

## THE RAW MATERIAL-RELATED CHALLENGES OF THE EUROPEAN UNION AND THE POSSIBLE CONTRIBUTION OF THE EAST- AND SOUTH-EAST EUROPE

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**ABSTRACT.** The raw material-related challenges of the EU are tackled by a package of European initiatives and - for the first time since the European Community on Coal and Steel - positive signals for the raw materials sector and a political willingness for a re-industrialization of Europe can be observed. Compared with the world powers, the USA, China and Russia, the supply of the EU with existentially important mineral raw materials is clearly considerably lacking behind. Whereas, China, the USA and Russia produce about 47% of world trade of mineral raw materials (Iron and Ferro-Alloy, Non-Ferrous Metals, Precious Metals, Industrial Minerals & Mineral Fuels), the EU produces only 4.73%. These results do not only pose strategic risks to the EU's supply, but also to the future industrial development of the EU, which, in any case, is in a critical phase of economic essential re-industrialization. In 2011 the reviewed group of 60 mineral raw materials showed a globally concentrated market (Herfindahl-Hirschmann Index > 2.000) for 33 mineral raw materials. More than 50% of the world mining productions of 48 mineral raw materials in this group are produced in only 3 countries. Whereas 75% of the world mining production of 27 mineral raw materials in this group are produced in also only 3 countries.

### ПРЕДИЗВИКАТЕЛСТВАТА НА ЕС, СВЪРЗАНИ СЪС СУРОВИННИЯ ОТРАСЪЛ И ВЪЗМОЖНИЯ ПРИНОС НА ИЗТОЧНА И ЮГОИЗТОЧНА ЕВРОПА

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**РЕЗЮМЕ.** Предизвикателствата на ЕС, свързани със суровинния отрасъл са в пакет от европейски инициативи и за първи път от основаването на Европейската общност за въглища и стомана се наблюдават положителни отзиви за суровинния сектор, както и политическа воля за реиндустриализацията на Европа. В сравнение със световните сили, САЩ, Китай и Русия, запасите на ЕС със стратегически минерални суровини са значително по-малки. Докато Китай, САЩ и Русия произвеждат около 47% от минералните суровини на световния търговски пазар (желязо и железни сплави, цветни метали, благородни метали, индустриални суровини и горива), то за сравнение ЕС произвежда само 4.73%. Тези резултати не само показват стратегическите рискове за запасите на ЕС, но също и за бъдещото индустриално развитие на ЕС, което е в критична фаза. През 2011 г. бе разгледана група от 60 минерални суровини, като за 33 от тях се наблюдава съсредоточаване на световния пазар (на Херфиндал-Хиршман индекс > 2.000). Повече от 50% от световното минно производство на 48 минерални суровини от тази група е концентрирано само в три страни. Докато 75% от световния минен добив на 27 минерални суровини от тази група също е съсредоточено само в три страни.

The raw material-related challenges of the EU are tackled by a package of European initiatives and - for the first time since the European Community on Coal and Steel - positive signals for the raw materials sector and a political willingness for a re-industrialization of Europe can be observed.

Compared with the world powers, the USA, China and Russia, the supply of the EU with existentially important mineral raw materials is clearly considerably lacking behind. Whereas, China, the USA and Russia produce about 47% of world trade of mineral raw materials (Iron and Ferro-Alloy, Non-Ferrous Metals, Precious Metals, Industrial Minerals & Mineral Fuels), the EU produces only 5,5 %. These results do not only pose strategic risks to the EU's supply, but also to the future industrial development of the EU, which, in any case, is in a critical phase of economic essential re-industrialization.

This contribution deals with

- Concentration of the Production
- Overview on the global production of mineral raw materials
- Production of the European Union

- Production of the East- and Southeast Europe
- Strategies for the ESEE Region
- Final remarks

The global extraction of mineral resources in overall is only to be estimated, because there is no global statistics for building materials. But for 63 minerals, that are produced on a global level and where there is a global market, statistics are available. This shows that the global extraction of minerals is about 40 billion t, a huge dimension of materials flow.

#### Global Extraction of Mineral Resources 2012 Estimations ~ 40 000 000 000 t +/-

World Mining	16.863.312.932
Source World Mining Data	
Iron, Ferro-Alloy Metals	1.449.257.272
Non-Ferrous Metals	82.334.814
Precious Metals	28.188
Industrial Minerals	744.482.542
Mineral Fuels	14.587.210.116

Building Materials	~ 24.000.000.000 t/a
produced on local level	+/- 10%
Estimations in the dimension of	

In 2012 the reviewed group of 63 mineral raw materials showed a globally concentrated market.

- 50 minerals: more than 50 % of the world production from only 3 countries
- 29 minerals: more than 75 % of the world production from only 3 countries
- 36 minerals: high concentration on the market (Herfindahl-Hirschmann Index<sup>1</sup> > 2000)
- 28 minerals: China is the leading producer;
- Asia is the biggest producer of mineral raw materials.

In detail the world mining production is showed in the following pictures:

Iron Ferro-Alloys	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Iron (Fe-Content)	1.407.941.547	1790	69,55	China, Australia, Brasil	1,3 %
Chromium Cr <sub>2</sub> O <sub>3</sub> -Cont.	12.502.010	2326	74,05	South Africa, Kzakhstan, Turkey	1,7 %
Cobalt	128.624	4632	77,64	Congo D.R., China, Canada	0,4 %
Manganese	18.909.988	1431	58,67	South Africa, China, Australia	0,1 %
Molybdenum	254.199	2519	77,93	China, USA, Chile	0



### Iron and Ferro-Alloy Metals

Source World-Mining-Data  
www.bmwfw.gv.at

Iron Ferro-Alloys	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Tungsten W-Content	81.072	6986	90,38	China, Russia, Canada	2,3 %
Vanadium V <sub>2</sub> O <sub>5</sub> -Content	75.100	3653	98,22	China, South Africa, Russia	0



### Iron and Ferro-Alloy Metals

Source World-Mining-Data  
www.bmwfw.gv.at

<sup>1</sup> "The Herfindahl-Hirschman Index (HHI) is a commonly accepted and used measure of market concentration. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. Only one firm means 100% market share. In this case the HHI would equal 10.000 (100<sup>2</sup>), indicating a monopoly. A market consisting of four firms with shares of 30%, 20%, 10% and 5%, results in a HHI of (30<sup>2</sup> + 20<sup>2</sup> + 10<sup>2</sup> + 5<sup>2</sup>) = 1425. The HHI takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. The HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases. In the United States markets in which the HHI is between 1000 and 1800 points are considered to be moderately concentrated, and those in which the HHI is in excess of 1800 points are considered to be concentrated. In the EU the threshold to concentrated markets is 2000. The concentration of producer countries is calculated by the HHI similarly to the firms index." (Source World Mining Data, www.bmwfw.gv.at)

Non-Ferrous Metals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Aluminium	46.581.454	2004	55,97	China, Russia, Canada	4,7 %
Antimony	162.766	6304	87,05	China, Russia, Tajikistan	0
Arsenic	53.508	3059	83,76	China, Chile, Morocco	1,9 %
Bauxite crude ore	259.883.227	1621	60,40	Australia, Indonesia, China	0,8 %



### Non Ferrous Metals

Source World-Mining-Data  
www.bmwfw.gv.at

Non-Ferrous Metals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Bismuth	7.470	6611	97,46	China, Mexico, Japan	0
Cadmium	21.583	1617	59,12	China, Korea, South, Japan	6,0 %
Copper	16.826.943	1363	49,77	Chile, China, Peru	5,0 %
Gallium	95	3339	83,16	China, Kazakhstan, Ukrain	4,2 %



### Non Ferrous Metals

Source World-Mining-Data  
www.bmwfw.gv.at

Non-Ferrous Metals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Germanium	111	5966	94,59	China, Finland, Russia	14,4 %
Lead	4.793.304	2679	68,96	China, Australia, USA	4,1 %
Lithium Li <sub>2</sub> O-Content	73.276	3082	85,66	Chile, Australia, Argentina	0,3 %
Mercury	1.850	5471	88,65	China, Mexico, Tajikistan	0



### Non Ferrous Metals

Source World-Mining-Data  
www.bmwfw.gv.at

Non-Ferrous Metals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Rare Earth Concentrates	103.942	8388	98,88	China, Australia, Russia	0
Rhenium	48.111	3208	79,71	Chile, USA, Uzbekistan	5,8 %
Selenium	2.175	1311	48,97	Germany, Japan, Belgium	52,1 %
Tellurium	133	2711	86,47	USA, Japan, Russia	5,3 %



### Non Ferrous Metals

Source World-Mining-Data  
www.bmwfw.gv.at

Non-Ferrous Metals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Tin	247.752	2731	75,16	China, Indonesia, Peru	0
Zinc	13.458.401	1707	57,60	China, Australia, Peru	5,6 %

Industrial Minerals	Production carat/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Diamonds Gem	71.908.024	1692	63,69	Russia, Botswana, Canada	0
Diamonds Ind	58.073.265	1912	68,25	Congo D.R., Russia, Zimbabwe	0



### Non Ferrous Metals

Source World-Mining-Data  
www.bmwfw.gv.at

Precious Metals	Production kg/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Gold	2.700.861	592	32,73	China, Australia, USA	1,0 %
Palladium	190.529	3380	87,21	Russia, South Africa, Canada	0,6 %
Platinum	176.044	5382	86,64	South Africa, Russia, Zimbabwe	0,4 %
Rhodium	22.290	6639	96,93	South Africa, Russia, Zimbabwe	0



### Industrial Minerals

Source World-Mining-Data  
www.bmwfw.gv.at

Industrial Minerals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Diatomite	1.968.117	2331	68,63	USA, China, Denmark	15,2 %
Feldspar	25.470.263	1133	53,35	Germany, Italy, Turkey	48,4 %
Fluorspar	6.017.863	3691	84,18	China, Mexico, Mongolia	2,6 %
Graphite	1.193.419	4929	87,17	China, India, Brazil	0,6 %
Gypsum and Anhydrite	155.968.234	965	43,79	China, Iran Thailand	15,8 %



### Precious Metals

Source World-Mining-Data  
www.bmwfw.gv.at

Precious Metals	Production kg/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Silver	25.096.719	1056	49,72	Mexico, China, Peru	6,9 %



### Industrial Minerals

Source World-Mining-Data  
www.bmwfw.gv.at

Industrial Minerals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	China, Brazil	Share of EU
Kaolin	34.347.070	891	40,55	USA, Germany, India	30,6 %
Magnetite	24.673.395	4377	79,85	China, Turkey, Russia	11,6 %
Perlite	2.765.587	2402	79,12	Turkey, Greece, USA	35,1 %
Phosphates P <sub>2</sub> O <sub>5</sub> Content	70.050.780	2137	67,74	China, USA, Morocco	0,4 %



### Precious Metals

Source World-Mining-Data  
www.bmwfw.gv.at

Industrial Minerals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Asbestos	1.966.186	2606	77,54	Russia, China, Brazil	0
Baryte	10.439.541	2279	68,59	China, India, Morocco	1,0 %
Bentonite	16.475.927	1479	57,87	USA, China, Greece	15,4 %
Boron	4.844.282	2907	81,99	Turkey, USA, Argentina	0



### Industrial Minerals

Source World-Mining-Data  
www.bmwfw.gv.at

Industrial Minerals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Potash K <sub>2</sub> O Content	34.332.097	1542	59,17	Canada, Russia, Belarus	12,1 %
Salt	277.988.069	1028	48,15	China, USA, India	18,4 %
Sulfur	66.345.772	752	38,74	China, USA, Russia	8,2 %
Talc	7.703.830	1326	52,02	China, India, USA	14,4 %



### Industrial Minerals

Source World-Mining-Data  
www.bmwfw.gv.at



### Industrial Minerals

Source World-Mining-Data  
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Industrial Minerals	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Vermiculite	544.223	1542	59,33	South Africa, USA, China	0
Zircon	1.387.862	2783	80,86	Australia, South Africa, China	0



**Industrial Minerals**  
Source World-Mining-Data  
www.bmwfw.gv.at

Mineral Fuels	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Uranium U <sub>3</sub> O <sub>8</sub>	68.746	1903	64,00	Kazakhstan, Canada, Australia	0,6 %



**Mineral Fuels**  
Source World-Mining-Data  
www.bmwfw.gv.at

Mineral Fuels	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Steam Coal	5.726.573.659	2922	72,92	China, USA, India	1,7 %
Coking Coal	978.244.470	3118	75,51	China, Australia, USA	2,3 %
Lignite	1.030.896.038	843	38,31	Germany, China, Turkey	42,6 %



**Mineral Fuels**  
Source World-Mining-Data  
www.bmwfw.gv.at

Mineral Fuels	Production t/a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Oil Shales	19.278.365	9512	100	Estonia, Germany, France	100 %
Petroleum	4.051.689.193	545	31,70	Saudi Arabia, Russia, USA	1,8 %
Oil Sands= part of petroleum	117.789.700	6143	100	Canada, Venezuela	0



**Mineral Fuels**  
Source World-Mining-Data  
www.bmwfw.gv.at

Mineral Fuels	Production Mio m <sup>3</sup> /a	Concentration of the Market (HHI)	Share 3 Producer countries (%)	The 3 big Producer countries	Share of EU
Natural Gas	3.475.575	853	42,38	USA, Russia, Canada	4,8 %



**Mineral Fuels**  
Source World-Mining-Data  
www.bmwfw.gv.at

In overall the European Union is producing less than 1 billion t of mineral raw materials and has only a share of 5,5 % on the global extraction of minerals.

### European Union

Production of mineral resources (t) 2012

Total: 911.686.068 t = ~ 5,5 % global production



Austria	5.622.196	Italy	25.461.500
Belgium	1.200	Latvia	252.710
Bulgaria	34.465.519	Lithuania	174.694
Croatia	2.412.112	Luxemburg	-
Cyprus	492.308	Malta	6.000
Czech Republic	58.860.462	Netherlands	68.996.560
Denmark	15.322.960	Poland	156.611.687
Estonia	1.979.600	Portugal	1.499.841
Finland	1.894.216	Romania	50.156.323
France	16.280.204	Slovakia	3.693.323
Germany	240.314.380	Slovenia	4.363.442
Greece	68.009.499	Spain	20.212.681
Hungary	12.051.425	Sweden	17.476.320
Ireland	880.906	United Kingdom	104.194.000

There are some concerns on the security of supply of the European Union and that has led to considerations on a list of critical raw materials; there is now a new list of critical raw materials shown by EC in 2014. And there is a need for that.

### Critical Materials 2014

Source C. Reich, 2014

List of „Critical Materials 2014“ = 20

Aluminium	Antimony	Bauxite	Beryllium	Bismuth	Scandium
Borates	Coking Coal	Chromium	Clay (and kaolin)	Cobalt	Copper
Diatomite	Fluorapatite	Fluorspar	Gallium	Germanium	Gold
Gypsum	Inghium	Indium	Iron ore	Limestone (high grade)	(Lithium)
Magnesite	Magnesium	Manganese	Molybdenum	Natural Graphite	Natural Rubber
Nickel	Niobium	Palladium	Phosphate Rock	Platinum Group Metals	Potash
Pulpwood	Rare Earth Elements - Heavy	Rare Earth Elements - Light	Rhenium	Sawn Lumber	Spentium
Selenium	Silica Sand	Silicon Metal	Silver	Talc	Tantalum
Tellurium	Tin	Titanium	Tungsten	Vanadium	Zinc

The ESEE region (“East & South-East Europe – Region”, where almost 100 million Europeans live in countries like Albania, Austria, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Greece, Hungary, Kosovo, Montenegro, Macedonia, Romania, Serbia, Slovakia and Slovenia is of utmost importance to the European Union.

## ESEE Region

Production of mineral resources (t) 2012

Total: 314.666.328 t = 1,87 % global production

Albania	1.186.500	Hungary	12.051.425
Austria	5.622.196	Kosovo	8.711.102
Bosnia-Herzegovina	15.325.116	Macedonia	7.584.130
Bulgaria	34.465.519	Montenegro	1.876.812
Croatia	2.412.112	Romania	50.156.323
Cyprus	492.308	Serbia	39.856.059
Czech Republic	58.860.462	Slovakia	3.693.323
Greece	68.009.499	Slovenia	4.363.442



The ESEE region is of particular interest due to its unique geological potential and unique potential on secondary raw materials.

The RM potential overall and especially for some critical minerals like Antimony, Borates, Chromium, Gallium, Germanium, Indium, Magnesite, PGMs and REEs makes it highly relevant in connection with the European raw materials strategy.

From an economic point of view (security of supply, economic value, employment) and from a political point of view (cohesion, regional development, "Candidate Countries" and "Potential Candidates") the ESEE Region is highly relevant.

The ESEE region is geographically and culturally in the immediate and logical scope of the Montanuniversitaet. The promotion of sustainable development in the ESEE raw materials sector is a specific and motivating task for the Montanuniversitaet, which can also serve as an expert in terms of experience and skills. Thus, the Montanuniversitaet is strongly involved in these European initiatives. Within the

consortium KIC Raw MatTERS (Tackling European Resource Sustainability) the Montanuniversitaet is currently developing an effective ESEE – cluster strategy on raw materials, for example:

- Forming a community of industry, research and universities in the ESEE Region
- Aiming at a comprehensive inventory of primary and secondary deposits, abandoned mines, mining enterprises, universities and R&D, reprocessing of known data
- Aiming at compressing information and feasibility studies to bridge the gap between high potentials and industrial activities, junior mining company concept
- Developing industrial projects from primary and secondary resources to generate an added value for the ESEE Region in terms of economic value and in terms of employment
- Developing new mining design for small scale mining
- Exchange of information on *Horizon 2020*, *European Regional Development Fund*, *European Social fund*, *Cohesion Fund*

And even when the ESEE region could add a lot of secure supply with minerals, there will be left a need for

- a fair and sustainable supply with minerals from the global markets,
- a sustainable supply with minerals from an own European production
- and strong efforts on resource-efficiency and substitution of materials.

Recommended for publication by Editorial board.