1) (*Source: http://news.xinhuanet.com/english/2016-11/05/c_135806982.htm*).
- Construction of Cernavoda nuclear power plant - according to Memorandum of Understanding (MU) signed by China General Nuclear and Romanian national nuclear company Nuclearelectrica in November 2015, they will develop, construct, and operate unit

three and four of the plant. With an investment of more than 7 bn EUR (7.74 bn USD). It is the largest cooperation project in terms of the volume of capital between China and CEEC.

- Project for modernizing the Belgrade-Budapest railway - the construction work of the railway section in Serbia began late 2015, and the section in Hungary was given go-ahead by the country's parliament in April 2016. The 370 km railway should significantly improve the transportation between the two countries and shorten the traveling time from 8 to less than 3 hours.

On the other hand, there has not been much green-field brown-field investment from China in the CEEC, which is a source of slight disappointment for some CEEC. (*Source: http://councilforeuropeanstudies.org/critcom/161-framework-and-economic-relations-between-china-and-ceec/*).

Motivation for 16+1 formation

1. To have the 'back door' and a 'testing ground' for Chinese investments in the EU;
2. To facilitate the shaping of relations between China and the EU - the CEEC states might become 'lobbyists' for Chinese interests in specific EU institutions and forums;
3. To become a tool in building a positive image for China - new cooperation could help to soften certain aversion to China and turn around its negative image in the region.;
4. To improve its long-term bilateral relations with selected states in the region and thereby to create a basis for Beijing's political and economic presence in CEEC;
5. To foster favourable conditions for Chinese investments in the region, and even allegedly to help China bypass EU regulations (*Source: https://www.osw.waw.pl/en/publikacje/osw-commentary/2015-04-14/china-central-eastern-europe-161-seen-beijing*).

Potential

1. The most promising element = inclusion of the 16+1 cooperation framework into the concept of the New Silk Road ("One Belt, One Road") as the CEEC region might, among other potential benefits, work as the Road's 'hub';
2. By promoting interconnectivity, China and CEE countries have reshaped their trade structure and scaled up their trade volume. On a regular basis, 16 Chinese cities operate the cargo trains to about a dozen European cities. The trade volume between China and CEE countries reached 56.2 bn USD in 2015, an increase of 28 % comparing to 2010 = China's readiness to build the China-Europe land-sea express line and promote connectivity in Europe;
3. Cooperation in new areas such as the sector of small and medium-sized enterprises etc;
4. Deepened cooperation in the fields like traditional Chinese medicine, agricultural products and financial network.
5. Promotion of mutual understanding between societies is also recommended - knowledge of the cultural, social and political characteristics of CEEC and vice versa makes common economic initiatives easier to apply.

Main obstacles

1. Large diversification of 16 CEEC (structure of their economies, division into EU member states and those outside the EU, members of eurozone and those which are not) – it is not possible to follow uniform policy towards participating countries;
2. Barriers related to EU legislation, in particular those laws which restrict access to the public procurement market;
3. Significant share of EU funds in financing infrastructural investments;

4. Restrictions concerning technical standards, equipment and employment rules, which make it impossible to implement methods of cooperation which have proved practical in China's relations with Asian and African countries;
5. Insufficient expertise of companies, lacking knowledge and practical expertise concerning the region; insufficient understanding of the legal conditions and characteristics of relevant countries;
6. Asymmetry of economic needs and expectations on both sides. The golden era of investing in the region, during which foreign investors were granted access to attractive assets covered by privatisation projects, is now over. The 16 involved CEE states are currently counting on greenfield investments, which some Chinese companies might consider as too risky.
7. The EU has been worried of the '16+1' framework from the start, arguing that the platform was dividing the EU.

There is palpable frustration on both sides of the China-CEE platform regarding the speed and substance of developments under the 16+1 framework. Many CEE countries find China's "set menu" offer to finance and build capital infrastructure projects ill-fitted to their needs, and have found China largely unresponsive to appeals to give a larger role to other forms and types of economic cooperation. On the other side, Chinese think tankers and officials are puzzled about the lukewarm response their initiatives, which are perceived as very generous, receive in the CEE countries. Chinese analysts also are frustrated that even those measures and projects that are agreed to in principle are moving too slowly, if at all, toward implementation. There is a shared sense that the platform has been underachieving. (Source: http://thediplomat.com/2016/06/china-in-central-and-eastern-europe-4-myths/)

Conclusion

1. 16+1 might be group that will compete with RoK-V4 cooperation initiatives. Nevertheless different motivation for establishment, 4+1 instead of 16+1 countries and different perception of RoK in V4 countries may help eliminate most obstacles.
2. The chapter and functioning of the 16+1 initiative may serve as a source of good and bad practice.

1.5.4 V4 + RoK

The institutional environment is formed by number of agreements or memoranda either on EU level or on the level of V4 particular state. As the list of all bilateral contractual relationships would be rather extensive, we include - as the example of sectoral focus – the case of the Czech Republic.

A number of bilateral agreements have been signed between the Czech Republic and the Republic of Korea since 1990.

- Agreement between the Government of the Czech and Slovak Federal Republic and the Government of the Republic of Korea on aviation service (Seoul, October 26, 1990)
- Agreement on trade and economic cooperation between the Government of the Czech and Slovak Federal Republic and the Government of the Republic of Korea (Seoul, October 26, 1990)
- Agreement between the Government of the Czech and Slovak Federal Republic and the Government of the Republic of Korea for the promotion and reciprocal protection of investments (Seoul, April 27, 1992)

- Convention between the Czech and Slovak Federal Republic and the Republic of Korea for the avoidance of double taxation ant the prevention of fiscal evasion with respect to taxes on income (Seoul, April 27, 1992)
- Agreement between the Government of the Czech Republic and the Government of the Republic of Korea on waiver of visas (Seoul, October 6, 1994)
- Agreement between the Government of the Czech Republic and the Government of the Republic of Korea on cultural cooperation (Seoul, October 6, 1994)
- Agreement between the Government of the Czech Republic and the Government of the Republic of Korea on the cooperation in science and technology (Prague, March 5, 1995)
- Agreement between the Government of the Czech Republic and the Government of the Republic of Korea on the cooperation for peaceful use of nuclear energy (Seoul, March 16, 2001)
- Arrangement between the Ministry of Education, Youth and Sport of the Czech Republic and the Ministry of Culture and Tourism of the Republic of Korea on Cooperation in the Field of Youth for 2003-2005 (Prague, November 11, 2003)
- Arrangement between the Ministry of Informatics of the Czech Republic and the Ministry of Information and Communication of the Republic of Korea on Cooperation in the Field of Information and Communication Technologies (Prague, May 7, 2004)
- Arrangement between the Ministry of Industry and Trade of the Czech Republic and the Ministry of Foreign Affairs and Trade of the Republic of Korea on Economic Cooperation (Prague, April 21, 2009)
- Agreement between the Czech Republic and the Republic of Korea concerning a Working Holiday Program (Prague, December 19, 2011)
- Implementing Programme of Cooperation in the Fields of Education and Culture between the Government of the Czech Republic and the Government of the RoK for the years 2014-2016

These agreements were amended by several memoranda of understanding. The list below summarizes the most important ones:

- Memoranda of Understanding related to Economic, Science and Technology, R&D Cooperation etc. between CR and RoK, for instance
    - MoU between the Ministry of Science, ICT and Future Planning of the RoK and the Deputy Prime Minister for Science, Research and Innovation of the CR on Cooperation in the field of Information and Communication Technology
    - MoUs between R&D Centres of both countries
    - MoU between the Ministry of Industry and Trade of the CR and the Ministry of Industry, Trade and Energy of the RoK and the Ministry of Industry and Trade of the CR on Cooperation in the field of Technology and Innovation
    - MoU between the Ministry of Health and Welfare of the RoK and the Ministry of Health of the CR on Cooperation in the field of Health Care and Medical Science
    - etc.
- Regular communication and cooperation between Ministries and other bodies
- Meetings of bilateral Business Forums
- Biennial meetings of the Korea-Czech Science and Technology Joint Committee
- Regular Korea-Czech Infrastructure and Transportation Meetings
- Working Holiday Program and Erasmus+ Programme

The potential for increased cooperation will be analysed in the light of the above mentioned initiatives.

2 Ways to promote V4-Korea cooperation

2.1 Analysis in the field of Energy

2.1.1 General facts

2.1.1.1 Czech Republic

The issue of energy is one of the most important topics in the Czech Republic. The energy industry in the Czech Republic covers both production and distribution of all forms of energy, including mining and the use of energy sources such as coal, oil, natural gas, uranium, etc. Lignite remains the main source of energy and continues to cover approximately 58 % of the primary energy sources and thus thermal installed capacity dominates the energy sector in the Czech Republic.

Table 19: Power Generation Installed Capacity in the Czech Republic

MW	2008	2009	2010	2011	2012	2013	2014	2015
Thermal	10 685	10 720	10 769	10 788	10 644	10 820	10 837	10 738
Combined cycle and gas fired	898	935	1 024	1 102	1 271	1 338	2 196	2 223
Hydro (including pumped-storage)	2 192	2 183	2 203	2 201	2 216	2 229	2 252	2 259
Nuclear	3 760	3 830	3 900	3 970	4 040	4 290	4 290	4 290
Wind	150	193	218	219	263	270	278	281
Photovoltaic	40	465	1 959	1 971	2 086	2 132	2 067	2 075
Total	**17 724**	**18 326**	**20 073**	**20 250**	**20 520**	**21 079**	**21 920**	**21 866**

Source: Energy Regulatory Office

Considering the share of production, thermal power stations and nuclear power plants significantly dominate. In 2015, the gross electricity production reached the total of 83,088 GWh, whereas 53.4 % of that was produced by thermal power stations and 32 % by nuclear power plants. The remaining sources covered just about 15% of the energy production.

Table 20: Power Generation Production Mix in the Czech Republic

GWh	2008	2009	2010	2011	2012	2013	2014	2015
Thermal	51 219	48 457	49 980	49 973	47 261	44 737	44 419	44 817
Combined cycle and gas fired	3 113	3 225	3 600	3 955	4 435	5 272	5 699	6 324
Hydro (including pumped-storage)	2 376	2 983	3 381	2 835	2 963	3 762	2 961	3 071
Nuclear	26 551	27 208	27 988	28 283	30 324	30 745	30 325	26 841
Wind	245	288	336	397	417	478	477	573
Photovoltaic	13	89	616	2 118	2 173	2 070	2 123	2 264
Total	**83 516**	**82 250**	**85 900**	**87 561**	**87 574**	**87 065**	**86 003**	**83 888**

Source: Energy Regulatory Office

The state still owns about 70% of shares of CEZ (Czech Power Company), the major energy production and distribution company. In the long-term, state influence in the energy sector is anticipated only in the form of indirect measures (legislation, pricing and taxes), regulating natural monopolies in particular industries and of course assuring energy security (mainly by management of ownership rights). About two thirds of electricity production is concentrated in CEZ, which owns 12 coal power plants in the Czech Republic, two nuclear power plants (Dukovany and Temelín), 31 hydro power plants (including three pumped-storage hydro power plants), 14 solar power stations and two wind power plants.

Strategic priorities of the Czech Energy Policy

1. Transformation of electricity industry
   - Decarbonisation
   - Generation adequacy (including strategy reserves)
   - Diversification (balanced energy mix)
2. Energy conservation and efficiency
3. Infrastructure development
   - Integration of electricity, gas and oil infrastructure (target model)
   - Infrastructure reinforcement

- Smart grids at distribution and transmission level

4. Research in energy and industry, human resources
5. Energy security (reserves, emergency)

Main policy goals

- Increasing energy efficiency in transformation, transportation and consumption
- Increasing role of nuclear in electricity generation (> 50 %)
- Smart renewables development
    - Electricity generation < 25 %
    - Integration to smart grids (control, balancing, storage)
- Decreasing share of coal (preference for cogeneration)
- Increasing role of natural gas (with security limits 25 %)
- Energy use of waste (after recycling) - no landfill after 2025
- Important role of district heating systems
- Increasing transit role in electricity, gas and oil
- Efficient market integration

2.1.1.2 Slovakia

In 2015, the total electricity consumption in Slovakia was 29,579 GWh, up by 4.32 % y-o-y. The high annual growth of electricity consumption was mainly caused by increased economic growth as well as higher temperatures in summer.

The total electricity production in Slovakia reached 27,191 GWh, decreasing by 0.23 % y-o-y. The dominant source of electricity production in Slovakia is nuclear energy. In 2015, nuclear power plants produced 15,146 GWh of electricity, making up 55.7 % of total electricity consumption in Slovakia. Hydropower plants produced 4,338 GWh, production from fossil fuels was 5,252 GWh and photovoltaic installations generated 578 GWh. The 2015 deficit in domestic production was covered by increased imports of electricity, which made up 8.1 % of the total consumption.

2.1.1.3 Hungary

Hungary's gross electricity consumption in 2011 reached 42,626 GWh. Consumption has been showing continuous growth since the 2008 crisis downturn. Within domestic electricity generation, nuclear power and natural gas represent the highest ratio.

As of end 2015, installed capacity of Hungarian power plants was 8,453 MW_e, down by 34 MW_e y-o-y. The peak load of the Hungarian electricity system was 6,457 MW. Though the increase in energy efficiency may help to reduce the rate of increase of primer energy consumption, it is still probable that the electricity demand will increase after overcoming the world crisis. The capacity expansion needed until 2030 will be between 600 and 2,600 MW. Taking into account the necessary closure of old fossil power plants new capacity between 6,000 and 8,000 MW is needed until 2030.

The structure of the Hungarian electricity system is presently well balanced, with about 14% gas, 53 % nuclear, 20% coal, and an increasing ratio of renewables. The electricity production from renewable energy sources is growing in accordance with the EU directive on green electricity. In 2014, renewable based electricity production made up a share of 7.28% of total electricity production. The Hungarian energy supply is around 60% import dependent, therefore its security is a crucial priority of the National Energy Strategy.

Table 21: Installed Capacity Hungarian Power Sector

GW_e	2005	2010	2011	2012	2013	2014	2015
Thermal	6.35	6.13	6.76	6.73	6.70	5.67	5.79
Hydro	0.05	0.05	0.06	0.06	0.06	0.06	0.06
Nuclear	1.87	2.00	2.00	2.00	2.00	2.00	2.00
Wind	0.02	0.29	0.33	0.33	0.36	0.33	0.33
Other renewables	0.36	0.52	0.50	0.29	0.30	0.36	0.28
Total	**8.60**	**8.99**	**9.65**	**9.41**	**9.40**	**8.42**	**8.45**

Source: IAEA

Table 22: Power Generation Mix Hungary

TWh	2005	2010	2011	2012	2013	2014	2015
Thermal	20.05	18.59	17.59	16.15	15.96	12.12	11.31
Hydro	0.20	0.19	0.22	0.21	0.21	0.21	0.23
Nuclear	13.83	15.76	15.69	15.79	15.79	15.37	15.83
Wind	0.01	0.53	0.63	0.77	0.77	0.72	0.69
Other renewables	1.66	2.30	1.86	1.66	1.86	1.86	2.22
Total	**35.75**	**37.37**	**35.99**	**34.58**	**34.59**	**30.27**	**30.29**

Source: IAEA

Whilst the Czech, Hungarian and Slovakian prices converged following the extension of market coupling from the Czech Republic and Slovakia to Hungary in September 2012, the same does not hold for other markets.

2.1.1.4 Poland

In 2014, the gross national electricity production in Poland reached 159 TWh (down by 3.3% y-o-y). The domestic consumption of electricity was 160 TWh (the difference was imported).

Table 23: Forecast of Polish demand for electricity

TWh	2015	2020	2025	2030
Final energy	115.2	130.8	152.7	171.6
Energy sector	11.6	12.1	12.7	13.3
Transmission and distribution losses	13.2	13.2	15	16.8
Net demand	140	156.1	180.4	201.7
Own needs	12.8	13.2	14.2	15.7
Gross demand	**152.8**	**169.3**	**194.6**	**217.4**

Source: Forecast of demand for fuels and energy by 2030, Ministry of Economy 2009.

The Polish energy sector has been historically based on fossil fuels, which occur abundantly in Poland (Poland has ninth largest deposits in the world). In electricity production, two major fuels play a key role: hard coal and lignite, which produce nearly 90 % of Polish electricity.

Table 24: Consumption of primary fuels in commercial power industry in Poland

	2011	2012	2013	2014
Coal	86.6%	84.1%	84.9%	82.7%
Natural gas	3.6%	3.9%	3.2%	3.3%
Biofuels	4.6%	6.2%	5.2%	6.3%
Renewables	3.6%	4.4%	5.5%	6.5%
Other	1.6%	1.3%	1.2%	1.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: IEA

As of end 2014, Poland's installed electricity capacity stood at over 38,323 MW, up by 0.25 per cent as compared to installed capacity at the end of 2013. Renewable energy accounted for about 10 per cent of the installed capacity. Meanwhile, the share of thermal sources in the total capacity has fallen over time. Thermal energy accounted for 77.6 per cent of the total installed capacity in 2014 as compared to 79.3 per cent in 2013.

The Polish government's priorities are torn between developing its renewables output and rescuing its coal industry. It is estimated that around 80% of Polish coals mines are unprofitable and the sector employs around 104,000 people, with another 208,000 people on miners' pensions. Poland has Europe's largest hard coal reserves and last year thermal coal and lignite

accounted for 84% of the country's electricity generation. Despite government subsidies, Poland's coal mining industry debts totalled more than EUR 3 billion at the end of October 2015.

Shale gas

Poland also has a vast potential for shale gas production. The Polish Geological Institute estimates that the Polish deposits most probably range between 346 and 768 billion cubic meters of gas.

District heating

In 2010, the volume of Polish production of thermal energy generated by licensed heating companies reached 462,500 TJ. Volume of total heat sold was 434,000 TJ and grew by 9 % compared to the preceding year. The dominant fuel in thermal energy generation is hard coal (76 %). The remaining fuels include among others fuel oil, natural gas and biomass. It should be noted that the use of hard coal is gradually decreasing and the use of biomass is increasing.

As of 2010, installed capacity of licensed heat producers was 59.2 GW and generating capacity was 58.1 GW. Compared to 2002, installed capacity decreased by 16.5 %. The licensed district heating companies had grids of a total length of 19,400 km, however it should be pointed out that this size included heating grids linking heat sources with heating nods and low parameter grids – external receiver installations.

2.1.2 Nuclear power

2.1.2.1 Czech Republic

The Czech Republic operates two nuclear power plants: Temelín and Dukovany. In 2010, there were government and corporate moves to expand Czech nuclear power generation capacity. Any expansion is likely to build on plans first developed in the 1980s.

The Temelín Nuclear Power Plant, with its 2,000 MWe (2x 1,003 MWe net, 2x 1,056 MWe gross) of installed capacity, is the largest power resource in the Czech Republic. Reactor type: VVER 1000/320 PWRs. Expected shutdown: 2042 – 2043 (with possible further lifetime extension).

The Dukovany Nuclear Power Plant a similar capacity as Temelín plant. It operates four reactors, with 505 MWe gross capacity (4 x 471 MWe net capacity) each. Reactor type: VVER 440. Expected shutdown: 2035 – 2038 (with possible further lifetime extension).

New projects

The Czech Energy Policy of 2004 envisages building two or more large nuclear reactors after 2020 in order to replace the Dukovany power plant. Following the Policy, the Ministry of Industry and Trade suggested to add two 600 MW_e reactors at Temelín plant before prior to 2025. The plans announced in 2006 envisaged a construction of one 1,500 MW_e unit at Temelín premises after 2020 with a second unit to follow.

In August 2009, ČEZ (the major Czech utility company controlled by the Czech government) sought bids for two pressurized water reactors (PWRs) for units 3 and 4 at Temelín plant. Shortly after the Fukushima nuclear accident, the Czech Prime Minister announced that the construction of new reactors will continue, however, delaying the decision about the award of the tender until 2013.

In July 2012, ČEZ opened bids for the public contract for completing the Temelín Nuclear Power Plant in the presence of the bidders' - Areva, Westinghouse Group and a consortium of ŠKODA JS, Atomstroyexport, and Gidropress. In October 2012, ČEZ informed Areva that its bid failed to meet statutory requirements for participation in the tender. In addition, Areva had

not fulfilled some other crucial criteria defined in the tender and as a result, it was excluded from further evaluation of the tender.

In April 2014, ČEZ cancelled the project after the Czech government announced it did not plan to provide guarantees to support the construction of low-emission power plants following discussions in the EU.

The National Action Plan for Nuclear Energy (NAPNE), approved by the Czech government in June 2015, envisages establishment of a specialized company (SPV) that would acquire all assets needed for the construction of new nuclear units at both Temelin and Dukovany sites. The SPV would identify a business model building new nuclear units and consult the model and its financing with the European Commission.

The SPV would prepare the 2-unit project variants at both Temelín and Dukovany sites with anticipated construction of 1 unit and possible expansion to 2 units at either location. Later on, it will re-evaluate, at the latest before the construction permit is issued, whether there is still a need for the construction of a new nuclear facility and whether or not the market situation has stabilized to allow commercial construction, i.e. with no need for government guarantees.

NAPNE recommends a two stage approach: in the first stage the preparation process with main goal to obtain construction permit should continue, in second stage, which is assumed around the year 2025, the construction itself should begin. The priority is to start the operation of new units around the year 2037 at Dukovany in order to sustain operation continuity and provide the replacement of decommissioned units of current NPP.

Current status of CEZ's new nuclear projects

New NPP Temelín

- SPV (Special Purpose Vehicle) preparation in process
- Fulfilment of conditions set by permission and licenses issued (EIA, Safety Report/nuclear siting, …)
- Related investments (at site, in the region)
- Other preparatory works (ČEPS (grid operator), …)

New NPP Dukovany

- Environmental Impact Assessment (EIA) – ready to start the process
- SPV (Special Purpose Vehicle) preparation in process
- Evaluation of the site aspect

New NPP Jaslovské Bohunice (Slovakia)

- On-going Environmental Impact Assessment (EIA)
- Received the Statement from the Ministry of Industry and Trade

Maintain and improve know-how of the ČEZ nuclear team

- Participation at Generation III+ certification at European Utilities Requirements
- Supply chain export activity with different vendors
- Engineering activities on new and existing NPPs abroad.

Six companies have expressed interest in the expansion of the Czech Republic's nuclear power programme, according to media reports on 2 November 2016.

- Russia's Rosatom Overseas (part of state nuclear corporation Rosatom);
- US-based Westinghouse (part of Japan's Toshiba Corp);

- Electricite de France;
- ATMEA, the joint venture of France's Areva and Japan's Mitsubishi;
  Korea Hydro and Nuclear Power, and
  China General Nuclear Power Corporation.

Spent fuel

The Czech Republic has no state policy on storage or reprocessing of nuclear waste but leaves the responsibility on CEZ utility company. CEZ utility company does not believe spent fuel reprocessing is economically viable and stores spent fuel until the government agency Radioactive Waste Repository Authority (RAWRA) assumes responsibility for it. RAWRA is in the process of identification of location for permanent storage of spent fuel and begin its construction beyond 2050.

2.1.2.2 Slovakia

Slovakia has four operational nuclear reactors, commissioned between 1984 and 1999. The net installed capacity is 1,815 MW_e and nuclear energy produces approximately 52% of the country's electricity.

Prior to its accession to the European Union, Slovakia had to shut down two of its older reactors at Bohunice, closing the first reactor in 2006 and the second in 2008. The closure of these units, prior to the completion of two new reactors, has left the country short of power and Slovakia became an energy importer after the first reactor was shut down.

Slovakia currently operates two sites:

- **Mochovce Nuclear Power Plant.** The first two units in Mochovce were commissioned in 1998 – 1999 with expected lifetime until 2028 – 2030. Each unit has an installed capacity of 470 MW_e.
- **Bohunice Nuclear Power Plant.** In Bohunice, there are 2 operational units of VVER-440 reactor type, each with 472 MW_e installed capacity (505 MW_e gross capacity). Units were commissioned during 1984 – 1985 with expected lifetime until 2044 – 2045.

New projects

Despite of phasing out of the older units, the Slovak government remains committed to nuclear power. In January 2006, it approved a new energy strategy envisaging capacity upgrades at Mochovce NPP units 1 and 2, construction of two additional units in Mochovce and also additional two reactors at Bohunice site.

In 2008, Slovenske Elektrarne, the major Slovak utility company (at that time owned by the Slovak government and Italian ENEL), decided to build two additional blocks at Mochovce site with 471 MW_e installed capacity each. Contruction started in 2008 and originally, it was scheduled to be completed in 2012 – 2013. However, the completion was postponed until 2018, also due to project redesign. Expected investment should attain €4.6 billion (an increase from original budget €1.6 billion).

The Slovak government plans to build 2 new nuclear units at Bohunice site. The construction is expected to start in 2021 with estimated installed capacity of 1,200 MW_e. The government owns 51% in the project, while the remaining 49% is owned by the Czech utility group ČEZ. The ČEZ group, who invested over €100 million in the project, weighs up selling its stake to Slovak government. Rosatom has been negotiating over entry in the project however, the talks have not been concluded yet.

Spent fuel

Radioactive waste in Slovakia is disposed without reprocessing. The spent fuel stays at the reactor site; however, some spent fuel has been exported to Russia. Slovakia has also begun a search for a high-level waste repository and established a fund with approximately €775 million to build it.

2.1.2.3 Hungary

Currently, in Hungary there are four nuclear reactors with a net output capacity of 1,900 MW_e, all of them operated at the Paks site. There are 4 reactors of 500 MW_e gross installed capacity (475 MW_e net) each, producing over 50 percent of Hungary's electrical power. Originally, the units had expected lives of 30 years; however, during 2000s the Hungarian government decided to carry out a 20-year life-extension project on the reactors worth USD 900 million. The expected lifetime of the existing units was extended until 2032 - 2037.

New projects

In 2009, Hungary approved a plan to build additional 2 VVER-1200 reactors with a capacity of 1,200 MW_e gross (1,114 MW_e) each at Paks site. The construction is supposed to start in 2018 and should be completed by 2025 – 2027. According to the agreement between the Hungarian government and Rosatom, signed on 14 January 2014, Paks Nuclear Power Plant will be expanded by the Russian state company Rosatom. Eighty percent of the project's cost will be financed by a EUR 10 billion credit line from Russian company. The loan is subject to approval of the European Commission.

Spent fuel

Hungary purchases all of its nuclear fuel from TVEL of Russia. Spent fuel is usually disposed without reprocessing; in some cases, however, spent fuel is sent to Russia for reprocessing. The spent fuel is kept at the nuclear reactor site for five years in pools and then sent to dry storage. In December 2012, the storage facility for low and intermediate-level radioactive waste started operation by receiving its first batch of nuclear waste. The construction costs amounted at 68 billion forint (approx. 310 million USD) and was covered by the Central Nuclear Financial Fund, funded by the nuclear power companies.

2.1.2.4 Poland

Currently, there is no operational nuclear power plant in Poland. In the 1980s, Poland had four Soviet VVER-440 reactors under construction at Zarnowiec site, but the project was cancelled in 1990 due to public opinion and Chernobyl disaster.

Nevertheless, due to high dependence of Polish power generation sector on fossil fuels and obligations to decrease CO_2 emissions, the Polish government plans to redesign its power generation fuel mix.

The 2006 feasibility study suggested it would be optimal to build 11,500 MW_e capacity nuclear power plant. However, this proving unaffordable, Poland decided to build a 4,500 MW_e nuclear power plant by 2030. In 2007, a draft energy policy proposed 10,000 MW_e of nuclear installed capacity to be built by 2030. The deadline gives an estimated ten years for investment and construction and five years of public campaigning.

In July 2006, Poland joined Lithuania, Estonia, and Latvia in a project to build a 3,400 MW_e nuclear power plant at Visaginas site in Lithuania. The new power plant is to replace the Ignalina Nuclear Power Plant that was shut down in 2009. The Polish company PSE participates in the development and plans to invest 22% in the project with expected costs of EUR 6 billion. Poland will be guaranteed to have 1,200 MW_e from the power plant and is in the process of upgrading transmission capacity between Lithuania and Poland. In July 2014, Lithuanian Energy Ministry

and Hitachi corporation signed a memorandum, declaring intentions to jointly perform preparatory work for setting up an interim project company.

2.1.3 Renewables

2.1.3.1 Czech Republic

Wind

As of end 2015, wind power installed capacity in the Czech Republic attained 281 MW and its share on net electricity production in 2015 was 564 GWh (0.72%). Over 97% of installations have an installed capacity over 1 MW. Over 76% of all installed capacity was commissioned between 2007 and 2012. The technical potential of wind power in the Czech Republic power varies between 5,800 MW and 12,500 MW; however, its higher utilisation is restricted by the lengthy approval process for new installations and negative public opinion.

Solar

As of end 2015, the Czech Republic had 2,075MW of photovoltaic capacity. Over 85% of the installed capacity was built during 2009 – 2011, owing to generous support scheme. Since 2012, the support for new installations, especially the ones bigger than 30 kWp, was significantly reduced and additions to installed capacity have been very low ever since. The current support scheme aims at smaller (up to 30 kWp) roof-top installations.

In 2015, the net electricity production of photovoltaic plants in the Czech Republic reached 2,244 GWh, making up 2.88 % of the total. The largest Czech photovoltaic plant is Ralsko solar plant with installed capacity of 38 MWp, operated by CEZ utility company. Installation over 1 MWp installed capacity make up over 64 % of the total installed capacity.

Hydro

The overall potential for all sizes of hydropower is quite modest as the technically exploitable capability reaches 3,978 GWh per year). Total net hydroelectricity output in 2015 was 1,779 GWh, representing 45 % of this potential. Hydropower furnishes less than 3 % of the Czech Republic's net electricity generation.

A relatively high proportion (nearly 40 %) of the technically exploitable capability is classified as suitable for small-scale schemes; installed capacity in this category at the end of 2015 was 335 MW, equivalent to about 31 % of the Czech Republic's total hydro capacity. Actual generation from small-scale schemes in 2015 was 989 GWh.

The State Energy Concept provides support for the construction of further small-scale HPPs, in particular through favourable feed-in tariffs, which guarantee a positive return on investment. Investment subsidies serve as another effective stimulus. The number of sites available for the construction of new small hydro plants is rather small. Licensing procedures are fairly complex and often somewhat protracted. Over half of the existing small HPPs use obsolete technology (dating from 1920 - 1950). There are plans to modernise the technology, with the aim of improving efficiency by up to 15 %.

2.1.3.2 Poland

Wind

Wind power is a minor but growing source of electricity in Poland. As of the end of 2013, total installed capacity was 3,390 MW_e, producing 5,822 GWh of power, i.e. 3.53 % of country's electricity production. During 2011 – 2015, the installed capacity rose by almost 3,400 MW_e, reaching 4,978 MW at the end of 2015. It amounts to 13% of the overall Polish installed capacity, and the share of energy from wind on the total energy production reached 6.21%. The average

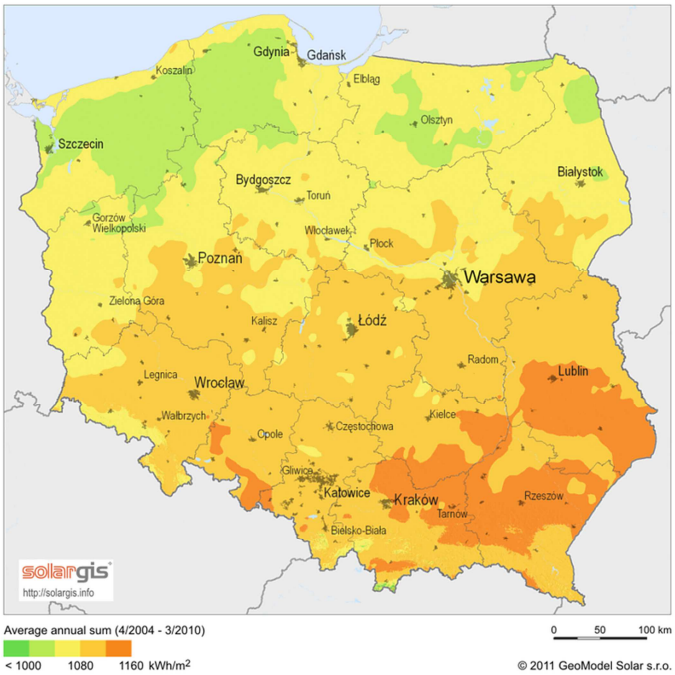
installed capacity of a single wind farm in 2015 was 12 MW. As of the mid-2016, the total installed capacity reached 5,660 MW_e.

Poland has one of the biggest potentials for offshore wind development in Europe, estimated at 6,000 MW_e by 2030. So far, 37 location permits have been issued. The first offshore wind farms in the Baltic Sea, with a total capacity of 2,200 MW_e, may be built in early 2020s.

Solar

The total solar photovoltaics (PV) power plants connected to the grid in Poland at the end of 2012 were about 1.29 MWp of capacity. According to Energy Regulatory Office photovoltaic power in Poland had 91.82 MWp installed capacity at the end of June 2016.

Figure 7: Solar irradiation map Poland



Source: GeoModel Solar

Solar thermal, used for heating water was widely used in about 1,700,000 square metres of solar thermal collectors at the end of 2014. This corresponds to about 1,200 MWth capacity. Solar collectors are the second, after the biomass heating plants, source of "green heat" in Poland. In 2014, Poland was ranked fourth in sales of solar collector installations among European countries.

Hydro

Despite the fact that hydropower is one of the oldest energy resources in Poland, it has not gained much popularity. Landscape, irregular rains and high investment costs caused other RES to be chosen over hydropower. The utilisation of resources is difficult and does not bring good economic return, as Polish water and energy resources are too small (due to relatively abundant and irregular rainfall during the year). Moreover, the geology of the country is unfavourable and can be characterized by high permeability and a slight decrease in land areas.

In Poland there are about 400 hydroelectric plants, including only a few with capacity higher than 5 MW. The biggest hydropower plants in Poland are mainly pumped storage. In 2013, electricity produced from hydropower in Poland was equal to 2.4 TWh.

The gross hydropower potential of Poland is estimated as 25 TWh/annum and technical potential is close to 12 TWh/annum. During last 40 years no large classic hydropower plant was been erected.

2.1.3.3 Hungary

Wind

Installed capacity of wind power in Hungary was 329 MW as of end 2015. There were 39 operational wind farms in Hungary with 172 turbines. Most of wind farms are situated in the Kisalföld region. The last wind turbine was built in 2011, during 2012 – 2016 there were no new installations made in Hungary.

Hungarian government introduced cuts in the money renewable energy producers receive for produced electricity, and later on also cancelled tenders for 410 MW of grid connection capacity, although the grid is perfectly capable of integrating more wind.

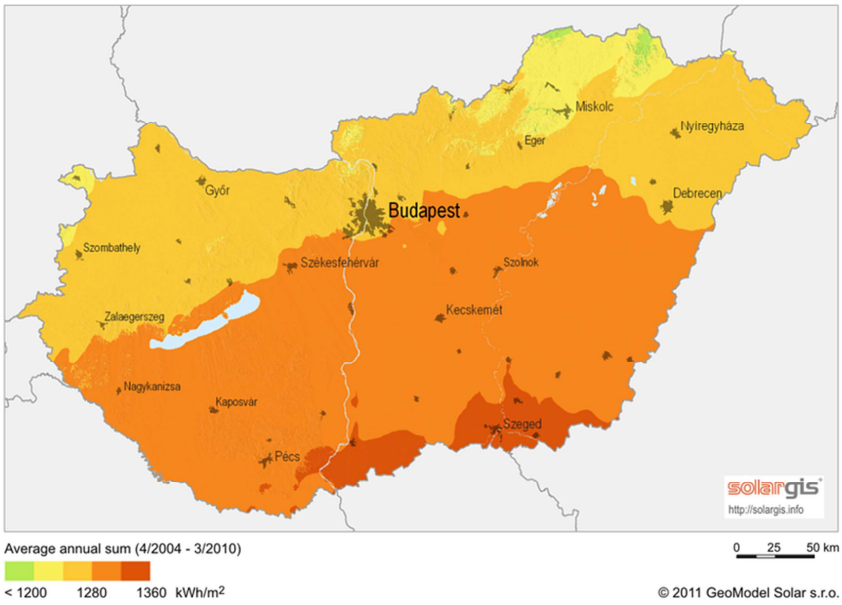
Hungary's 2020 target in the National Renewable Energy Action Plan (NREAP) is for just 750 MW of wind by 2020. It is half of the 1,200 MW EWEA and Hungarian Wind Energy Association believes it can be easily connected and significantly below 2,020 MW and installed if circumstances are right.

As of 2016, a series of new regulations technically prohibit the installation of new wind turbines in Hungary as the new law banned wind turbines in a 12 km radius around populated areas, effectively covering the whole country.

Solar

Solar energy potential of Hungary is very good, as it has 1,950-2,150 hours of sunshine per year at an average annual irradiation of 1,300 kWh/m2 per year. Hungary's photovoltaic potential is estimated at about 480 million MWh. Solar power in Hungary is rapidly advancing, despite significant lagging behind most of the European states. By the end of 2015 Hungary had installed more than 110 MW of photovoltaics. The country's capacity is expected to double in 2016. However, the government imposed an import tax on solar panels, which might slow down the development of Hungarian photovoltaic sector.

Figure 8: Solar irradiation map Hungary



Source: GeoModel Solar

Hydro

But the most profligate country in the region regarding water resources is Hungary, where hydro facilities amount to just 46 MW (0.6% of the total) and generate a paltry 200 GWh annually (again, 0.6% of the total).

There are 31 hydro power generators in Hungary.–The largest are, by far, the Kisköre and Tiszalök units in the eastern part of Hungary, owned by state through Tiszavíz Hydro Power Plants Ltd., with capacities of 28 MW and 11 MW respectively. The average age of the large HPPs in Hungary is approximately 40 years.

Hungary's technical hydro power potential is around 8,000 GWh a year, or about 20 % of net production. The second largest river in Europe, the River Danube bears a great deal of this potential (72%) but on the Hungarian section of the river these resources are not utilized. There are also far-reaching plans on several possible locations for the construction of a pumped storage hydroelectric power plant in Hungary. Hungary's failure to harness its water resources to provide more electricity provides a series of case studies illustrating the pros and cons of hydro power - both real and perceived.

2.1.3.4 Slovakia

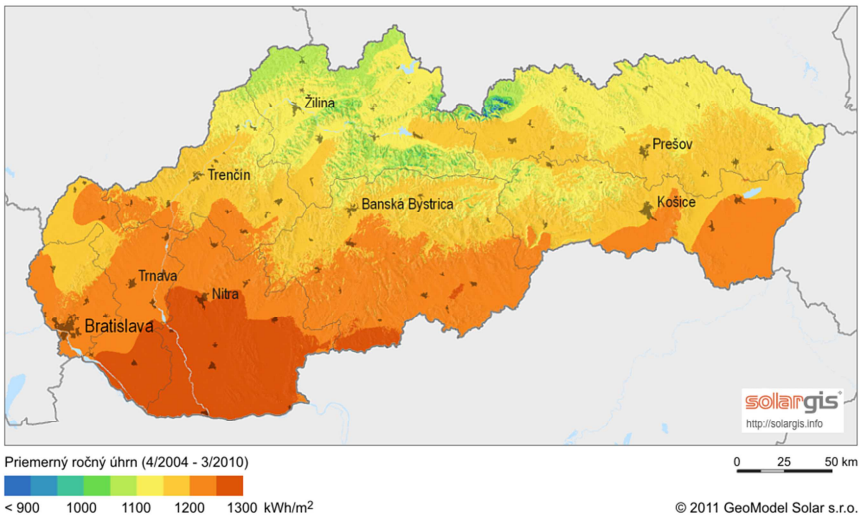
Wind

At the moment, there are 3 locations with installed wind turbines in Slovakia with combined capacity of 5.1 MW, covering consumption of ca 3,000 households. Real potential of wind energy in Slovakia is estimated at 600 – 1,000 MW. However, the main reason for low utilisation of wind power is predominantly lack of suitable locations. Many of technically suitable locations are blocked by environmental protection. At the moment Slovenská elektrizačná a prenosová sústava (SEPS), the owner and manager of the grid, does not issue any permits for connections to network, waiting for an evaluation study on connection of wind plants to grid.

Solar

As of 2015, installed capacity of solar power plants in Slovakia was 512 MWe. In total, solar plants produced in 2015 578 GWh of electricity. There are no new additions to installed capacity expected for on the ground installations, as the targeted installed capacity was already reached. However, there is still untapped potential in rooftop installations.

Figure 9: Solar irradiation map Slovakia



Source: GeoModel Solar

Hydro

Hydro power has played a major role in Slovakia's electricity generation ever since the first large hydropower plant (HPP) was constructed in the 1950s. Currently, there are 243 HPPs making up about 15% share of the total electricity generated in Slovakia. Much of the hydroelectric development in Slovakia is throughout the Váh River valley, with more than 20 HPPs found there whose total installed capacity is 1,600 MW. HPPs in Slovakia are quite old, their average age 44 years, while the average age of large hydro installations is approximately 30 years.

The technical hydro power potential of electricity generation is estimated at about 7,000 GWh annually, thus approximately 62 % of this was harnessed in 2008. The Slovak hydro power development programme focuses on the continued and increased utilization of hydro power via rehabilitation of existing facilities and construction of new ones. The major projects designed to enhance hydro power potential utilization are the HPP Sereď (51 MW) and the HPP Nezbudská Lúčka (23 MW) on the Váh river and pumped storage power plant (PSPP) Ipeľ (entailing 600 MW).

2.1.4 Refineries

2.1.4.1 Czech Republic

The Czech Republic is a small consumer of refined fuels as the country's electricity generation is mostly based on coal and nuclear fuel. The country has a total refining capacity of 173 kbpd with two refineries in operation. Both plants belong to Unipetrol after Eni and Shell sold their stakes in the Ceska Rafinerska Consortium in 2014. The majority shareholder of Unipetrol is a Polish group PKN.

2.1.4.2 Slovakia

Slovnaft as the only refinery in Slovakia refines 5.5 to 6 million tonnes of crude oil per annum and produces a broad range of motor fuels, fuel oils and petrochemical products. After intensive modernisation, the refinery is today noted for its high rate of conversion and flexibility, and nowadays it is one of the three most modern and complex refineries in Europe. The refinery has been a subsidiary of Hungary-based MOL Group since 2000.

2.1.4.3 Hungary

Hungary has one operational refinery called Danube Refinery. It is located at Százhalombatta near Budapest and began operations in 1965. Operated by MOL group, the refinery employs about 1,200 people, and with a capacity of 165 kbpd (8.1 mtpa) of crude oil it is one of the largest refineries in CEE region.

2.1.4.4 Poland

Poland operates two major refineries. The Gdańsk refinery is an oil refinery located in Gdańsk owned by Grupa Lotos. The refinery capacity is 210 kbpd of crude oil and it has a Nelson complexity index of approximately 10. The Płock refinery is an oil refinery and petrochemical complex in Płock owned by PKN Orlen. The refinery has a Nelson complexity index of 9.5 and a capacity is 276 kbpd of crude oil.

2.1.5 Networks

2.1.5.1 Natural gas

The Central Europe region is particularly vulnerable to an interruption of gas supply. Europe's gas sector is considered vulnerable due to its high import dependence (66 % of gas is imported) and significant market power exerted by Russia as the supplier of 42 % of all imported gas into

the European Union. This vulnerability is exacerbated by an ageing gas infrastructure which is aligned on an east-west axis to accommodate the single gas supplier.

Further, the existing gas transmission network is fragmented and has a limited capacity to accommodate reverse flows of gas. This makes it difficult to create a single efficient and competitive market for gas across the EU. These network gaps result in less security of supply and price premiums due to limited competition in the gas supply market of some countries.

The policy makers' energy security concerns have been heightened in recent years by the rising geopolitical tensions on the eastern and southern borders of the European Union. These tensions could result in energy supply disruption due to conflict or use of energy as a geopolitical tool.

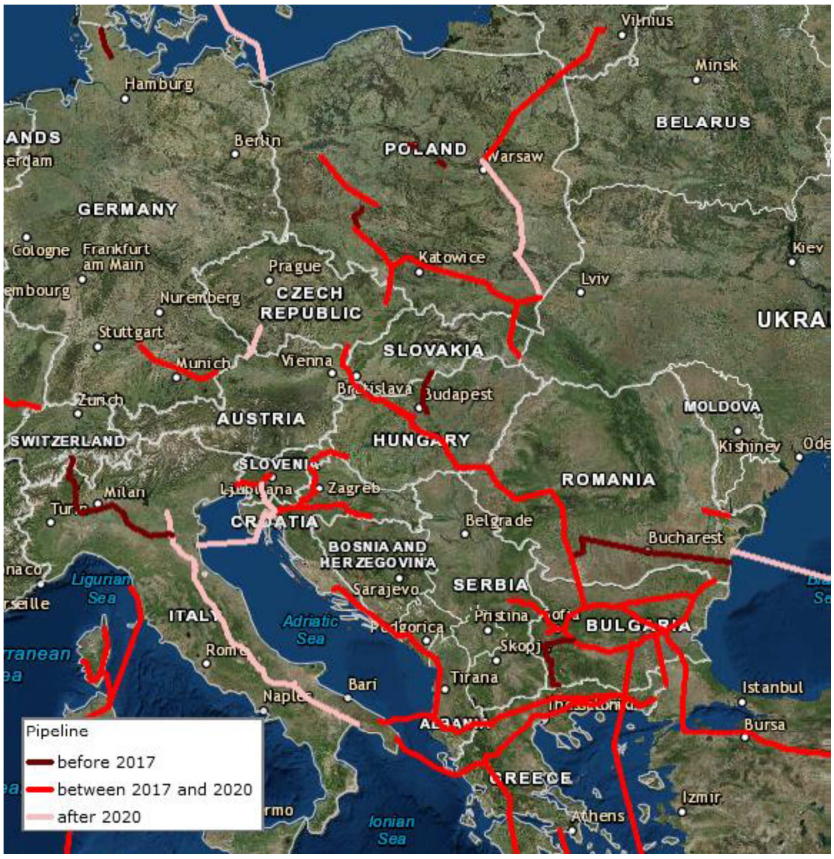
Gas infrastructure projects in Central Europe

The European Commission has identified that €70 billion in gas infrastructure investment will be required to improve gas energy security. This includes 53 gas pipeline and 23 other gas projects designated as Projects of Common Interest (PCI) by the European Commission.

PCIs are projects designated by the EU as essential for creating an integrated European energy market, increase competition and improve energy security by diversifying sources of supply. As priority projects, the PCIs have access to streamlined approval and permitting processes and may be eligible to access €5.35 billion in funding under the Connecting Europe Facility (CEF) to accelerate development of these projects.

There are 43 PCI projects planned in the Central European region alone with total length of new pipeline construction of over 7,600 km. significant projects are planned in Poland, Hungary, Bulgaria, Romania, Croatia and Greece.

Figure 10: Gas pipeline projects of common interest in Central Europe



Source: European Union 2016

Gas infrastructure maintenance

The main cause of gas pipeline failure incidents in Europe is due to third party interference with pipelines (28 %), with construction defects (16 %), corrosion (26 %) and ground movements (16 %) less frequent causes of failure.

The existing TSOs and distributors have an extensive existing pipeline network that needs to be maintained. Gaz-System in Poland and Net4Gas in the Czech Republic maintain 10,323 km and 3,800 km of high-pressure transmission networks respectively. The TSOs generally have in-house maintenance units to manage maintenance including corrosion surveillance and maintenance, telemetrics, technical diagnostics and measurement. Self-regulation by TSOs has been largely effective, however, increasing awareness of pipeline locations and adoption of new technology has capacity to improve the integrity of gas pipeline infrastructure.

Opportunities

The scale and diversity of gas infrastructure development across Central Europe offers opportunities across the project lifecycle from engineering design, supply of products and services to support the construction of pipelines, through to support and maintenance of new and existing pipelines. Specific areas of opportunity include:

- front end engineering and design
- subsea pipeline design and construction
- pipeline construction fault reduction
- gas treatment, processing, compression, storage and monitoring
- Pipeline integrity and repair – anti-corrosion maintenance and monitoring
- environmental and risk management, monitoring and evaluation
- LNG industry research, education and training
- education and training – geoscience, safety and offshore operations.

2.1.5.2 Electricity

As a part of its Energy Union for Europe package, EU adopted a 10% electricity interconnection target, which has become an essential part of the energy transition to a low-carbon economy. When it comes to the electricity grid, most of the political attention in Brussels so far has centred on the 10% interconnection goal. This means that each Member State must have interconnection capacity that is equal to at least a tenth of its installed electricity production capacity.

The European Commission's estimate that EUR 35 billion will be needed to reach the 10 % target by 2020 across all member states. The European Commission stressed that special attention must be given to projects that address the most significant gaps in the integrated EU electricity market and the lack of sufficient interconnectivity and considers that adequate EU financing should continue to be made available also beyond 2020 to support the construction of non-commercially viable electricity connection projects necessary to ensure the functioning of the internal energy market and security of the operation of electricity systems.

2.1.6 Smart Grids & Metering

The Third Energy Package requires member states of the EU to ensure implementation of intelligent metering systems. This implementation is conditional on a positive economic assessment of the long-term costs and benefits (CBAs) to be completed by 3 September 2012. For electricity, there is a target of rolling out at least 80% by 2020, of the positively assessed cases.

Furthermore, complementing the provisions of the Third Package, the Energy Efficiency Directive supports the development of energy services based on data from smart meters, demand response and dynamic prices. The Third Energy Package does not set a specific implementation target for smart metering in the gas sector, but it should be achieved in a 'reasonable period of time'. The results of cost-benefit analyses are as follows:

Electricity

- In Poland, the CBAs yielded positive results but official decisions on roll-out are still pending;
- In the Czech Republic and Slovakia, the CBAs for large-scale roll-out by 2020 were negative or inconclusive, but in Slovakia smart metering was found to be economically justified for particular groups of customers;
- In Hungary, the CBAs or roll-out plans are still not available.

Gas

- In the Czech Republic and Slovakia the results of the CBA were negative.

2.1.7 Trends & Opportunities

Microgrids

Microgrids are modern, localized, small-scale grids, contrary to the traditional, centralized electricity grid (macrogrid). Microgrids can disconnect from the centralized grid and operate autonomously, strengthen grid resilience and help mitigate grid disturbances. They are typically low-voltage AC grids, often use diesel generators, and are installed by the community they serve. Microgrids increasingly employ a mixture of different distributed energy resources, such as solar hybrid power systems, which reduce the amount of emitted carbon significantly.

Distributed energy resources (DER)

DER are smaller power sources that can be aggregated to provide power necessary to meet regular demand. As the electricity grid continues to modernize, DER such as storage and advanced renewable technologies can help facilitate the transition to a smarter grid. DER systems typically use renewable energy sources and increasingly play an important role for the electric power distribution system.

Energy-Prosumer

The utilities model is undergoing a paradigm shift these days. With the emergence of advanced, smarter technology, consumers can now make more informed choices about energy usage and become energy producers and storers themselves – known as "prosumers" - resulting in a two way directional flow of power.

And there are further opportunities. In future, the energy customers might proactively choose which energy source they want to consume and green, renewable sources might be supplying most or all of the energy needed for every purpose: lighting, heating, processes, and transportation. That would lead to a completely reliable electricity supply.

Advanced Metering Infrastructure (AMI)

AMIs are systems that measure, collect, and analyse energy usage, and communicate with metering devices such as electricity meters, gas meters, heat meters, and water meters, either on request or on a schedule. These systems include hardware, software, communications, consumer energy displays and controllers, customer associated systems, Meter Data Management (MDM) software, and supplier business systems.

Government agencies and utilities are turning toward advanced metering infrastructure (AMI) systems as part of larger "Smart Grid" initiatives. AMI extends current advanced meter reading (AMR) technology by providing two way meter communications, allowing commands to be sent toward the home for multiple purposes, including "time-of-use" pricing information, demand-response actions, or remote service disconnects. Wireless technologies are critical elements of the "Neighbourhood Area Network" (NAN), aggregating a mesh configuration of up to thousands of meters for back haul to the utility's IT headquarters.

Energy Storage Systems

Grid energy storage (also called large-scale energy storage) is a collection of methods used to store electrical energy on a large scale within an electrical power grid. Electrical energy is stored during times when production (especially from intermittent power plants such as renewable electricity sources such as wind power, tidal power, solar power) exceeds consumption, and returned to the grid when production falls below consumption.

By far the largest form of grid energy storage on grids is dammed hydroelectricity, with both conventional hydroelectric generation as well as pumped storage. There is research going on the possible use of electric vehicles to meet peak demand. A parked and plugged-in electric vehicle could sell the electricity from the battery during peak loads and charge either during night (at home) or during off-peak.

Electric vehicles

For utilities, transportation electrification presents numerous challenges. Business models for utilities providing charging services have yet to be worked out, and will depend on how actively a utility wants to participate in the market, on their technology infrastructure, and on whether they're in a regulated or deregulated market. Three approaches are: 1) the utility owns the EVSE; 2) the utility subsidizes EVSE; or 3) EVSE as an appliance.

Even low levels of electric vehicles adoption will have a significant impact on utilities and the grid—a single EV plugged into a fast charger can double a home's peak electricity demand. Consequently, it is crucial for utilities to manage EV charging. A smart grid is the key to "smart" EV charging, providing the visibility and control needed to protect components of the distribution network, such as transformers, from being overloaded by EVs and ensure electricity generating capacity is used most efficiently. With a smart grid, utilities can manage when and how EV charging occurs while adhering to customer preferences, collect EV-specific meter data, apply specific rates for EV charging, engage consumers with information on EV charging, and collect data for greenhouse gas abatement credits.

By planning now for EVs, utilities can maximize the utilization of their infrastructure, create closer relationships with customers, and leverage EVSE communications investments for other energy initiatives. Working closely with their Public Utility (or Service) Commissions (PUC/PSCs) and other regulatory bodies, utilities can develop expedited processes for EV-related infrastructure and establish rate structures that allow them to incentivize the adoption and use of EVs.

UltraHeat Pump

UltraHeat Pump is renewable energy technology capable of reusing urban waste heats including thermal wastewater of power plant as energy using the heat pump. UltraHeat pump can be a technology that can be applied in many ways in industrial fields.

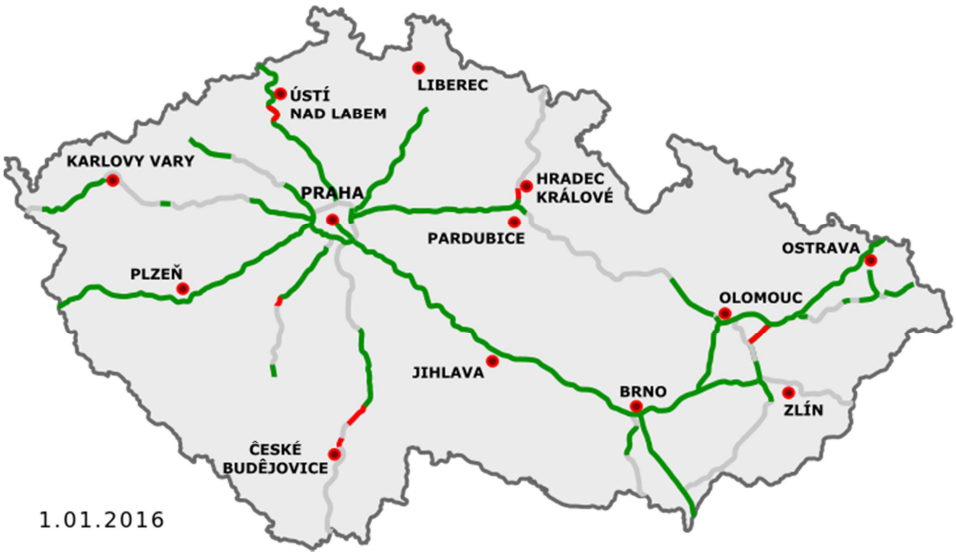
2.2 Analysis in the field of Infrastructure

2.2.1 Roads

2.2.1.1 Czech Republic

Motorways in the Czech Republic are managed by the state-owned Road and Motorway Directorate of the Czech Republic (RSD), established in 1997. At the moment, 1,242 km of highways is completed and operational, 67 km is under construction, while 743 km is in planning and/or preparation phase. According to the current plans, the entire Czech highway network should stretch at 2,052 km.

Figure 11: Map of Highways in the Czech Republic



Note: Green: completed; Red: under construction, Grey: planned

Source: RSD/Wikipedia

Toll System

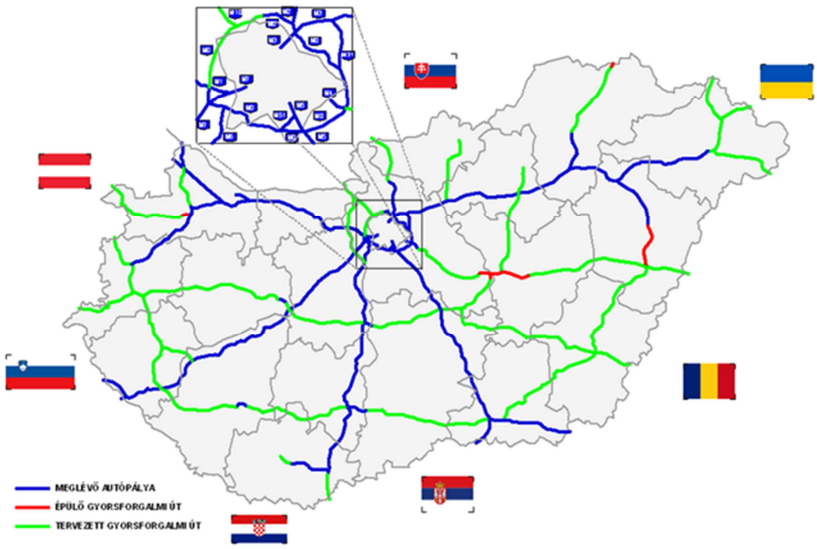
In January 2007, the Czech Republic's nationwide electronic toll collection system "MYTO CZ" was introduced for vehicles over 3.5 tons of weight. The system was build and is operated by Kapsch, whose 10-year contract terminates at the end of 2016. In August 2016, the Czech government prolonged the Kapsch's contract by another 3 years, although this step has been challenged by its competitors.

The Czech toll network is an open system, which enables tolling of moving vehicles in unimpeded driving conditions. This multi-lane free-flow system uses microwave antennas mounted on gantries above the highway which communicate with OBUs installed on the windscreen of passing trucks. The tolling process is fully automatic and requires no intervention on the part of the driver. Behind the scenes, a major IT facility deals with transactional, financial and billing data.

2.2.1.2 Hungary

According to the, the total length of the Hungarian motorway system was 1,480 kilometres in 2016. As of 2016, Hungary operates 1,600 km highways and motorways. The network is operated and maintained by state-controlled *Állami Autópályakezelő Zrt.* (State Motorway Management Plc.) The total planned length of the network is 2,970 km.

Figure 12: The map of Hungarian Highways



Note: Existing (blue), under-construction (red) and planned (green) highway-network of Hungary as of 2016
Source: Wikipedia

Toll System

In Hungary every motorway is a toll road, administered by the National Highway Authority (Á.A.K. Zrt.). The roads M0, M2 and M15, although divided multilane roads, are not considered as motorways, and can be used free of charge.

As of 1 July 2013, an electronic, distance-based toll system (DTS) has been introduced on a total of 6,500 km designated road sections of the Hungarian public road network (motorways, highways, main routes) for vehicles over 3.5 tons of weight.

2.2.1.3 Poland

Highways in Poland are public roads which are grouped into four categories related to the republic's administrative division. Motorways and expressways are part of the national road network. As of January 2016, there are 3,274 km of motorways and expressways in use. Currently, expressways are free of toll, however A1, A2 and A4 motorways are planned as tolled (some parts are already such). The payments from motorways are coming to the National Roads Fund.

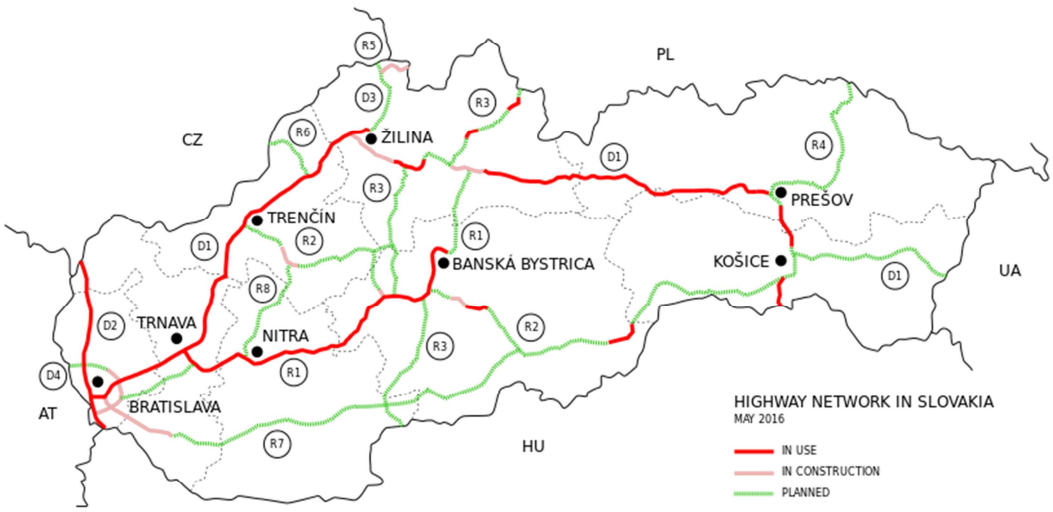
Figure 13: Map of Highway Network in Poland

Source: Wikipedia

2.2.1.4 Slovakia

Highways in Slovakia are divided into motorways and expressways. These are managed by the state-owned National Motorway Company of Slovakia (NDS), established in 2005. NDS is currently managing and maintaining 464 km of motorways and 258 km of expressways. The full network should consist of 704 km highways and 1,164 km of expressways.

Figure 14: Highway Map in Slovakia



Source: Wikipedia

Toll System

Beginning January 2010, Slovakia introduced on highways a toll system for vehicles over 3.5 tons of weight. The toll system applies to 17,738 km of roads, however only on 2,681 km toll is paid.

The system is owned by NDS and operated by SkyToll company. The use of highways by cars under 3.5 tons of weight is subject to use of a vignette. Vignettes are available in three different lengths of validity: 10 days, 1 month and 1 year.

Opportunities

- **Project financing.** Currently, the V4 countries finance its highways infrastructure projects predominantly by a combination of state budget money and EU funding. Beyond 2020 (2022), the EU funding is expected to be considerably lowered. The V4 governments are expected too for alternative sources of financing, such as PPP financing or debt financing for specific projects (bonds)
- **Toll systems.** Highway toll systems already introduced in Slovakia, Hungary and the Czech Republic with an outlook of implementation in Poland in near future. Potential for improvement (microwave/satellite technology) and extension (passenger cars, minor roads).
- **Maintenance contracts.** Maintenance of highways and main roads today mostly carried out by government controlled entities. A potential for cooperation of private and public sector.
- **Advanced telematics.** Equipment of V4 highways by advanced telematics systems that would enable for higher capacity and improved safety.

2.2.2 Railways

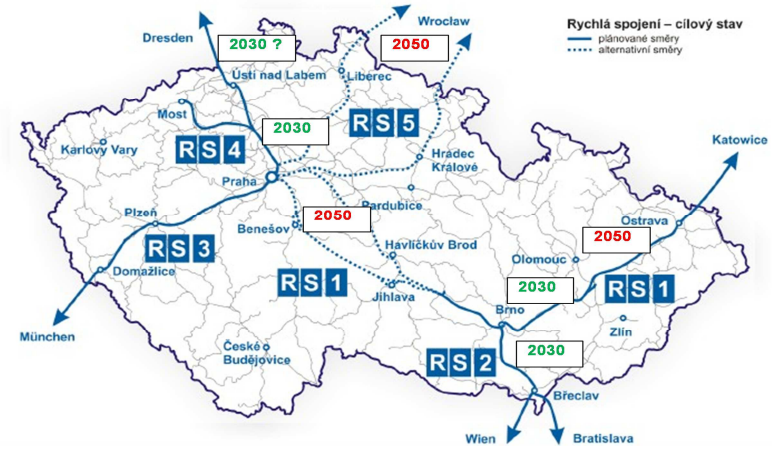
2.2.2.1 Czech Republic

The Czech railway network stretches along 9,600 km of mostly 1,435 mm gauge track, out of which 1,800 km is double track. Over 3,100 km of the network is electrified. The network is operated by SZDC, the entity fully controlled by the Czech government. During the last two decades, SZDC upgraded most of the major routes to 160 km/h speed.

The Czech Republic currently discusses the strategy of developing a high-speed network. The basic outline of the network was drafted a long time ago and currently, preparatory works are carried out. However, there is no master plan and clear timetable at place at the moment. The new HSR routes should be designed for speed 250 km/h or higher and Individual routes are prepared in cooperation with DB Netz AG (Germany) and ÖBB Infrastruktur AG (Austria). The main routes should be:

- RS1/RS2: Prague - Brno - Breclav (- Wien/Bratislava)
- RS3: Prague - Pilsen - Munich/Nuremberg
- RS4: Prague - Dresden (- Berlin)
- RS5: Prague - Wroclaw (- Warsaw)

Figure 15: Map of planned Czech High-speed Railway Network



Source: SŽDC

2.2.2.2 Hungary

Hungary operates a network of 7,200 km of 1,435 mm network of railways. Out of that 1,300 km is double track and 2,600 km is electrified. Almost the whole network is owned and operated by MAV, the entity controlled by the Hungarian government.

The maintenance and upgrades of the network have been largely neglected during the last 20 years, also due to financing of highway network extension and to this day, 120 - 160 km/h is the top speed for trains in Hungary. In the recent years, EU funds have become available to upgrade the network, especially tracks of the Trans-European Transport Networks and the works slowly start to move on. As a part of TEN-T network, Hungary plans a few cross-border projects:

Hungary – Serbia link

There are currently ongoing negotiations between two countries and China to build a 350 km long high-speed line between their capital cities Budapest and Belgrade, as a part of a larger corridor Budapest-Belgrade-Niš-Skopje-Thessaloniki-Athens. It is expected to upgrade current railway line Budapest-Belgrade to 200 km/h (some plans mention even 350 km/h).

The expenditure for the Hungarian section of the route (188 km) is estimated at EUR 1.8bn and 85 percent of the project is to be financed by a low interest Chinese loan. The Chinese party was supposed to draw up its financing proposal by 31 October 2016.

Romania – Hungary link

In November 2007, Hungary and Romania agreed to build a high-speed line between their capital cities Budapest and Bucharest which would be a part of a larger transportation corridor Paris-Vienna-Budapest-Bucharest-Constanţa. The link will be designed for speeds up to 300 km/h, but no technical details have been made public yet. In November 2014, hosting the China-South-East Europe Business Forum, the Romanian Prime Minister discussed the project with his Chinese partners, however, there is no clear schedule for the project yet.

At the moment, the railway from Bucharest to Constanța is designed for speeds of up to 160 km/h. The plan for a high-speed railway through Budapest-Arad-Sibiu-Brasov-Bucharest-Constanta was officially included in the revised TEN-T plan in October 2013 as part of the Rhine-Danube Corridor. Works are planned to be carried out between 2017 and 2025.

2.2.2.3 Slovakia

Slovakia operates about 3,600 km railway tracks mostly of 1,435 mm gauge. Double track network stretches at 1,000 km and 1,600 km of the network is electrified. The railway network is owned and operated by ZSR, the entity fully controlled by the Slovak government.

ZSR currently upgrades the backbone railway route Bratislava – Košice to 160 km/h speed. The project is divided into 2 parts: Bratislava – Žilina (203 km) and Žilina – Košice. The Bratislava - Žilina part is under construction and should be completed by 2020. The upgrade of the second part from Žilina to Košice (239 km) is in the planning phase. ZSR also plans to upgrade the Slovak part (about 70 km) of the Prague – Bratislava route to speed 200 km/h, the project is currently in the planning phase and ZSR plans to finance it predominantly from the EU sources. Currently, Slovakia has no approved master plan or a strategy of high-speed railway network.

The Slovak government contemplates an extension of broad gauge route from Košice to Bratislava and further to Vienna, linking it to Ukrainian and Russian railway network. In June 2015, the Slovak Railways and Russian Railways signed a Memorandum of Understanding on the project. To carry out the project a joint venture of Russian, Ukrainian, Slovak and Austrian railways with a seat in Vienna was established. The total costs of the project are estimated at €6 – 9 billion. Currently, a feasibility study was procured by the joint venture.

2.2.2.4 Poland

In Poland, there are 23,429 km of railways. The dominant part of the network is owned and managed by PKP SA, an entity fully controlled by the Polish state. While previously the Polish governments invested primarily in Poland's road network, from 2012 onwards they shifted their focus toward development of rail transport. The government hopes to link Poland's twelve largest cities by high-speed rail by 2020.

Figure 16: Plan Poland's High-Speed Railway Network

Source: Wikipedia

The high-speed rail service was launched in Poland in December 2014 with the introduction of 20 non-tilting Pendolino trainsets operating on 4 lines radiating from Warsaw. The state-owned PKP operator started passenger service trains operating at a speed 200 km/h on a 80 km stretch Olszamowice-Zawiercie (part of railway line called CMK, from Warsaw to Katowice/Kraków). PKP Intercity was initially using only nine sets a day to operate 23 EIP services from Warsaw to Gdynia, Kraków, Katowice, and Wrocław. Today most of the 20 units operate on the core Kraków – Warsaw – Gdańsk – Gdynia route.

In addition to the Central Rail Line from Warsaw to Kraków and Katowice, and from Warsaw to Wrocław, the Pendolinos also operate on the 350 km route from Warsaw to Gdańsk and Gdynia on the Baltic Sea. In 2011 - 2015 the Warsaw-Gdańsk-Gdynia route underwent a major upgrade worth USD 3 billion, partly funded by the European Investment Bank. The route allows for speeds up to 200 km/h.

High-speed network

PKP plans to develop high-speed rail in Poland. The plan is designed as a "Y" line that would connect Warsaw–Łódź–Kalisz. The line would split into two branches to Wrocław and Poznań. The geometric layout of the line was planned to permit speeds of 360 km/h. It was planned that construction begun around 2014 and would be completed by 2019. In April 2010, the tender for a feasibility study was awarded to a consortium led by Spanish company Ingenieria IDOM. The total cost of the line including construction and train sets were estimated at 6.9 bn EUR.

The "Y" line project was put on hold in 2011 due to insufficient funding. As of February 2016, the project is still a subject of public debate only. However the central hub of the "Y" line (the Łódź Fabryczna Underground Station) is almost completed.

2.2.3 Waterways & Ports

Poland is the only V4 country with a direct access to sea, with about 440 km of coastline. The main ports in Poland are Gdansk, Gdynia and Szczecin/Swinoujscie. Gdansk, the largest Polish port, is divided into two major parts, the Internal Port and the North Port. Visitors to Gdansk arrive at the modern terminal connected with the city centre by a network of public bus services. The Port of Gdynia can be easily accessed from the sea and offers an easy route into the city. The Port of Szczecin in north-west Poland is closely linked to the smaller Port of Swinoujscie.

Table 25: Overview of major Polish ports

Authority	City	Tons	Containers TEU	Passengers	Notes
Port of Gdańsk	Gdańsk	35,913,639	511,876	164,331	2015 data
Port of Gdynia	Gdynia	14,735,000	485,255	460,231	2012 data
Szczecin & Swinoujscie Seaports	Świnoujście/ Szczecin	19,215,900	42,542	930,022	

Source: Wikipedia

Czech Republic, Slovakia and Hungary are landlocked countries. Slovakia and Hungary are located on Danube river, which is the second-longest European river flowing through 10 countries from Germany and Austria through Slovakia, Hungary, Balkans and Ukraine into the Black Sea. Since the completion of the German Rhine–Main–Danube Canal in 1992, the river has been part of a trans-European waterway from Rotterdam on the North Sea to Sulina on the Black Sea, a distance of 3,500 km. In 1994, Danube was declared one of ten Pan-European transport corridors.

Danube Ports

Slovakia has two main river ports on Danube, Bratislava and Komarno. Both of them are operated by Slovenska plavba a pristavy. Bratislava port (1,431 ths sq metres) is suitable for general cargo, bulk cargo, liquid cargo, containers as well as Ro-Ro. Komarno port is smaller (643 ths sq meters) and compared to Bratislava, it is not equipped for liquid cargo neither for Ro-Ro.

Hungary has 7 ports at Danube river: Győr-Gönyű, Komárom, Budapest, Dunaújváros, Dunaföldvár, Baja and Mohács. The largest ports are Győr-Gönyű (1,100 ths sq metres) and Budapest (1,520 ths sq metres). Győr-Gönyű is operated by Györ-Gönyü Kikötö Zrt., Budapest port by MAHART-Szabadkikötö Zrt. Both of them are equipped for general cargo, bulk cargo, liquid cargo, containers as well as Ro-Ro.

The Czech Republic has, as a result of post WWI treaties, a right of a long-term access to a port in North Sea by Hamburg. The port is owned by the Czech government and is rather

undeveloped. The Czech government currently negotiates with the city of Hamburg on swapping the existing port location for a location closer to sea and develop the port anew.

2.2.4 Airports & Airways

2.2.4.1 Czech Republic

The main airport of the Czech Republic is Václav Havel Airport Prague, the international airport of Prague. With over 11 million passengers in 2014 and a plan of 13.5 million in 2017, it's the busiest airport in the new EU member states. It serves as a hub for Czech Airlines as well as a base for Travel Service including its subsidiary SmartWings. It is also a base for low-cost carriers Wizz Air and Ryanair. The airport is able to handle wide-body aircraft including the Airbus A380. The airport is fully owned by the Czech government.

As the capacity of the airport has been reaching its limit further development of the airport is being considered. Besides regular repairs of the existing runways, Prague Airport began the preparations for building a new runway. The construction with estimated costs of CZK 5 – 7 billion was scheduled to begin in 2007, and the new runway was to be put into service in 2010. However, because of plenty of legal problems and protests of people who live close to the airport premises, the construction has not yet begun.

The Czech Republic has a flagship carrier operated by the company Czech Airlines (CSA). CSA is the national airline of the Czech Republic and is based at the Prague airport. It operates scheduled, charter and cargo services and is a member of the SkyTeam alliance. As of 2016, CSA has three main shareholders, Korean Air (44%), Travel Service (34%) - private Czech airlines, and PRISKO (20%), an arm of the Czech government. CSA now accounts for 15% of all passengers of the Prague airport. CSA operates a fleet of 17 aircrafts (10 Airbuses and 7 ATRs) having ordered further 8 aircrafts. It flies to 43 destinations and carried 2 million passengers in 2015.

2.2.4.2 Slovakia

Bratislava Airport is the main international airport of Slovakia. The airport is owned and run by Letisko M. R. Štefánika – Airport Bratislava, a.s. (BTS), a fully-owned arm of the Slovak government. Bratislava Airport serves as a base for Ryanair, AirExplore, Go2Sky and Travel Service Slovakia. Two maintenance companies, Austrian Technik Bratislava and East Air Company are also based at the airport. The current runways enable the landing of virtually all types of aircraft used in the world today. The airport features two perpendicular runways, both of which underwent a complete reconstruction in the 1980s. In 2015, the airport served 1.56 million passengers (+15.4% y-o-y) and dispatched 21 thousand tonnes of cargo.

In November 2016, the Slovak government announced a plan to lease the airport for the alleged period of 30 years to a private operator. In 2015, the airport booked a loss of EUR 7.3 million and requires investments in the range of hundreds of millions of EUR.

2.2.4.3 Hungary

Hungary operates 5 international airports (Budapest, Debrecen, Gyor-Pér, Pécs-Pogány, Sármellek), with Budapest being the most important one. In 2015, the airport served 10.3 million passengers (+11.8% y-o-y). Budapest airport has three main terminals: 1, 2A and 2B, and a smaller one for general aviation flights. From the Budapest city centre, Terminal 1 can be reached by train directly and Terminal 2 is served by bus. The Budapest airport serves as a base for Ryanair and Wizz Air. It used to be the hub for Malév (a former Hungarian flag carrier) until the airline's bankruptcy in February 2012.

The owner and operator of the airport is Budapest Airport Ltd. As of July 2015, the ownership of the Budapest Airport is as follows: AviAlliance (52.666%) owned by PSP Investments,

Canada, Malton Investment (22.167%) owned by GIC Special Investments, Singapore, Caisse de depôt et placement de Québec, Canada (20.167%) and KfW IPEX-Bank, Germany (5%).

Until December 2012, 261 million euros was spent in order to expanding and modernising the airports infrastructure. Until 2020, the airport plans, together with private investors, projects worth EUR 300 million, including: New Airport Hotel *(spring 2017),* New pier for Terminal 2B *(2018)* and New Terminal 2C *(2020)*

2.2.4.4 Poland

In 2015, Polish airports with commercial passenger service served over 30 million passengers. The largest was Warsaw's Chopin airport with 11.2 million passengers, followed by Krakow airport (4.2 million), Gdansk (3.7 million) and Katowice (3.1 million). Warsaw Chopin handles just under 40% of the country's air passenger traffic, approximately 300 scheduled flights a day and an ever-rising number of charters.

The final and most recent developments in the airport's history came in the period covering 2010–2011, when the airport's new central and south piers were finished and opened along with a redesigned terminal complex which saw the airport's two terminals merged to form a single 'Terminal A' complex. Despite this, work continues on reconstructing taxiways, ramps and access roads, the most important projects of which will see the airport connected to Poland's expressway network. An underground railway station connected to Warsaw's suburban rail system was opened in June 2012.

The airport is managed by the State Enterprise Polish Airports (PPL), which is responsible for construction and operation of airports and provision of services to passengers and airlines. PPL is owned by the Polish Ministry of Infrastructure and Development.

LOT is the Polish flagship carrier and the member of Star Alliance. It operates a fleet of 43 aircrafts (Boeing, Embraer and Bomardier) with further 12 aircrafts to be delivered and options for another 11. It flies to 60 destinations in Europe, the Middle East, North America, and Asia. Most of the destinations originate from its hub, Warsaw Chopin Airport. In 2015, the airlines served 4.3 million passengers.

Currently, the Polish government owns 68 % of shares in LOT, Regionalny Fundusz Gospodarczy owns 25 % and company employees own 7 %. The government intended to privatise LOT in 2011 and although advanced talks were held with Turkish Airlines, the deal failed to materialise. This was largely due to the inability of Turkish Airlines, as a non-EU airline, to buy a majority of the airline.

LOT reported losses in every financial year in 2008 – 2012 and faced increasing liquidity problems. Previous restructuring attempts undertaken in 2009 - 2012 had not been successful. The financial difficulties culminated in December 2012 when LOT was forced to ask for rescue aid in order to avoid bankruptcy.

Company was provided a €100 million rescue loan and later also a €200 million capital increase. As a part of restructuring, the company cut costs, reduced capacity, withdrew from some profitable routes and returned several airport slots. In April 2015, LOT announced that it made a PLN 99.4 million profit on its core operations in 2014. It was the first profit on its core operations in seven years.

2.3 Analysis in the field of Science, Technology and R&D

2.3.1 Korea

Korea is committed to technology-based economic development and enjoys a national consensus on the importance of STI. It has high levels of R&D expenditure, a highly educated labour force, good and improving innovation framework conditions, large knowledge-intensive and internationally competitive firms, and a strong ICT infrastructure. Almost three-quarters of Korean R&D is performed by business, with 88% in manufacturing in 2010, second only to Germany; 48% was carried out in a single sector, Radio, television and communication equipment, by far the largest share among OECD countries. According to the Bloomberg Innovation Index 2016, Korea (index 91.31) is currently a global leader in innovations ahead of Germany (index 85.54), Sweden (index 85.21) and Japan (index 85.07).

Business enterprise expenditure on *R&D (BERD)* grew by 9.5% a year in real terms during the decade to 2010, rising from 1.70% of GDP in 2000 to 2.80% of GDP in 2010. The shares of public research funded by industry and of patents filed by universities and public labs per GDP are well above the OECD median. Levels of international collaboration are very low: just 26% of scientific articles are produced with international co-authorship, and only 4% of PCT patent applications were produced with international collaboration, the latter owing in part to Korea's conglomerate industrial structure which tends to retain technology development within the group.

Korea's gross domestic expenditure on R&D (GERD) was 3.74% of GDP in 2010 and has grown by a robust 9.3% a year over the past decade, and by 10% a year over the five years to 2010. In 2010, 72% of GERD was funded by industry, 27% by government and only 0.2% from abroad. Korea's 577 Initiative aims to increase GERD to 5% of GDP by 2012, nurture seven strategic technology areas, and become the world's seventh "S&T power". To meet these targets, the government has increased government expenditure on R&D and has used various tax incentives to encourage more private investment in R&D. In line with a decade-long trend, government support has continued to shift away from large firms towards SMEs.

Although Korea has relatively high public-sector expenditures on R&D, its universities and research publication outputs rank comparatively low by international standards. Its university research sector has only recently started to perform a larger share of public- sector R&D (policy mix figure) and still produces small numbers of PhDs in S&E. The research system is also heavily skewed towards thematic R&D which is largely applied and development-oriented (policy mix figure) with a focus on industrial technologies. There are signs of change, however: as part of the 557 Initiative, basic research increased to 35% of the total in 2012 and government support is placing greater emphasis on "high-risk, high-return" research.

The structure of BERD shows that R&D is mainly conducted by large manufacturing conglomerates. Small and young firms have contributed relatively little to innovation, though there are signs of improvement. Much government support to the business sector goes to SMEs.

Given the presence of Korea's home-grown global IT firms the ICT sector is exceptionally strong. The Telecommunication Technology Association plays an important role in ICT standardisation. Other ICT initiatives include a software bank for innovation in software ecology. Korea invests heavily in research infrastructures and has established the National S&T Information Service (NTIS), a centralised database on S&E human resources and S&T infrastructure, to better monitor these developments.

A draft of schemes aim to improve commercialisation and knowledge transfer from public sector research. These include the Technology Holding Company system, which promotes the establishment of venture businesses by universities and research institutes, as well as the Leaders

in Industry-University Programme (LINC) and the Brain Korea Programme (BK), both of which seek to improve industry-academia collaboration. In a more global perspective, the Intellectual Management Property Council manages overseas patent disputes, while various IPR-related laws were amended in 2011 to protect core national technologies.

Korean R&D has been relatively closed as few foreigners work in Korean labs. Several schemes have been launched to internationalise the Korean research system, including the CAMPUS Asia Programme and Global Korea Scholarships Programme, as well as adjustments in various laws to promote researcher mobility. The World Class University Project was launched in 2008 with funding of USD 143 million; its aim is to attract leading researchers to Korea. To encourage entrepreneurship, the Entrepreneurship Leading Universities Programme supports entrepreneurship education with block funding.

Korea has prioritised green innovation at the highest level. The Presidential Committee on Green Growth was established to address climate challenges through low-carbon green growth and the Global Green Growth Institute (GGGI) was launched in 2010 to conduct policy research. The 557 Initiative has earmarked USD 2.4 billion to invest in green technology.

Based on citation of Korean authors as well as statistics on patent registrations the strengths Korean R&D sector the following:

- materials science
- metals & alloys
- nanotechnology
- chemistry & chemical engineering
- nuclear energy and nuclear physics
- renewables, sustainable environment technologies
- power plant technologies,
- information and communication technologies, informačné a komunikačné technológie telecommunication, digital communication, audio & video technology
- IT, Big Data, Internet of things

Industry 4.0

With respect to Industry 4.0 initiative, the Korean government introduced a strategy called „Manufacturing Industry Innovation 3.0“ that was introduced in July 2014. The strategy aims for extension of use of modern technologies in industrial production and support in opening intelligent factories (plants). Joint investment of public and private sector in the total amount of EUR 750 million aim to build 10 000 new intelligent plants by 2020. The Ministry of Trade, Industry and Energy currently work on partial action plan for 13 key industrial segments including e.g. wearablles or modern health care.

2.3.2 V4 Overview

The European Union has also put in place significant support instruments aimed at research and innovation, for projects of different scope and areas of focus. Strategic research projects are funded by the European Fund for Strategic Investments (EFSI). Projects of excellent in science and industrial leadership are supported by Horizon 2020, EUs research and innovation programme of nearly 80 billion EUR, promoting the transfer of knowledge between European and national research programs.

Programme Horizon 2020

Horizon 2020 is the eighth framework programme funding research, technological development and innovation. The framework programme is implemented by the European Commission, the

executive body of the European Union. The framework programme's objective is to complete the European Research Area (ERA) by coordinating national research policies and pooling research funding in some areas to avoid duplication.

Horizon 2020 itself is seen as a policy instrument to implement other high-level policy initiatives of the European Union, such as Europe 2020 and Innovation Union. The programme runs from 2014–20 and provides an estimated €80 billion of funding, an increase of 23 per cent on the previous phase, 7th framework programme FP7. Horizon 2020 provides grants to research and innovation projects through open and competitive calls for proposals. Legal entities from any country are eligible to submit project proposals to these calls. Participation from outside the European Union is explicitly encouraged. Horizon 2020 is also implementing the European environmental research and innovation policy. The programme consists of three main research areas (pillars):

- **Excellent Science.** The pillar with a budget of €24 billion focuses on basic science. The European Research Council (ERC) delivers 13 billion euro to researchers and teams of researchers based on scientific excellence of the applications. This pillar funds future and emerging technologies, researcher mobility (Marie Sklodowska-Curie Action (MSCA)) and large European research infrastructures.
- **Industrial Leadership.** The pillar based on Europe 2020 and Innovation Union strategies has a budget of €14 billion. The pillar consists of six sub-programmes within "Leadership in Enabling and Industrial Technologies": Information and communication technologies, Nanotechnologies, Advanced materials, Advanced manufacturing and processing, Biotechnology, Space. This pillar contains special efforts to SME funding and gives also risk financing e.g. through loans of the European Investment Bank.
- **Societal challenges.** The third pillar of €31 billion funds potential solutions to social and economic problems, (SC), in the following seven sub-programmes: Health, Food, water, forestry, bioeconomy, Energy, Transport, Climate action, environment, resource efficiency, and raw materials, European society, Security. This pillar also funds themes names as "Science with and for society" and "Spreading excellence and widening participation".

The structure follows the previous framework programme to the level of the sub-programmes under the pillars. In the industrial pillar the goal is to find ways to modernize European industries that have suffered from a fragmented European market. In societal challenges the goal is implementation of solutions, less on technology development.

Overview of R&D spending in V4 countries

Table 26: R&D spending as a share on GDP

% GDP	2005	2010	2011	2012	2013	2014
Czech Republic	1.17 %	1.34 %	1.56 %	1.79 %	1.91 %	2.00 %
Slovakia	0.50 %	0.62 %	0.66 %	0.81 %	0.83 %	0.89 %
Hungary	0.93 %	1.15 %	1.20 %	1.27 %	1.40 %	1.37 %
Poland	0.57 %	0.72 %	0.75 %	0.88 %	0.87 %	0.94 %
European Union	1.75 %	1.93 %	1.97 %	2.01 %	2.03 %	2.03 %
Korea	2.63 %	3.47 %	3.74 %	4.03 %	4.15 %	4.29 %

Source: OECD

Industry 4.0

The study carried out by Roland Berger consultants brought up a metrics called RB Industry 4.0 Readiness Index, which is represented on the vertical axis of Figure 17. The horizontal axis represents the traditional industry measure – the manufacturing share. Korea as well as all 4 Visegrad countries strongly rely upon industry in their GDP generation mix.

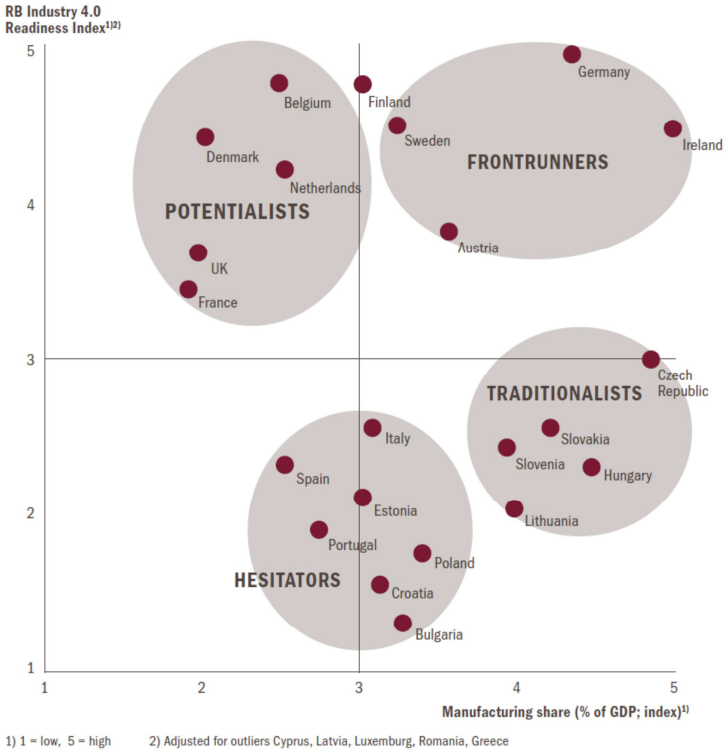
Table 27: Share of Industry on Country's GDP

	2010	2011	2012	2013	2014	2015
Czech Republic	36.8%	37.1%	37.0%	36.9%	38.0%	38.1%
Slovakia	35.2%	35.2%	35.6%	35.3%	33.0%	34.4%
Hungary	30.2%	30.1%	30.3%	30.1%	31.2%	
Poland	33.3%	34.0%	33.6%	32.3%	32.5%	33.5%
European Union	25.0%	25.0%	24.7%	24.4%	24.3%	24.4%
Korea	38.3%	38.4%	38.1%	38.4%	38.1%	38.0%

Source: OECD

Figure 17 roughly divides the European economies into four major groups. The Frontrunners are characterized by a large industrial base and very modern, forward-looking business conditions and technologies. The Traditionalists still thrive on their sound industrial base, but few of them have thus far launched initiatives to take industry into the next era. The Potentialists have an industrial base that has been weakening over the past few years. But in the corporate sector, we find indications of a modern and innovative mindset. They just have to find the right way to tap their potential. Hesitators lack a reliable industrial base. Many of them suffer from severe fiscal problems and are therefore not able to make their economies future-proof.

Figure 17: Industry 4.0 Readiness Index



Source: Roland Berger

Hungary, Slovakia and the Czech Republic belong to Traditionalists, while Poland is a Hesitator. With Smart Industry, V4 countries can propel their industries into the smart era, and reposition itself into the Frontrunners group, characterised by modern, forward-looking business conditions, technologies and innovative environment.

Cooperation in Science & Technology between V4 and Korea

The aim of the initiative is to develop cooperation in the field of science, technology and innovation by funding joint projects. The Memorandum of Understanding between research funding institutions was signed in December 2015. The signatories of the MoU are the following institutions:

- National Centre for Research and Development, Poland,

- Ministry of Education, Youth and Sports, Czech Republic,
- Slovak Academy of Sciences, Slovakia,
- National Office for Research, Development and Innovation of Hungary, Hungary,
- Ministry of Science, ICT and Future Planning Republic of Korea, Republic of Korea,
- International Visegrad Fund.

The first joint call for proposals is scheduled to be announced in IV quarter 2016.

2.3.2.1 Czech Republic

Overview of the current situation

Despite the economic crisis and major slowdown of economic growth, R&D intensity of the economy in terms of gross domestic expenditure on R&D (GERD) as % of GDP increased from the bottom 1.24% in 2008 to 2% in 2014. Since 2011, public funding has slightly dominated over private one, but mostly due the intensive use of the Structural Funds. Business and foreign R&D funding, including from the EU Structural Funds, grew rapidly over the recent years, while national public funding of R&D has been stagnating.

The Reform of the Research, Development and Innovation (RDI) System was launched in 2008. The main success area lies in the upgrading of research infrastructures, while the progress has been slow in promoting excellence, opening the research labour market, reforming the evaluation framework and getting ideas to market.

Key developments in the R&I system in 2015 included:

- The Section for Science, Research and Innovations section started operation at the Office of the Government.
- Technology Agency launched the EPSILON programme supporting applied research and experimental development in three priority areas of competitive knowledge-based economy, sustainability of energy and material resources and environment for quality of life, while Ministry of Trade and Industry approved the TRIO programme to support business R&I and public-private research collaboration in key enabling technologies
- The new Operational Programmes of the EU Structural Funds were launched
- Metodika 2013 guidelines for evaluation of public R&I support were extended until the end of 2016, while new guidelines are expected to be put in place in the period 2017 onwards.
- The IPN Metodika project proposed a new methodology for evaluation of research organizations and principles for allocation of institutional funding

The Czech R&I system is aligned with many ERA policies but it would benefit from larger extent of internationalisation. There are restrictions on access to and portability of grants as public funding agencies support almost exclusively resident researchers. Open access to both scientific publications and data for research purposes hinges on underdeveloped infrastructure and institutional framework.

In 2008, a comprehensible reform of the RDI system was launched refocusing the policy measures on innovation and private-public research linkages. Business investment in research and innovation is not only supported by direct subsidies anymore, which used to be the dominant policy measure but by much broader portfolio of instruments, including R&D tax credits, support programmers for joint public-private research projects or regional innovation voucher programmes. Nevertheless, RDI policies continue to be focused predominantly on the supply side and are rooted in the linear model of innovation.

Oveview of the current cooperation between Korea and the Czech Republic in R&D field

Many MoUs were signed between the CR and the Republic of Korea in the field of the Science & Technology and R & D cooperation. A great emphasis has been put on the Science & Technology and R & D cooperation.

National Research foundation of Korea (NRF) – Czech Science Foundation (GACR)

The Presidium of the Czech Science Foundation (GACR) has set the promotion and strengthening of international cooperation and supporting the better integration of Czech scientists into the world scientific community as one of the priorities of the GACR program. The main objective of the international cooperation is to establish bilateral research project schemes with foreign partner funding agencies, in order to enable the better exchange of scientific information and techniques and the use of specialized equipment available in the countries involved.

Centres of Excellence

Major R&D centres of excellence in the Czech Republic such as BIOCEV, CEITEC, UJV Rez (SUSEN Project), ELI-BEAMLINES, IT4INNOVATIONS, FNUSA-ICRC, CIIRC and others have been encouraged to cooperate with responding Korean counterparts of R&D Centres as follows

BIOCEV

BIOCEV (Biotechnology and Biomedicine Centre in Vestec) is an association of several institutes of the Academy of Sciences of the Czech Republic, the Faculty of Science and the First Faculty of Medicine of the Charles University in Prague. The Centre was opened in 2015 and was financed mostly by EU funds.

The centre focuses on detailed study of cellular mechanisms at the molecular level, research and development of novel therapeutic strategies, early diagnostics, biologically active agents including chemotherapeutics, protein engineering and other technologies with impact on the quality of life and development of knowledge economy and competitive capacity of the Czech Republic. The research is develops five programme areas: Functional Genomics, Cell Biology and Virology, Structural Biology and Protein Engineering, Biomaterials and Tissue Culture Engineering, and Development of Therapeutic and Diagnostic Strategies.

Current cooperation with Korea: Korea Research Institute of Bioscience and Biotechnology and BIOCEV

ELI-BEAMLINES (www.eli-beams.eu)

The Extreme Light Infrastructure (ELI) is a Research Infrastructure (RI) of pan-European interest and part of the European ESFRI Roadmap. It is a laser facility aiming to host the most intense Beamline system world-wide, develop new interdisciplinary research opportunities with light from these lasers and secondary radiation derived from them, and make them available to an international scientific user community. It's the world's biggest and first international user facility in beamline and laser research.

The facility is based on four sites. Three of them are presently being implemented in the Czech Republic, Hungary and Romania, with an investment volume exceeding €850 million, mostly stemming from the European Regional Development Fund (ERDF). In Dolní Břežany, near Prague, Czech Republic, the ELI-Beamlines facility will mainly focus on the development of short-pulse secondary sources of radiation and particles. The ELI Attosecond Light Pulse Source (ELI-ALPS) in Szeged, Hungary is establishing a unique facility which provides light sources within an extremely broad frequency range in the form of ultrashort pulses with high repetition rate. In Măgurele, Romania, the ELI Nuclear Physics (ELI-NP) facility will focus on laser-based nuclear physics. The location of ELI's fourth pillar, the highest-intensity pillar, is still to be

decided. Its laser power is expected to exceed that of the current ELI pillars by about one order of magnitude.

SUSEN (www.susen2020.cz)

The Sustainable Energy Project (SUSEN) is implemented as a regional R&D centre in Priority Axis 2 and its objective is to act as a relevant research partner for cooperation in the segment of application including the establishment of partnerships and cooperation with important European research centres. This so-called large-scale project, that is to be financed from EU funds (over EUR 50 million), is to be approved by the European Commission.

The centre's activity is based on four pillars: Technological experiments circuits (build up large-scale experimental facilities allowing research and development in the area of generation IV nuclear reactors and in the field of fusion reaction), Structural and system diagnostics (support of life-time extension of nuclear power plants of current G-II and G-III generations, support of construction and future service of reactors of G-IV generation and fusion reactors and investigation of highly irradiated materials), Nuclear fuel cycle (extend and build up a research infrastructure to support the back end of the nuclear fuel cycle) and Material research (build a unique workplace to support research in the field of structure and substructure of materials with regard to their degradation changes during exploitation in demanding conditions.)

Current cooperation with Korea: UJV Rez – KAERI (Korea Atomic Energy Research Institute)

IT4Innovations (www.it4i.cz)

IT4Innovations is the Czech National Supercomputer Centre that was estabilished in 2011 at the Vysoká Škola Báňská – Technical University Ostrava. It operates two supercomupters, so called small and big cluster. The small cluster has been in operation since May 2013. The second, final part of the supercomputer, so called big cluster, was commissioned in 2015, ranking itself among 100 biggest supercomputers globally.

Current cooperation with Korea: KISTI (Korea Institute of Science & Technology Information)

FNUSA – ICRC (http://www.fnusa-icrc.org**)**

The International Clinical Research Centre of St. Anne's University Hospital Brno (FNUSA-ICRC) is a new generation science and research centre focusing on finding new methods, technologies and medicaments for effective prevention, early diagnostics and individualized treatment of cardiovascular and neurological diseases.

The centre is located in Brno and collaborates with a number of foreign (Mayo Clinic, University College London, University of Minnesota etc.) and Czech (Masaryk University, Brno University of Technology, Academy of Sciences etc.) academic institutions and industrial companies. Currently, the Centre employs more than 400 poeple, including approximately 350 specialists working in 17 international research teams.

Current cooperation with Korea: FNUSA (ICRC) – KBRI (Korea Brain Research Institute), CVUT (CIRC) – SungKyunKwan University CIEE (Centre for Innovative Education).

CEITEC

CEITEC is a scientific centre specialising in life sciences, advanced materials and technologies whose aim is to establish itself as a recognized centre for basic as well as applied research. It is a consortium whose partners include the most prominent universities and research institutes in Brno The following participate in the setting up of the centre of excellence: *Masaryk University, Brno University of Technology, Mendel University in Brno, University of Veterinary and Pharmaceutical Sciences in Brno, Veterinary Research Institute* and *Institute of Physics of Materials of the Academy of Sciences of the Czech Republic.*

The research is divided 7 programmes: Advanced Nanotechnologies and Microtechnologies, Advanced Materials, Structural Biology, Genomics and Proteomics of Plant Systems, Molecular Medicine, Brain and Mind Research, Molecular Veterinary Medicine.

Current cooperation with Korea: KAIST (Korea Advanced Institute of Science and Technology); POSTECH (Pohang University of Science and Technology).

Further cooperation

MoUs between the above listed R&D Centres of both countries are desirable for the mutual benefits. A MoU on the cooperation in the field of Industry 4.0 between the Ministry of Industry and Trade of the CR and the Ministry of Industry, Trade and Energy of the ROK is desirable.

Korean and the Czech Republic intend to intensify cooperation research, development and innovation in industrial technologies with the main emphasis on support and development of innovative technologies, KETs, space applications and technologies, smart and green technologies as stated in the main areas of cooperation in the Memorandum of understanding between the Ministry of Trade, Industry and Energy of the Republic of Korea and the Ministry of Industry and Trade of the Czech Republic.

Furthermore, the Korea Institute for Advancement of Technology (KAIT) and Technology Agency of the Czech Republic (TACR) will aim at collaborating in technological areas such as green cars, automobile parts, nanotechnologies and biotechnologies, and so forth: and provide necessary support for bilateral R&D projects. Strategic cooperation will also include exchange of information, know-how and best practices regarding the support in applied research and innovation.

Industry 4.0

On 24 August 2016, the Czech government approved the Initiative Industry 4.0 prepared by the Czech Ministry of Industry and Trade, whose long-term aim is to maintain and strengthen the competitiveness of the Czech Republic. Although expected by the industry, the document is not an action plan.

Industry 4.0 represents a brand new challenge for organisation and management of applied research in the Czech Republic and will require a formulation of a complex national programme of applied research with enough room for small flexible projects.

Strengths of Czech Economy for Industry 4.0

- Developed industrial sector;
- Extensive manufacturing base of producers of standard robots and production automation;
- Experience with implementation and launching of production;
- Extensive production base of manufacturers of sensors and measuring appliances;
- Available infrastructure for basic and applied research in additive production;
- Quality research basis in the Academy of Sciences and a few universities faculties in the field of sensorics and big data analysis;
- Quality research in cybernetics, robotics and artificial intelligence at a few faculties of Technical Colleges;
- Quality research in computer aided vision and computer graphics, necessary for implementation of enhaced reality;
- Interconnection of research insitutions in additive production with application sector;
- Creation of innovative communication applications with an impact at global market;
- High-level (on par with global) of cloud services, respective know-how and sufficient amount of experts in the field of data warehousing and cloud calculations;

- A very good location and geoplitical stability of the Czech Republic for development of data centres.

Experienced teams of supercritical size can be found e.g. in following technological segments:

- Controlling systems and algorithms of automatic (autonomous) control
- Intelligent and industrial robotics, intelligent systems
- Special sensors (non-destructive ultrasonic testing, vibrations, radiation)
- Advanced systems of control system for propulsion (drives) in industry and e-mobility, generally also other technologies for e-mobility
- Systems of monitoring and diagnostics of machines, predictive maintenance, simulation tools
- HMI including interface of voice, heptic, including virtual reality systems
- Simulation and optimization methods
- Noise, vibrations, machinery dynamics
- Aeromechanics (flow)
- New materials (materials engineering), including nanomaterials
- Micro- and nanoelectronics, photonics, laser technologies
- Theory and practical application of system integration
- Industrial design

Opportunities

Additive production. The segment of additive production has been developed by several Czech companies in the last 15 years. The companies focus mostly on polymers processing, while the development of own 3D systems has taken place only in the recent years. However, the additive metal production technology have is still been rather neglected segment in comparison to Western European and American markets. The technology of additive metal production has been installed at two universities and several large enterprises. However, the number of installed machines is still low and the private sector is not very aware of the technology.

European Space Agency. A very strong tool for the development of new technologies with a primary use in is participation of the Czech Republic in optional programmes of European Space Agency. These programmes are focused on domains such as satellite navigation, satellite telecommunication, Earth observation, expandable launch systems etc. but also cross-sectional segments of development of new technologies, including those at the low level of technical readiness.

Sensors. There are several high-tech sensor manufacturers located in the Czech Republic. Te support of domestic high-tech sensors industry might be helpful not only for Industry 4.0 concept, but also the development of the segment itself and support of domestic producers.

National Centres. Planned National centres could incorporate and manage HW infrastructural platforms, that reuire high investments, so called Testbeds. They are actually small production lines or a few interconnected manufacturing machines that can be used for making experiments in automated control, diagnostics and predominantly system integration.

Creative industries/arts. The share of cultural creative industries is estimated at 5 - 7 % GDP and is starts to play an important role e.g. in the economy of Prague. It is still a very fragmented sector and a major share is made up by emerging small and medium enterprises. Digital humanities will become new focal points of research will such as the sector of extracting information from text sources and combined structured and non-structured data („text and

data mining“ including also more and developing corpus linguistics). Media (film, video, TV, radio, animation, games, intermedia, visual arts, light-design, photography, ads, publishing, digital platforms) will play an increasing role as well.

Energy sector. The systems of decentralised energy sector will be operated by the methods and principles of Industry 4.0 – in fact, it will be a decentralised system of relatively autonomous energy subsystems (islands).

2.3.2.2 Slovakia

Current situation overview

The Slovak gross expenditure on research and development (GERD) was €670 m (0.89% of GDP) in 2014 (+9.8% y-o-y). The 2014 National Reform Programme for the Slovak Republic set 2020 targets for GERD and the business expenditure on research and development (BERD) to 1.2% and 0.8% respectively. These targets are rather modest, but they seem realistic. There were some significant increases in business research spending since 2008 (albeit from a lower base).

Slovakia performs rather modestly in most publication indicators compared to the EU-28 average. This may have been triggered by insufficient funding and mechanisms for funding allocation. There is also little connection between the results of evaluation exercises and the allocation of institutional funding. However, the Accreditation Commission has implemented several noteworthy initiatives aimed at increasing excellence in science.

Despite the considerable efforts that have been made over the past few years, the Slovak research policies still lack a clear focus on the joint research agendas addressing grand challenges and joint programming. The amount of national funding appears to be still insufficient to integrate the Slovak science properly in European and international co-operation networks.

Overview of science and technology cooperation between Korea and Slovakia

The mutual cooperation between Korea and Slovakia has not developed very much so far, however new activities, especially in 2015 indicate a possible turnover. In the past there existed cooperation between the Slovak Academy of Sciences and KOSEF (Korea Stock Exchange Trade Fund) a KORANET (Korea scientific cooperation network with the European research area), the part of which was a successful project in the field of green technology, approved for financing. On 2 December 2015, a Memorandum of Understanding between the Slovak Academy of Sciences and Korean Institute of Material Science. Beginning 2016, based on the Agreement on Scientific and Technology Cooperation, the date of the first meeting of the joint commission for Science and Technology was set for October 2016. Simultaneously, a negotiation process of V4 countries and Korea is going on as a part of „Knowledge Sharing Programme“ and as a part of joint research programme that will include Slovak Academy of Sciences for Slovak part.

Previously, the cooperation developed along The Agreement of Scientific and Technical Cooperation between the governements of Slovakia and Korea, signed by the Ministers of Foreign Affairs on 25 November 2013 in Seoul. Earlier, the Memorandum of Understanding on Economic and Industrial Cooperation between the Ministry of Economy of the Slovak Republic and the Ministry of Knowledge Economy of Korean Republic, signed 22 April 2009 in Bratislava during the visit of the Korean Prime Minister Han Seung-Soo.

Scientific parks

CEPIT

CEPIT (Central European Park for Innovative Technologies) is a project of science, technology and industrial park in Bratislava. The parke, that should stretch across 630 000 square meters, should accommodate 23 000 people and focus on public and private research and educational facilities.

Eurovalley

Eurovalley is an industrial and technology park located in Malacky, 25 km off Bratislava. It focuses on research and development aims, manufacturing of high-tech products in software, electronics, microelectromechanics, medicine, food and biotechnologies.

Scientific Park of the Komensky University

Scientific Park of the Komensky University is a unit of Komensky University in Bratislava. The park was opened on 26 February 2016 and is focused on applied research and development, especially in domians of biomedicine, molecular biology, genomics, proteomics, system biology, genetics etc. The ecosystem of the scientific park enables for easeier cooperation with private sector.

Research Centre of Žilina University (www.vyskumnecentrum.sk)

Research Centre of Žilina University is a unique R&D unit of Zilina University, serving as a regional centre of applied research since 2013. Its primary aim is to establish environment supporting acceleration and integration of research and innovative activities of Zilina University departments, fast implementation and commercialising of R&D results. It focuses on research and development in three main segments: Monitoring and evaluation of quality of transport infrastructure, Progressive materials for construction of transport infrastructure and building of vehicles and Design, construction and controlling of intelligent building and renewable energy.

Industry 4.0

In 2016 Slovakia introduced the Concept of Smart Industry for Slovakia, a policy paper that evolved from intense collaboration of the Ministry of Economy of the Slovak Republic with industry representatives, with the goal to introduce the principles of Smart Industry not only to stakeholders from business sector but also to the general public. The Concept identifies the main areas, which should be analysed in order to formulate an Action Plan implementing the Industry 4.0 concept.

For the needs of implementation of new technologies and measures to strengthen R&D, the Concept recommends effective coordination of financing mechanisms that will enable shorter development timelines and faster deployment using state budget and Structural funds (ESIF) in line with RIS3. Particularly important are measures that will match public financing with private investments (PPP) and facilitate access to financial instruments, which are available at national and EU level in support of innovation, research and SMEs. A possible option for financing is innovation is through innovative public procurement, innovative partnership and implementation of large-scale pilot projects in energy, transport, health care and cities.

2.3.2.3 Hungary

Current situation overview

The Hungarian R&I system is characterised by relatively low R&D intensity in both the public and private sectors. In 2013, the gross R&D expenditure (GERD) was €1.4 bn (1.41% of GDP) and BERD was €983 million (0.98% of GDP). The share of R&D funding from abroad continues to be significant (16.6% of GERD in 2013). The share of EU funding is still only around 4% of GERD. However, the amount that the country received annually from the 7th

Research Framework Programme (ca. €40m) is around one third (27%) of the annual budget of the two main national sources of competitive project funding (i.e., Research and Technological Innovation Fund (KTIA), and Hungarian Scientific Research Fund (OTKA), with a total annual budget of €120 m and €26m respectively). This shows the key role that EU funding has in the national public R&D funding. According to the outlook, GERD should increase to 1.8% of Hungarian GDP in 2016.

Concerning BERD in Hungary, the pharmaceutical industry has traditionally been the engine of R&D expenditure realizing the highest amount of R&D expenditure in 2012 (around €214 million). The long-term, steady upward trend in R&D dynamics is related to pharmaceutics (globally the most competitive among Hungary's highly productive industries), followed by ICT and vehicle manufacturing.

Overview of scientific and technological cooperation between Hungary and Republic of Korea

Hungary and the Republic of Korea signed an Agreement on Scientific and Technological Cooperation in 1989, right after the establishment of diplomatic relations. As a result of this Agreement, a Scientific & Technology Joint Committee was established. The meetings of the Committee are usually organized regularly in every second year. In addition to this Agreement, the common research projects are supported within the framework of two-year working programs.

In March 1992, the Hungarian-Korean Technical Cooperation Centre (HKTCC) was established, residing at the Budapest University of Technology and Economics. In 1993, a Foundation came into existence with the aim of support of the Cooperation Centre (www.hktcc.bme.hu). From the Hungarian side members of the advisory board are: Ministry of Education and Culture, Ministry of Economy and Transport and Budapest University of Technology and Economics, from the Korean side the members are: Ministry of Science and Technology (MOST), Korea Institute of Materials Science (KIMS) and the Korea Foundation for International Cooperation of Science and Technology (KICOS).

The Hungarian-Korean Technical Cooperation Centre is not engaged in individual research activities, however, it organizes science-political conferences and programs about different scientific topics, where besides the Hungarian and Korean participants, researchers and experts from Central and Eastern European countries are to be invited.

Another important task of the Centre is the so called "match-making" searching for participants to carry out common future science projects. Due to the intensive activities in this field a large number of academic and university research institutes established South Korean relations. The Korea Research Council for Industrial Science & Technology and the Hungarian Academy of Sciences (MTA) operate 5 joint research centres in Budapest.

Korean-Hungarian Joint Laboratory Programme

The purpose of the programme is to activate science and technology cooperation between Korea and Hungary through research exchanges and joint lab operation between the National Research Council of Science & Technology (NST) and research institutes under the umbrella of Hungarian Academy of Sciences. It aims to ensure the window for Korea-Hungary science and technology cooperation and the base for science and technology cooperation with neighboring Eastern European countries. Joint research supports the fields that would bring the maximum synergistic effect through joint-lab establishment in Budapest and research cooperation with Hungary.

The Korea Research Foundation (KRF) - The Hungarian Scientific Research Fund (OTKA)

Brief information: KRF and OKTA facilitate and promote contacts between institutes and scientists under the auspices of the parties with the aim of identifying research topics of common interest which would lead to establishing and implementing joint research projects.

Opportunities of the Hungarian RDI system

- high-quality higher education with established knowledge centres;
- increasing focus on natural science and engineering education, expansion of practice-oriented training (dual training) and reinforced innovation management education and entrepreneurship training;
- increasing economic role of networking, cooperation and innovation clusters as well as spreading of incubator services;
- closer cooperation between academia and the business sector;
- strengthening excellence in public research and education as well as development of centres of excellence that take part in world-class research projects;
- integrated research and innovation funding system that supports smart specialisation and avoids double financing.

2.3.2.4 Poland

Overview of the context

The Polish research and innovation (R&I) system has been significantly restructured since its 2010 -2011 reform, but those changes have not yet triggered significant changes to output indicators. Poland scores poorly in the EU's 2015 Innovation Union Scoreboard ranking as moderate innovator and lags in the Research Excellence indicator.

GERD as percentage of GDP in 2014 was 0.94%, which remained well below the target of 1.70%, set for 2020, but it is steadily increasing every year. The R&D funded by the business sector amounted in 2014 to 0.44% of GDP (EU-28: 1.3% in 2014) and the business expenditures on R&D have gradually increased in recent years (2010-2014). Public expenditures on R&D remain the main source of funding (47.4% of GERD in 2014). The European Structural Funds are an important source of funding for R&D as well as Innovation activities, altogether the R&D funding from abroad accounted for 13.4% of GERD in 2014. GERD and BERD show a steady increase, and meeting the long-term targets is likely, especially with the substantial R&I allocations based on the 2014-2020 EU Structural Funds (13.2% of the total amount, i.e. €10.1 billion over seven years). Share of public R&D funding distributed as grants (project funding) was 65% in 2014.

Bilateral Korean-Polish Projects

KORANET & Polish Academy of Science (PAS)

KORANET (Korean scientific cooperation network with the European Research Area) aimed at intensifying and strengthening science & technology cooperation between Korea and Europe. The project was funded under the 7th EU Research Framework Program and runs from January 2009 until December 2012. Polish Academy of Sciences was among eleven partners from nine European countries and Korea which form the KORANET consortium.

Science parks

Poznan Science and Technology Park

Poznan Science and Technology Park (PSTP), founded in 1995, is the first Science and Technology Park of its kind in Poland. It is located in the north district of Poznań (Wielkopolska region), Naramowice. A non-profit managed by the Adam Mickiewicz University Foundation, it supports science and industry by conducting research, offering technological consultations, training small and medium-sized enterprises, and offering guidance on technology transfer and international co-operation. PSTP focuses on incubation of start-ups and technology companies, support and promotion of innovation and innovative companies, co-operation of science and business, research on new technologies and their improvement, conversion of scientific results into technological innovations and participation in the economic development of the region by encouraging entrepreneurs.

Wrocławski Technology Park

Wrocławski Technology Park was established in 1998 as a result of agreement between local governments, regional government, universities, private institutions and banks. One of the initiatives of WPK is Dolnoslasky incubator (DAIP). Its aim is to create suitable infrastructure and conditions for innovations. Support and help with creation, development and support of entrepreneurship using modern technologies, especially for SMEs. Helps to transfer new technologies, commercialise research outcomes WTP focus on research and development in biotechnologies and technical sciences. It operates Laboratory of vacuum technology, Laboratory of biotechnology methods and prototypes, Laboratory of manufacturing and diagnostics of electric circuits and printed circuit boards.

Challenges in Polish R & D and how to tackle them

1. Low intensity of private R&I

Poland has been gradually increasing the business expenditures on R&D as a result of the catching-up process with its Western European counterparts (0.18% of GDP in 2010 to 0.44% in 2014, more than double in nominal terms). Yet, it continues lagging behind most EU countries, also when compared with its neighbours (1.12% of GDP in CZ and 0.98% in HU in 2014).

<u>Policy measures</u>

The Enterprise Development Programme for the years 2014 - 2020, adopted in 2014 and implementing the high-level Strategy 'Dynamic Poland' contains a comprehensive list of planned measures to support the development of innovation and entrepreneurship including tax incentives for R&D. The national smart specialisation strategy is an integral part of the document.

The science and higher education reforms from 2010 - 2011 established the operations of two executive funding agencies for basic research and applied research. The National Centre for Research and Development leverages business R&D spending by introducing multiple grant programmes as public-private partnerships (e.g. BRIdge, CuBR). The principle is also used for sectoral programmes financed from the Structural Funds 2014 - 2020 (e.g. INNOMED or INNOLOT). In 2014, the average private co-funding from business enterprises in all programmes funded by NCBiR amounted to 23%. The NCBiR requests its beneficiaries to adequately report their own financial contributions in order to better account for the BERD.

The Polish Agency for Enterprise Development offers innovation vouchers stimulating collaboration between SMEs and research institutions (in 2002 - 2012, a total of €7.3m was distributed among over 2 000 entities). The allocations per voucher were subsequently enlarged and are offered also in the current programming period. In parallel, similar instruments are also

offered by some of the regions. Overall, the programming of the EU Structural Funds for 2014 - 2020 in Poland was guided by an explicitly stated shift in focus from financing technology absorption to technology development with several measures focused on launching new services and products (e.g. PARP-managed Research for the market and NCBIR-managed DEMONSTRATOR+ or Applied projects).

2. Weak cooperation between science and industry

The weak linkages between business sector and academia continue to be a challenge for the young Polish R&I system and were subject of Country Specific Recommendations in 2011 and 2013. The bulk of business expenditures in the last years was on technology absorption (that was supported both by the system of tax incentives, which included the tax relief for technology acquisition, and by the EU Structural Funds in 2007 - 2013). On the supply side, the academia still lacks sufficient skills in R&D commercialisation and until recently was not incentivised to look for new sources of financing, since the share of institutional funding was very high and commercialization of R&D results is still not part of the formal career evaluation of individual researchers.

3. Low quality of the public research base

Poland ranks low among research performers in the European Union, as evidenced by the score in the Research Excellence Output Indicator of the EU Innovation Union Scoreboard.

4. Attracting R&D focused FDI and creating knowledge spill-overs from FDIs

The FDI policies of the Central and Eastern European countries were focused on FDI inflows with the main aim of generating employment in less economically developed regions. Yet, this focus on cost competitiveness attracted mostly low to mid-low technology and required a relatively low-skilled labour force. As a result, even though Poland experiences a constant influx of foreign direct investments, being one of the most attractive FDI locations in the EU, its main strength still lays in relatively cheap labour. Yet, the character of the largest FDIs in Poland gradually evolves towards knowledge-based activities (the amount of R&D expenditures by FDIs more than doubled from 2009 to 2013, growing from €301 million to €694 million according to the national statistical office).

Expected policy response

In 2014, the government amended the rules for the "Programme for the support of investments of considerable importance for Polish economy for years 2011 - 2020", which supports FDIs and will be oriented towards R&D-type investments, with specific funding allocated by the Ministry of Economy. The amendments include incentives for R&D investments, and investors from priority sectors (automotive, electronics, aviation, biotechnology, business services sector). The government agency dealing with foreign investments, PAIZ, treats R&D investments as a priority, with focused efforts of PAIZ specialists interacting with potential investors. The National Centre for Research and Development cooperates with foreign VCs, co-funding the establishment of a dedicated fund to support the commercialization of R&D-based companies.

2.4 Analysis in the field of Culture

Culture is often (and simplistically) perceived by foreign public as a synonym of the country. Image of some countries are inextricably linked with their distinctive cultural aspects (particular personalities or historical context). If the perception is positive, culture may be the key and very effective tool in presenting the country abroad. The cooperation between V4 and RoK can thus be significantly strengthened even if only cultural perception of both parties improves.

The culture of the country is also an asset that can be sold or borrowed abroad. Resulting transactions can be profitable. The instruments of cultural diplomacy can develop into a major motivation of investment projects, development of tourism, implementation of bilateral exchanges and signing of contracts.

Opportunities for cooperation in the field of culture will be therefore examined in next chapters.

2.4.1 Film industry

2.4.1.1 RoK

Table 28: Key facts

Indicator	Value
Population 2015[e]	50.6 million
GDP per capita 2015[e]	27,512.9 USD
Gross box office 2015[e]	1,590 bn KRW (1.37 bn USD)
Admissions 2015[e]	217.3 million
Average ticket price 2015[e]	7,318 KRW (6.3 USD)
Average admissions per capita 2015[e]	4.3
Screens 2014/2015	2,381/2,492
Digital screens 2014/2015	2,381/2,492
Digital 3D screens 2014/2015	876/-
Share national/others films produced	52.2/47.8 %
Number of RoK feature films produced 2011-2015	186/204/207/248/269
Admissions 2011-2015 (million)	159.8/194.9/213.3/215.1/217.3
Gross box office 2011-2015 (KRW billion)	1,236/1,455/1,551/1,659/1,590

Source: EAO
Note: e - expected

RoK has relatively strong film industry, which has been able to achieve international acclaim and recognition. In the early 2000s, the South Korean entertainment industry, including films, experienced slight crisis. But, as the years went on, the sector grew steadily, experiencing unprecedented levels in sales and developing an audience base all around the world. Today, RoK has a reputation as a leading innovator in both technology and creativity. Aside from top technology brands like Samsung and LG, the country has successfully exported K-Pop and K-drama to large number of households internationally. RoK can also be considered as a leader in demonstrating how the relationship can exist between traditional cinemas and online day and date releases as the Korean film industry has experienced a rapidly growing digital online market, with IPTV and VOD. (*Source: https://www.filmdoo.com/blog/2016/04/14/the-success-of-the-south-korean-film-industry-creating-a-synergy-between-cinema-and-vod/*)

Regarding particular numbers, 269 domestic films were produced in 2015 in RoK (21 more than in 2014), amounting to almost twice the figure in 2009 according to EAO reports.

Korean gross box office dropped (by 4.1 % on 2014) for first time since 2008, down to KRW 1,590 billion. In turn, admissions increased, yet just 1 % year on year (217.3 million in 2015), confirming the consolidation of theatrical market after the hike at the beginning of the decade. The market share by admissions for domestic films went up to 52 %, an improvement on last year but far from recent milestones. Korean actioncrime comedy Veteran topped the box office list, followed by another local production, Assassination. In total, 10 local titles made it into the top 20 box office list of the year; the remainder being mainly Hollywood blockbusters. RoK has always had a remarkable box office concentration at the top – in 2015, the 20 highest-growing films generated 57.1 % of the admissions.

2015 saw the signature of bilateral co-production agreements with China and India. (*Source: EAO*)

Table 29: Top 20 films by admissions in RoK, 2015

	Original title	Country of origin	Admissions
1	**Veteran**	**RoK**	**13,414,009**
2	**Assassination**	**RoK**	**12,705,700**
3	Avengers: Age of Ultron	US	10,494,499
4	**Ode to My Father**	**RoK**	**8,911,437**
5	**Inside Men**	**RoK**	**7,213,317**
6	**The Throne**	**RoK**	**6,246,851**
7	Kingsman: The Secret Service	GB inc/US	6,129,681
8	Mission: Impossible – Rogue Nation	US/CN/HK	6,126,488
9	**Northern Limit Line**	**RoK**	**6,043,784**
10	Jurassic World	US/CN	5,546,792
11	**The Priests**	**RoK**	**5,442,144**
12	**The Himalayas**	**RoK**	**5,128,397**
13	Inside Out	US	4,969,735
14	The Martian	US/GB	4,880,800
15	**Detective K: Secret of the Lost Island**	**RoK**	**3,872,015**
16	Mad Max: Fury Road	AU inc/US	3,842,441
17	The Intern	US	3,610,564
18	Furious Seven	US/JP/CN	3,247,955
19	Terminator Genisys	US	3,240,370
20	**Twenty**	**RoK**	**3,044,134**

Source: EAO

Korean films are supported and promoted by KOFIC – Korean Film Council, which was established in 1973. KOFIC provides Korean filmmakers with diverse form of support. Moreover, KOFIC offers up to 25% cash rebate on foreign audio-visual works production expenditures incurred for goods and services in Korea. The grant amount shall be determined by taking into account the remaining grant program budget on the date of the application. Feature films, television series and documentaries produced by a foreign production company, in which the allocation of foreign capital in the production cost exceeds 80 % may apply. Eligible works must satisfy the following requirements:

- 25% cash rebate: Shoot no less than 10 days and spend no less than 2 billion KRW (approx. 2 million USD) in Korea
- 20% cash rebate: Shoot no less than 3 days and spend 100 million ~2 billion KRW (approx. 100K~2million USD) in Korea

The film must receive approval from the Review Committee who will evaluate the following three elements:

- the degree to which the work promotes tourism;
- the degree to which the work contributes to the Korean film industry;
- the extent to which the foreign producer participates in the production of the work. (*Source: KOFIC*)

2.4.1.2 Poland

Table 30: Key facts

Indicator	Value
Population 2015[e]	38 million
GDP per capita 2015[e]	12,662 USD
Gross box office 2015	822.9 million PLN (218.3 million USD)
Admissions 2015	44.7 million
Average ticket price 2015	18.4 PLN (4.9 USD)
Average admissions per capita 2015	1.2
Screens 2014/2015	1,256/1,256
Digital screens 2014/2015	986/1,074
Digital 3D screens 2014/2015	670/680
Film produced 2014/2015	46/49
Share national/others films produced	18.7/81.3 %

Source: EAO
Note: e - expected

The Polish film industry has continued to strengthen in the past year, both artistically and commercially, building on a decade of growth. A total of 49 Polish, including four minority co-productions, were produced in 2015, three films more than in 2014. The average budget of local production amounted to PLN 4 – 4.5 million (USD 1.4 million).

According to EAO, the renewed strength of Polish cinema is largely due to work of the Polish institute, the country´s national film funding body, which celebrated its 10th anniversary in 2015. The PISF provided about PLN 102 million (USD 33.8 million) in production support in 2015 making it the largest source of funding with additional funds coming from a network of 13 regional funds, television and private resources. It recently introduced a new funding option for Polish minority co-productions of up to EUR 0.5 million per project and is one of the partners of the new Polish-German Film Fund (budget of EUR 0.3 million).

2015 also turned out to be another strong year for the Polish film industry as Pawel Pawlikowski´s drama Ida won the Oscar as the Best Foreign Language Film and Polish box office reached record levels: admissions continued to grow by an impressive 10.5 % to 44.7 million, the highest level in the past 25 years. Thanks to a slight increase in ticket prices gross box office even jumped 13 % to PLN 823 million.

In contrast to 2014 box office growth was driven by US blockbusters rather than local films. A total nine US studio films ranked in the top 10 films of the year and drove US market share to jump to 64.6 %, up to 15 % percentage points from 2014.

The second instalment of local romantic comedy Listy do M (Letters to Santa) became Poland´s most successful film in 2015. It was the only Polish film to rank among the top 10, compared to six films in 2014. Admissions to national films decreased from the 2014 record level of 11 million to 8.3 million and national market share plunged accordingly from 27.5 % to 18.7 %. (*Source: EAO*)

Table 31: Top 10 films by admissions, 2015

	Original title	Country of origin	Admissions
1	Listy do M 2 (Letters to Santa 2)	PL	2,874,420
2	Star Wars: The Force Awakens	US	2,058,857
3	Fifty Shades of Grey	US	1,814,116
4	Spectre	GB inc/US	1,750,671
5	The Minions	US	1,669,881
6	The Pinguins of Madagascar	US	1,634,542
7	Hotel Transylvania 2	US	1,154,354
8	Fast&Furious 7	US/JP/CN	995,199
9	Inside Out	US	952,617
10	The Hobbit: The Battle of Five Armies	US/NZ inc	950,232

Source: EAO

2.4.1.3 Czech Republic

Table 32: Key facts

Indicator	Value
Population 2015[e]	10.5 million
GDP per capita 2015[e]	17,330 USD
Gross box office 2015	67.9 million USD
Admissions 2015	13 million
Average ticket price 2015	5.2 USD
Average admissions per capita 2015	1.2
Screens 2015[e]	689
Digital screens 2015	467
Digital 3D screens 2015	280
Film produced 2015	56
National market shares 2015[e]	18.4 %

Source: EAO
Note: e – expected

Czech film industry has long tradition and may offer experienced professionals as well as quality infrastructure.

In 2015, Czech cinemas introduced 262 premieres, out of which a total of 51 first-run films were domestic productions - 24 feature films (31 in 2014), 18 documentaries (24 in 2014) and 5 animations, which was decrease compared to 2014. The cinemas were attended by 12,958 million spectators, the second highest attendance since 1989. In comparison with the previous year it was by 1.4 million spectators more and means approximately 12 % increase. Gross box office reached record sales of 1,669 billion CZK (14 % more than in 2014), although the average ticket price increased by less than 2 % compared with the previous year.

The results of 2015 attendance prime minister, however, disrupted the tradition of interest in Czech film production – for the first time no Czech film ranked among the 10 most popular films. The biggest success was recorded by the film *Life is life*, which ended up in 12th rank with 258,000 admissions. Total admissions to Czech movies achieved 2.3 million in 2015 and gross box office amounted to 282.8 million CZK. Compared to 2014, this meant a decline in the share of domestic production from 23.8 % to 18.4 % and it was the first time since 2002, when the share of Czech films dropped under 20 %. (*Source: APA*)

Important part of the film infrastructure in the CR is formed by Barrandov studio. The most recent investment in Barrandov was made in 2006.

Table 33: Top 10 films by admissions, 2015

	Original title	Country of origin	Admissions
1	Minions	US	830,984
2	Fifty Shades of Grey	US	557,291
3	Star Wars: Episode VII – The Force…	US	478,261
4	Spectre	GB inc/US	420,420
5	Hotel Transylvania 2	US	344,981
6	Jurassic World	US/CN	344,871
7	Avengers: Age of Ultron	US	338,170
8	Furious Seven	US/JP/CN	309,864
9	Inside Out	US	294,883
10	The Martian	US/GB	289,146

Source: EAO

The film industry in the CR is supported by the Cinematography Fund, which administrates also the FISP (Film Industry Support Programme) with a maximum annual spend of CZK 800 million. FISP was designed to create a legal and financial framework to facilitate the creation of film co-productions in the Czech Republic. Within this, it was intended that productions would come both from the wider European industry and from third countries, in particular the United States. By introducing the incentive, the Czech government also aimed to support Czech film culture both domestically and internationally. While the Czech film industry has historically been

very strong at a national level, this has not always translated to export success, but it was hoped that with additional funding further export sales might also be achieved.

In many ways, the introduction of FISP can be seen as a response to the 2004 introduction of the Hungarian indirect rebate system (described below), which had led a greater number of inward investment productions to shoot in Hungary rather than the Czech Republic.

The incentive is structured as a cash rebate on qualifying spend in the Czech Republic, valued at 20 %; a 10 % incentive is available for non-resident cast and crew who, nonetheless, pay withholding tax in the Czech Republic.

The FISP provides for different minimum spend requirements depending on the kind of project:

- CZK 15 million (EUR 579,000) for feature films or animated films intended for cinematic exhibition or television broadcast;
- CZK 3 million (EUR 116,000) for documentary films intended for cinematic exhibition;
- CZK 10 million (EUR 386,000) for live action or animated television series or episodes.

Films, whether for cinema or television, must have a minimum length of 70 minutes, whereas each television segment or episode must have a minimum length of 40 minutes.

For the purposes of accessing the incentive, a cultural test is required, from which the production must gain 23 points out of a possible 46, of which a minimum of 4 points must be gained for cultural criteria. This section of the test covers Czech and European culture, history, society, and values, and is worth a maximum of 16 points, with two available in each of 8 separate sections. The other section of the cultural text covers production criteria, requiring the use of Czech production and post-production facilities, locations, and EEA cast and crew. In line with the cinema communication, the producer is able to spend 20 % of the budget outside of the Czech Republic without detriment to the amount of incentive. (*Source: SFK*)

After FISP introduction, Slovakia has proven to be the most prolific co-production partner, with Germany and France also co-producing significant numbers of films with the Czech industry. Other productions have come from other European countries, including Denmark, Poland, and Norway, while bigger-budget productions have been attracted from the USA and the UK. Smaller numbers of productions came from other non-traditional partners – including India, China, Hong Kong and RoK.

Among other support measures program supporting regional film offices by SFK can be mentioned, with allocation of CZK 1 mil. It offers one-year grants to emerging and existing regional film offices and entities in the region that serve as the focal points for filmmakers. Besides, two regions in the CR offers film subsidies for productions, which shoot the film in their region.

Impacts of the film industry on tourism are in most cases difficult to measure. However, despite the difficult measurability of these effects they can be observed in the economy. As an example the South Korean series Lovers in Prague can be mentioned. It demonstrates the success of films with Czech scenery and the subsequent interest of foreign visitors in the destination. A year after broadcasting the number of South Korean tourists increased in the Czech Republic by more than 60 % according to CSO data. Of course the overall effect cannot be attributed only to impacts of the film industry, but partial effect is obvious. Ratings for the drama averaged 26 – 27 % (31 % at its peak). The series was also broadcasted in the Czech Republic.

2.4.1.4 Hungary

Table 34: Key facts

Indicator	Value
Population 2015[e]	9.8 million
GDP per capita 2015[e]	12,021 USD
Gross box office 2015	62.8 million USD
Admissions 2015	13 million
Average ticket price 2015	4.8 USD
Average admissions per capita 2015	1.3
Screens 2015[e]	330
Digital screens 2015	315
Digital 3D screens 2015	188
Film produced 2015	21
National market shares 2015[e]	4.2 %

Source: EAO
Note: e - expected

Hungary has had a notable cinema industry from the beginning of the 20th century, with Hungarians who affected the world of motion picture both inside and outside the borders.

Hungary produced 15 films in 2014 including minority co-productions (down from 39 in 2010 and 38 in 2013). Admissions are stable since 2010, at about 11 million. But box office revenues increased by 23 % since 2011. National films market share of admissions was 4 % in 2014.

Table 35: Top 10 films by admissions, 2015

	Original title	Country of origin	Admissions
1	Star Wars: Episode VII – The Force…	US	866,357
2	Minions	US	736,934
3	Jurassic World	US/CN	486,791
4	Furious Seven	US/JP/CN	405,921
5	Avengers: Age of Ultron	US	385,768
6	Fifty Shades of Grey	US	375,863
7	Hotel Transylvania 2	US	304,146
8	The Martian	US/GB	303,294
9	Spy	US	271,951
10	Taken 3	FR	269,313

Source: EAO

The Hungarian government introduced the indirect subsidy in 2004, which at the time consisted of corporate income tax regulations such as corporate tax allowance with deduction from the tax base up to 20 % of direct production costs. In essence, it provided a tax shelter for investments. The Motion Picture Act structured the Indirect Subsidy as a corporate tax shelter, with companies registered in Hungary being able to use the investment to lower their tax base, the benefit of which can be taken from any corporate tax bill in the six years following investment. By 2012 the system had started to show significant leakage, with intermediaries taking a significant amount of the incentive's value in commission. The structure was thus reformed in 2012, with the Hungarian Film Office now operating a deposit account system to direct funding to productions, thus removing intermediaries. The Film Office is permitted to collect a maximum of HUF 9 billion (EUR 29.2mln) per year in this account. The Hungarian Parliament passed an extension to the scheme until 2019, and increased the value of the rebate to 25 % of production spend. (*Source: SFK*)

The film tax incentive

- may be granted to films (for cinema and television) produced in Hungary, which are then eligible for a 25 % rebate based on their expenditure emerged in the country;
- is available through local business companies who receive tax relief after their support of films or through the custody account of the Hungarian National Film Fund.

The National Film Office is also responsible for the management of the cultural test, which is scored out of 32; 16 points are required for passage. Eight points are available for Section A of the test, covering Hungarian or European culture, stories, and settings, while 24 points are available for the use of EEA citizens in leading positions and roles, as well as the use of Hungarian locations and facilities.

2.4.1.5 Slovakia

Table 36: Key facts

Indicator	Value
Population 2015[e]	5.4 million
GDP per capita 2015[e]	15,893 USD
Gross box office 2015	26.3 million USD
Admissions 2015	4.6 million
Average ticket price 2015	5.7 USD
Average admissions per capita 2015	0.9
Screens 2015[e]	226
Digital screens 2015	177
Digital 3D screens 2015	102
Film produced 2015	28
National market shares 2015[e]	6.7 %

Source: EAO
Note: e - expected

Until now Slovakia has lagged behind its neighbours Hungary and the Czech Republic which have had tax incentive schemes for a number of years but now that seems set to change. Slovak films continue to find international success, powered by documentary film production and more recently by genre-bending feature films fuelled by documentary techniques and a couple of female directors taking the lion's share. Slovak animated film also started to attract critical notice abroad and local cinema audiences have begun responding to domestic films, driving attendance for both feature films and documentaries. (*Source: http://www.filmneweurope.com/*)

In 2014, there were 27 feature films produced in the Slovakia, of which 15 were 100% national films and 12 were co-productions. Cinema admissions have risen slightly from 3.91 million to 4.13 million over the last five years. Gross box office earnings have shown an increase of 16% over the same time period. National and other European films take a total of 29% of the gross box office in the Slovak Republic. Digital cinema screen penetration has leaped from 10% in 2010 to 70 % in 2014. (*Source: EAO*)

Table 37: Top 10 films by admissions in RoK, 2015

	Original title	Country of origin	Admissions
1	Minions	US	365,184
2	Fifty Shades of Grey	US	239,521
3	Hotel Transylvania 2	US	161,466
4	Spectre	GB inc/US	149,321
5	Furious Seven	US/JP/CN	144,468
6	Star Wars: Episode VII – The Force…	US	130,976
7	Inside Out	US	122,521
8	Jurassic World	US/CN	115,059
9	The Hunger Games: Mockingjay – Part 2	US/DE	102,526
10	Avengers: Age of Ultron	US	90,344

Source: EAO

The main funding body is the Slovak Audiovisual Fund, launched in 2010 with a budget of EUR 6.9 million. The budget was lower in succeeding years, falling to an estimated EUR 5.5 million for 2013 and growing again in 2014 to 6,6 million EUR. The fund was granted EUR 5.9 million through November 2015.

The fund gives 80 % of its budget for development and production of audiovisual works. The maximum grant for a Slovak feature film is EUR 1.2 million and the maximum grant for a Slovak

minority coproduction is EUR 500,000. In 2015, the fund awarded grants to seven minority co-productions. The Czech Republic is Slovakia's main coproduction partner, accounting for 80 % or more of all co-productions, followed by Poland, Hungary and Germany.

Animated films and especially documentaries are vital and productive segments of the Slovak film industry. A documentary film can receive a maximum of 84,000 EUR.

In total, the development and production of some 280 documentary films was funded between 2010 and 2014 with a total amount of EUR 4.1 million. Feature films received EUR 15.5 million support (with 160 applications) and animated films received EUR 1.2 million (with 62 applications) between 2010 and 2014.

Foreign film production has been nearly non-existent for the past two years. Bratislava once boasted the newest and best-equipped film studio in Central and Eastern Europe, Koliba Studios, but it was later converted into a TV studio and offices, and is now expected to be transformed into a housing complex. The introduction of film incentives and plans for the construction of a film studio near the Austrian and Hungarian borders could be a hopeful sign for the future of the foreign film service industry. New programme of support for the audiovisual industry in Slovakia has been launched in 2015, based on a 20% cash rebate for private investment into film production in Slovakia with a minimum limit of 2m EUR over a period of three years after the registration of the project, which could be a film, a TV series, or a group of projects. A new funding scheme of Bratislava Self-Governing Region has also been launched in 2015 for supporting the culture of the region.

Conclusion

Film industry either in V4 or in RoK forms important part of the economy. With direct, indirect, induced and other soft not measurable impacts it has huge benefits for all stakeholders. It is therefore worth utilizing advantages of particular countries and use them for strengthening of position of film sectors. The cooperation may have form of

- higher number of co-productions,
- transfer of knowledge in high-tech services (in production, distribution or exhibition),
- alternative platforms of content distribution (VoD, IPTV etc.),
- promotion (festivals of Korean films (in the CR Asian film festival organized by Axman production, Hungarian Film Festival in Korea etc.).

2.4.2 Fine arts, music, theatre, literature

2.4.2.1 Poland

Promotion of culture is carried out by Polish-Korean friendship societies, diplomatic missions and learned societies such as the Korea Foundations and its partner the Adam Mickiewicz Institute or Culture Centre of Embassy of The Republic of Korea. Moreover, the cultural exchange between universities is significant means of cooperation.

As was mentioned above, Polish culture in Asia has been promoted by the Adam Mickiewicz Institute. It for instance organized following events:

- Polish cinematography was showcased at the Busan International Film Festival (BIFF)
- Selection of some of the most interesting theatre productions from Poland were put on at the PAMS (Performing Arts Market in Seoul) and SPAF (Seoul Performing Arts Festival).

- In 2014, the prestigious LG Arts Centre in Seoul hosted a theatre production "A Piece on Mother and the Fatherland"
- Uijeongbu Music Theatre Festival presented Maja Kleczewska`s contemporary interpretation of „Macbeth".
- Maciej Fortuna Trio and Rafal Sarnecki Quintet performed at the Jarasum International Jazz Festival.

Korean culture in Poland is intermediated by the Cultural Centre of the Embassy of the RoK, which was opened in 2010. It offers diverse programs, workshops or seminars (Taekwondo, K-pop, "HanStyle" exhibitions etc.) to introduce Korean culture to Polish citizens.

2.4.2.2 Czech Republic

The first important milestone of the Czech-Korean cultural diplomacy was signing of the Agreement on Cultural Cooperation between the Government of the Czech Republic and the Government of RoK in 1994 in Seoul. The second major milestone was the establishment of the Czech Info Centre in 2009. The most significant period for the Czech cultural diplomacy, however, was then the year 2013, when foreign branch of the Czech Centre was opened and foreign representation of CzechTourism in Seoul was re-opened. Besides, the governments of both states signed the Implementing Programme of Cooperation in the Fields of Education and Culture between the Government of the Czech Republic and the Government of the RoK for the years 2014-2016.

Examples of events in RoK introducing the CR

- Cooperation between the National Museum of Art & Deoksugung Gallery in Seoul and the National Gallery in Prague.

  Joint meetings between institutions and ministries of culture led to borrowing of 107 paintings by 28 prominent Czech authors. After a long time such extensive exhibition of Czech artists abroad was organized. Czech Republic was refusing such borrowings abroad primarily because of threat of their seizure in the dispute with Diag Human. The Korean side, however, offered above-standard protection conditions and paid all related costs so that the Czech Ministry of Culture the conditions accepted.

- Cooperation between Seoul Museum of History (SMH) and the Prague City Museum (MMP).

  Both institutions agreed on mutual borrowings of works and organization of thematic exhibitions on the history and present of the Czech, respectively RoK metropolis. The first exhibition was organized in 2013 by the Museum of the City of Prague and called "Soul - the walled city". Korean side then prepared exhibition "Prague - the fort in the heart of Europe".

- One of the most successful exhibition in the Czech Centre in Seoul was an exhibition of photos by Jan Saudek "Goodbye, John," that was seen by 555 visitors in one month. During 2012, the collection of 100 photos travelled to galleries in major South Korean cities (Seoul, Daegu, Busan, Incheon).

  Another successful exhibition was the presentation of Czech puppet tradition. The exhibition called "Puppets from the year zero" included photo collections from various authors who mapped the transformation of the Czech puppet theatre after the Velvet Revolution. The exhibition also presented puppets of Korean artist, puppeteer and stage designer Mun Su-ha, who studied at the Academy of Performing Arts in Prague.

  Last project worth mentioning is the exhibition "Radek Pilar for children" in the Gallery of the National Library for Children & Young Adults.

- Cooperation agreement between one of the leading Czech publishing houses Argo and the Korean institute Literature Translation Institute (LTI) in 2013.

  The contract included commitment to prepare translations of Czech writers into Korean and vice versa. In 2013 and 2014, first novels were published.

- Korean audience also appreciated Czech musicals. Korea is de facto the only non-European state, where musicals under Czech direction are exported in such scope. The first topic that was exported to Korea was Dracula in the late 90s then followed by Jack the Ripper, Three Musketeers, Cleopatra, Hamlet or Casanova. Each of these musicals had over 500 performances in halls with a capacity of up to 2,000 spectators. Thanks to the success of Jack the Ripper and Hamlet in South Korea both musicals were also exported to Japan. Czech versions of musicals are also played in RoK.

- In the year 2014, which was declared as the „Year of Czech Music", the Czech Philharmonic Orchestra headed by Jiri Belohlavek, played in Seognam Arts Centre near Seoul. The Czech Philharmonic Orchestra presented Smetana's Vltava, Brahms's Piano Concerto no. 1 and Dvorak's Symphony no. 6.

- Czech pop music diametrically differs from South Korean K-POP. It might be the reason why it is for many Koreans so interesting, especially when combined with Korean music ensemble playing completely different genre. Cooperation between the Czech rock band Tata Bojs and classical piano trio Ahn Trio was launched over a decade ago. After concerts in the Czech Republic and in New York they appeared also in RoK in the autumn of 2014. Two concerts were given during BIFF, Asian International Film Festival in Busan, where Tata Bojs with Ahn Trio played even at the closing ceremony.

Korean cultural events in the CR are organized mainly by the Czech-Korean Society - a non-governmental non-profit organization.

2.4.2.3 Hungary

Key intermediator of Hungarian culture in RoK is the Embassy of Hungary in Seoul.

Key milestone in the bilateral cultural relations was when the Hungarian Minister of Culture awarded the Pro Cultura Hungarica prize for the first time to Korean citizens with outstanding contribution in developing cultural cooperation in 2004. Five people were awarded the prize until now: Hwang Yun-ha pianist, President of the Korean Liszt Society; Park Soo-young, Professor of the Hankuk University of Foreign Studies and founder of the Hungarian Department; Park Jae-sang, President of the Korean Kodály Society; Cho Hong-ky, Director of the Kodály Society and Ambassador Eom Chong-seok, who made significant contribution to the establishment of the Korean Department at Eötvös Loránd University (ELTE).

Other selected cultural events are summarized in following list:

- Hungarian symphonic orchestras (Győr Philharmonic Orchestra, Pécs Philharmonic Orchestra, Debrecen Philharmonic Orchestra, Liszt Ferenc Music Academy Philharmonic Orchestra, Hungarian Philharmonic Orchestra) are regularly invited for guest performances in RoK.

- The Korean Kodály Society organizes concerts, symposiums and lecture series, while the Korean Liszt Society organizes regular concerts and competitions, the International Liszt Piano Competition is regular and well-known event.

- Several outstanding Hungarian artists were invited to give concert in Korea, including pianists Jenő Jandó, Andráss Schiff, Sándor Falvay, Adrienn Hauser and renown violinist József Lendvay, saxophone Quartett, pianist György Ciffra and András Kemenes, violinist Rodrigo

Puskás, pianists Ernő Fehér, János Balázs, Jenő Jandó and the Szalai Gypsy Band; dance choreographer and performer Rita Bata and Ferenc Fehér were invited to several dance performance and movement festivals.

- The Hungarian Comedy Theatre featured „Othello" at the International Theatre Festival in Seoul, Hungarian State Theatre of Cluj presented „Richard III" in Seoul or the Hungarian Theatre Museum and Institute participated at the Seoul Performing Arts Festival.
- Hungarian artists of arts and crafts are regularly present in Korea attending art symposiums and resident art programs, as well as appearing at exhibitions.
- The National Palace Museum of Korea opened a special exhibition "Magnificent Life of the Hungarian Aristocracy under the Reign of the Habsburg Dynasty in the 17-19th Century" in 2013, the exhibition was the first joint project of the Hungarian National Museum and the National Palace Museum of Korea.
- On 1 May 2014 cimbalom, a traditional Hungarian music instrument made its debut in Korea within the framework of a concert at the Seoul Arts Centre featuring the renowned Hungarian musician and a virtuoso of the instrument, Ms. Viktória Herencsár and the artists of the KNUA Symphony Orchestra.

In 2012, RoK founded Korean Cultural Centre (KCC) in Budapest, Hungary. The net space of the Hungarian centre is more than 1,000 square meters which ranks it among the biggest in CEE. It is equipped with 13 different rooms to learn about Korean culture, providing diverse facilities such as a multi-purpose art hall, a cultural workshop, a library with 3,000 volumes, a training room for taekwondo, a PC room, a cutting-edge multimedia lounge and three classrooms etc. The KCC hosts a variety of cultural programs from Korean language and cooking courses to Korean film screenings and Taekwondo training.

2.4.2.4 Slovakia

Key intermediator of Slovak culture in RoK is the Embassy of Slovakia in Seoul. Following list contents selection of cultural events presenting Slovakia in RoK:

- 2014 - Slovak Film Festival in Busan
- 2014 - Participation of Slovakia at International Travel Fair in Seoul
- 2014 - Concert tour of Gypsy Devils Orchestra in Korea
- 2013 - Participation of Slovakia at International slow-food festival AsiO Gusto in Namyangju
- 2013 - "Slovakia - land of colours" - opening of the pastel painting exhibition of Mrs. Jana Jamborova
- 2013 - Participation of Slovakia at the 16th Busan International Travel Fair
- 2013 - Slovak artists' exhibition "Vulnerable Failures" in National Art Studio in Changdong
- 2013 - Presentation of the collection of contemporary plays from Visegrád 4 countries "Between Loneliness and Intimacy" translated into Korean
- 2013 - Concert tour of Slovak Chamber Orchestra in Korea
- 2013 - Opening of the Slovak photo exhibition at the National Assembly of the ROK
- 2012 - Participation of Slovakia at the 2012 Global Costume Festival in Goyang
- 2012 - Participation of Slovak Chamber Theatre Martin at World Festival of National Theatres in Seoul
- 2012 - Musical performance of Slovak guitarist Miriam Rodriguez-Brullova in Seognam Art Centre
- 2011 - Exhibition Czech and Slovak Photography at SEOUL PHOTO 2011.

- 2010 - Performance 'Curious Fairy-tale' by Slovak Chamber Theatre in Martin at 22nd International Festival of Theatres in Keochang
- 2009 – The exhibition "SLOVAKIA: FOLLOWING THE WAY OF THE VELVET REVOLUTION"

Korean events in Slovakia, supported by the Embassy of RoK in Slovakia, included for instance K-pop World Festival 2016, Taekwondo Korean Ambassador's Cup & Bratislava Open 2016, presentation of kimchi and cooking contest of Korean meals, day of Korean meals, K-pop showcase etc.

2.4.3 Sport

South Korea will organize the Winter Olympics games in 2018 in Pyeongchang. This is the first time when South Korea will organize winter Olympic games. The organization of such event represents opportunities to co-operate among South Korea with V4 countries in sports that are more traditional with a long history in V4 countries than in South Korea, e.g. with Czech Republic (ice-hockey, biathlon), Slovakia (hill skiing), Poland (ski jump). The co-operation could have form of training camps, using local trainers etc.

2.4.4 Tourism

The tourism industries' shares of value added at factor cost in V4 accounted for 2.66 – 3.32 % of the value added of the non-financial business economy when working with wider definition of tourism industry, for 0.67 to 1.56 % when working with narrower definition. This is rather significant contribution to economy performance to devote sufficient attention to this sector. Moreover, the direct effect is accompanied by indirect (when companies in the tourism sector value chain procure supplies and services from outside the value chain, they generate an indirect economic impact) and induced impacts (the employment generated at both the direct and indirect impact stages raises these employees' household income which is also spent on goods and services and this spending and subsequent re-spending it in the economy further increases economic activity across the broader economy). Besides, there are other not quantifiable benefits, for instance in the form of better understanding between relevant countries.

Table 38: V4 tourism industries' shares of value added on value added of the non-financial business economy

GEO/TIME	2012	2013	2014
Czech Republic - Total tourism industries	n.a.	2.95 %	2.92 %
Czech Republic - Tourism industries - mainly tourism	n.a.	0.90 %	n.a.
Hungary - Total tourism industries	n.a.	2.47 %	3.32 %
Hungary - Tourism industries - mainly tourism	0.86 %	1.26 %	1.56 %
Poland - Total tourism industries	n.a.	n.a.	n.a.
Poland - Tourism industries - mainly tourism	n.a.	n.a.	n.a.
Slovakia - Total tourism industries	3.24 %	2.96 %	2.66 %
Slovakia - Tourism industries - mainly tourism	n.a.	n.a.	0.67 %

Source: Eurostat

As the Czech Republic is the only country in V4, which established special foreign office of business tourism agency (CzechTourism) in Seoul, it is worth illustrating basic parameters and opportunities for cooperation in this field just on case of the Czech Republic.

In 2013, 150,000 South Korean tourists arrived to the Czech Republic. In the first half of 2014, significant increase in the number of South Korean tourists in the Czech Republic was recorded especially in the first quarter (43 % - 30,438 tourists). Several factors might have caused such increase. In June 2013, Czech airlines started to fly to RoK and large number of early birds and people travelled before the peak season for better prices. The whole Europe was on the rise and awareness of the Czech Republic grew. The number of South Korean tourists headed to number 200 000. Tourism, however, was then negatively affected by the tragedy of the sinking the ferry Sewol. The Czech Republic finally recorded an increase of 10.5 % in the second quarter of 2014.

In 2015, the Czech Republic experienced total of 257,110 arrivals with progressively increasing trend. Presently, the South Korean tourists ranks third in the number of visitors from countries outside Europe following the Americans and the Japanese

Key characteristics of South Korean tourism in the Czech Republic:

- Motivation:
  - Romance, European culture, the experience of "old Europe" (architecture and history - UNESCO), favourable price, Czech tradition - puppets, Czech specialties - beer and pork knuckle, themed trips (music, Christmas markets, etc.).
  - The Czech Republic is mostly combined with Austria and Hungary within one package, in FIT itineraries Prague is combined with Vienna, Paris, Budapest.
- Direct air links: Soul - Prague - number of flights per week: 13
- Source cities: Seoul, Busan, Daegu, Incheon Seongnam, Ulsan
- Average length of stay: 2.6 day to arrival
- Seasonality of arrivals: standard with peak in July and August.

Opportunities

In historical and socio-cultural comparison of V4 countries and RoK common intersections and critical differences can be found. Intersections in history and culture in general may mean that the countries can understand one another as they share similar fate or values. Cultural differences can cause (and often cause) mutual incomprehension of mentality and customs. On the other hand, they are signs of cultural diversity that many people, especially tourists, attracts. They can thus be a major driving force for the development of tourism as well as economic opportunities for all countries that benefit from the decisions of tourists to travel (entrance of Korean Air into CSA, taxes etc.).

Export of culture to the final destination may be increased, for instance, by:

- touring exhibitions around the embassies, cooperation between relevant museum and gallery institutions
- foreign tours of local artists (Philharmonic Orchestra, solo musicians, bands, theatre and dance troupes etc.)
- promotion of domestic films in the international/foreign film festivals
- support of RoK productions to film in Prague and other romance locations
- publications of past and present works in literature
- lectures and workshops of cultural theorists, experts, politicians
- special student exchange programs and grant projects for art students
- language teaching
- regular or one-off events, cultural participation of both countries
- promotion of projects, artists and institutions on the Internet or on social networks.

2.5 Analysis in the field of Education

Regarding the study exchanges and university relations, most known V4 universities are connected with Korean universities. In the Czech Republic, University of Economics receives South Korean students from Seoul National University, Charles University (CU) students from the University of Sung Kyun Kwan and Hankuk University of Foreign Studies in Seoul, etc.

The key issue might be the development of cooperation between the technically oriented fields of study in the Czech Republic and the Korean employers who operate in the Czech Republic. CU is constantly expanding range of study programs for foreigners. Significant Czech-Korean exchanges occur at medical faculties of CU. Cooperation, however, increases also in teaching, where students of the Faculty of Arts in Prague, in cooperation with Korean bohemists publish school supplies for teaching Czech to Korean universities. In 2013, there were 13 regular Korean students mostly master's programs (medicine, pharmacy) and 17 Korean trainees at CU. Both categories Koreans are funded by scholarship program.