PD Dr. Lutz Mez
Freie Universität Berlin
lutz.mez@fu-berlin.de
www.fu-berlin.de/ffu

Rare Earth Strategies of EU/Germany and Japan in Comparison

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Outline

- Rare Earth Elements (REE)
- Global reserves of RE Oxides
- Distribution of REE Reserves
- Geopolitics, Geo-economics and REE
- REE Reserves in the European Union
- REE Reserves in Japan
- REE Strategies of EU/Germany and Japan
- Comparison of Strategies
- Summary

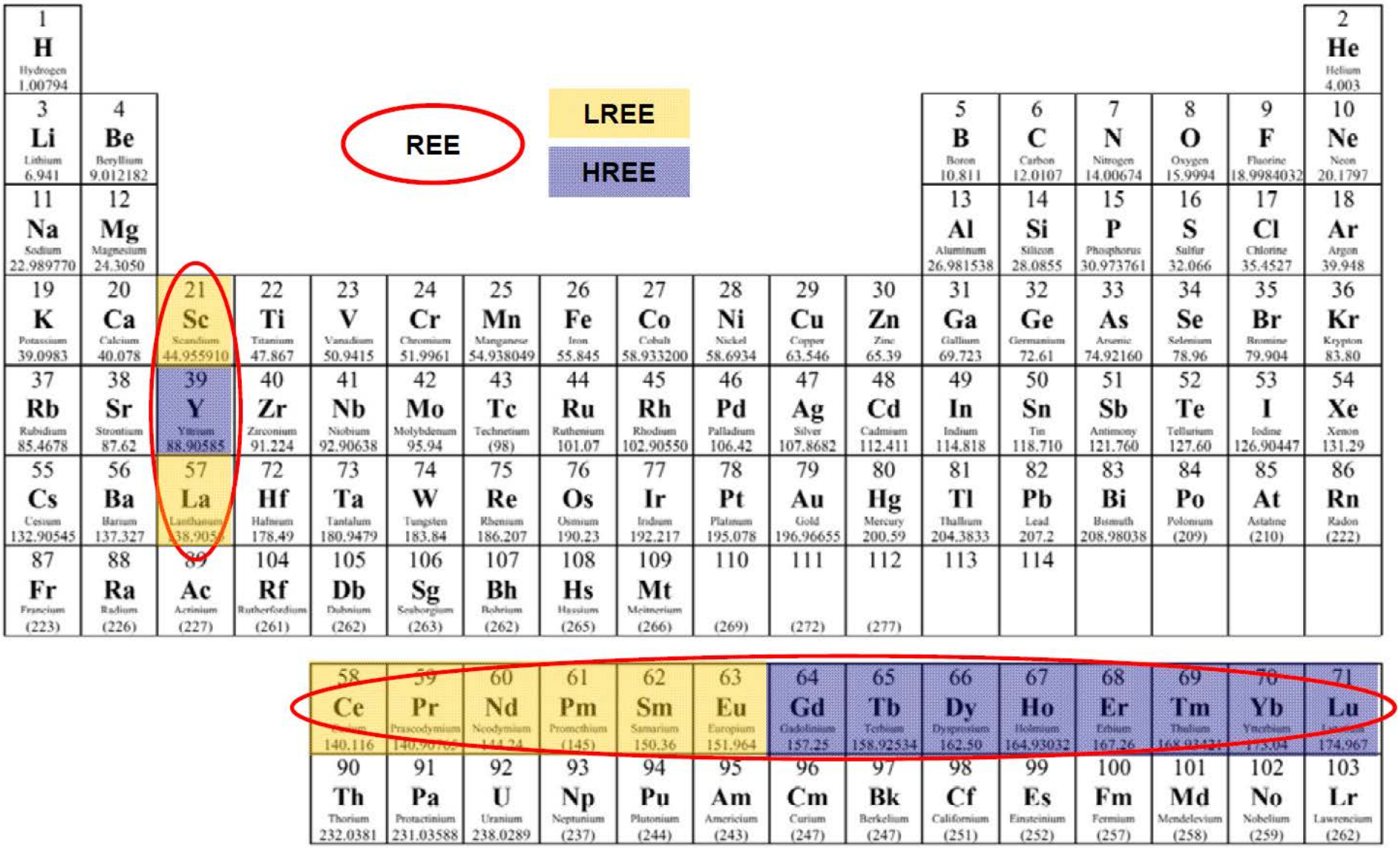
Introduction

- For strategic important resources the „Great Geopolitical Game“ has started, mainly because big industrial countries want to control the access to rare earth elements und critical metals like Tantalum or Cobalt

- Strategic important resources are called “critical resources”. For supply security the EU, Japan and USA started upgrading their geopolitical strategies and implementing them.

- The new resource initiatives follow three lines:
  1) Access to raw material markets on the global scale
  2) Production of raw materials in the national frame, and
  3) Recycling of raw materials

Rare Earth Elements & Periodic Table



1 H Hydrogen 1.00794																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
11 Na Sodium 22.989770	12 Mg Magnesium 24.3050											13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955910	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.845	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.29
55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.078	79 Au Gold 196.96655	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98038	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93032	68 Er Erbium 167.26	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
90 Th Thorium 232.0381	91 Pa Protactinium 231.03588	92 U Uranium 238.0289	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

Use of REE and SCM

- REE are 17 elements, distinguished between LREE and HREE
- REE were discovered at the end of the 18th century, in form of oxides (REO), which were called “earth” at that time.
- Today REE are essential for the whole HiTec sector, e.g. cell phones, catalysts, energy saving light bulbs and LED. Another sector is the use in metallurgy, improving iron and steel, in batteries and accumulators.
- REE are used to polish glass, and computer chips, LCDs and special glasses. Also in engines for e- and hybrid cars, for generators in wind turbines or hydro plants, or in the military sector.

Global Reserves of REO

The US Geological Survey (USGS 2010a) estimates the global reserves of the sum of all rare earth oxides to be at 99 000 000 t REO. This is quite high compared to the estimated world production of 124 000 t REO (USGS 2010a) in 2009. Hereby, the reserve is defined by the USGS as “the part of the reserve base which could be economically extracted or produced at the time of determination.” On the contrary, the reserve base not only comprises the resources that are currently economic (= reserves) but also marginally economic reserves, and some of those that are currently sub-economic. The reserve base was estimated to amount to 150 000 000 t REO by USGS (2008). In 2009, reserve base estimates of the USGS were discontinued.

Distribution of REE Reserves

The overall global reserves are spread with larger reserves in the United States, the states from the former Soviet Union, China, Australia, India, Canada, Greenland, South Africa, Malawi and other countries. However, the analysis showed that the total sum of reserves is not relevant for the forecast of shortages of individual REE. Hence, an individual analysis for selected rare earth elements is necessary.

Principally, all deposits contain more light rare earth elements (LREE) than heavy rare earth elements (HREE). Mostly only a few percentages of the rare earths are HREE. Among them are the potentially critical elements dysprosium (Dy), terbium (Tb) and yttrium (Y). According to the chosen definition for this study the LREE comprise eight REE, among them are the widely used lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd) and europium (Eu).

Geopolitics, Geo-economics and REE

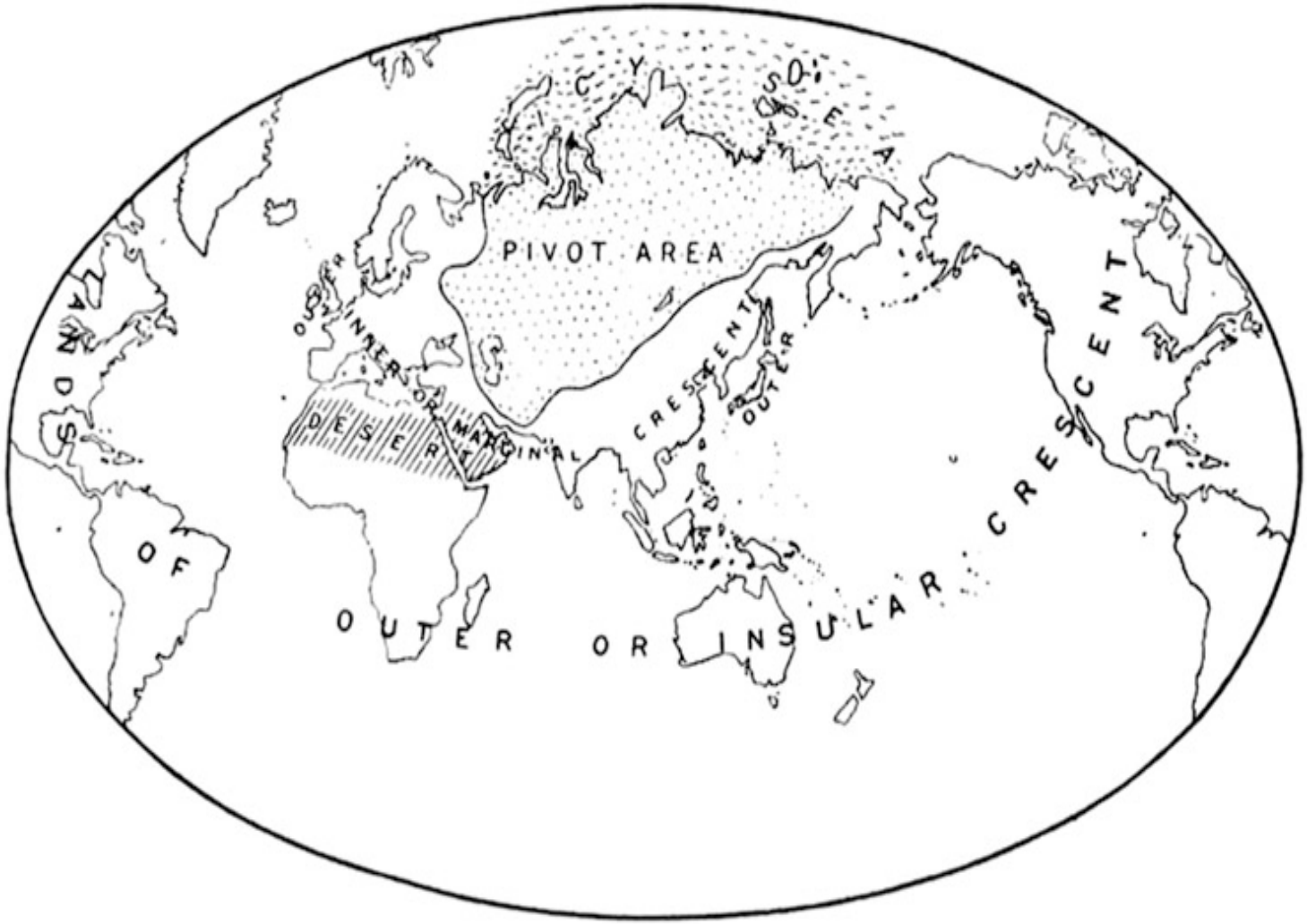
- Raw materials always plaid a central role in world politics
- Over centuries the big powers looked at the resources in Central Asia, Africa and Latin America.
- “The Great Game” was the name for the historical conflict between UK and Russia for hegemony in Central Asia
- 1904 “The Geographical Pivot of History” by Halford Mackinder
- 1944 “The geography of the peace” by Nicholas Spykman

Rare Earth Reserves in the European Union

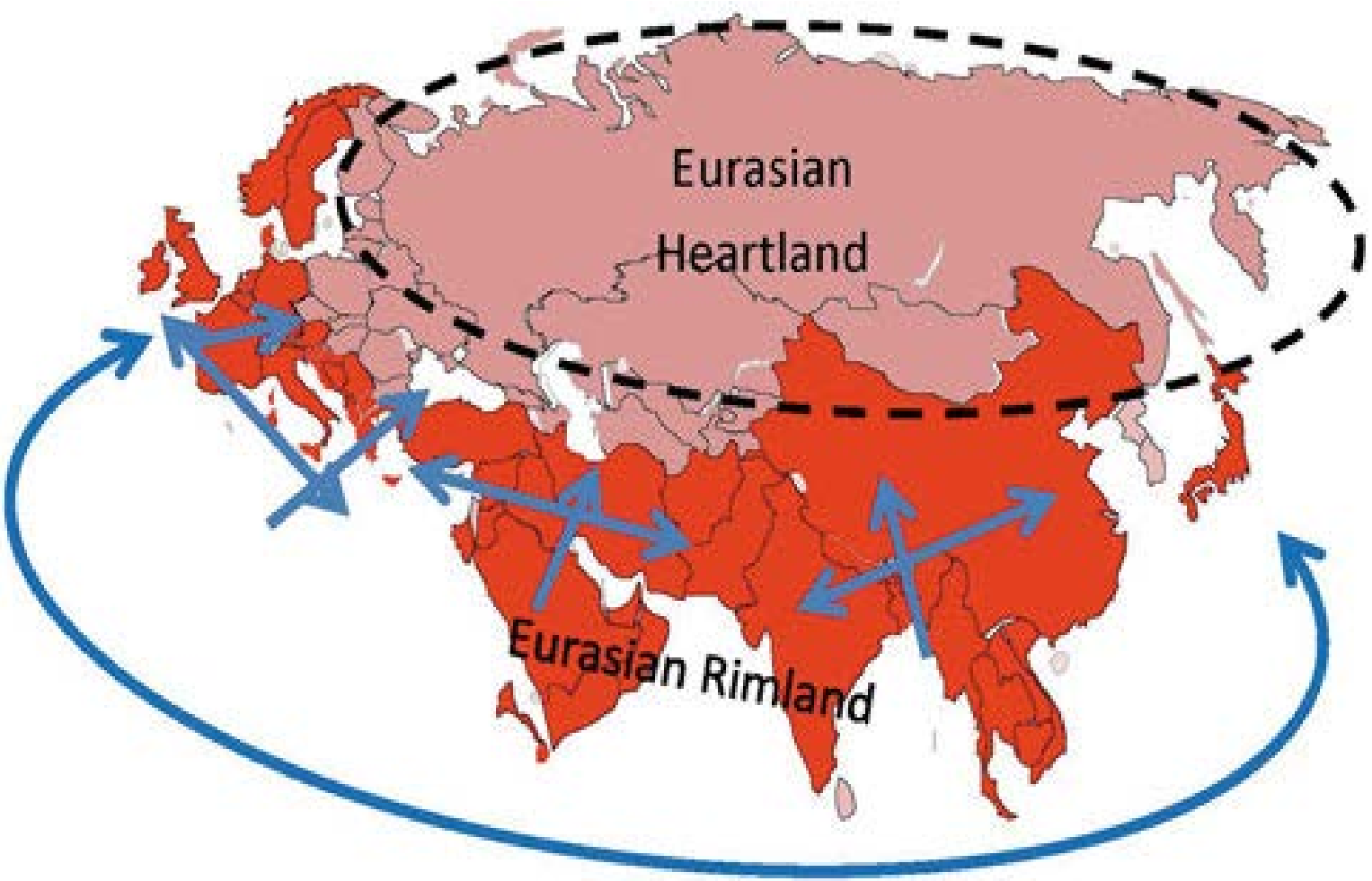
There is only limited information on European rare earth deposits. The major findings are listed below:

- The British Geological Survey (BGS 2010) states that there has been no systematic, comprehensive evaluation of REE resources in Britain. Though small occurrences are known, they have no demonstrated economic potential.
- Oakdene Hollins (2010) cites news published on the website Metal Pages (2009) that there are possible exploration activities in Ireland.
- The German Federal Institute for Geosciences and Natural Resources (BGR 2009) records a potential rare earth output of a maximum of 1 400 t per year as by-product of iron mining in the north of Sweden.
- The BGR (2009) reports on a German deposit in Saxony with probable resources of about 40 000 t REO with an average grade of 0.5 %.
- Orris & Grauch (2002) cited in BGR (2009) mention reserves in Norway and Turkey.

Mackinder‘s Theory 1904



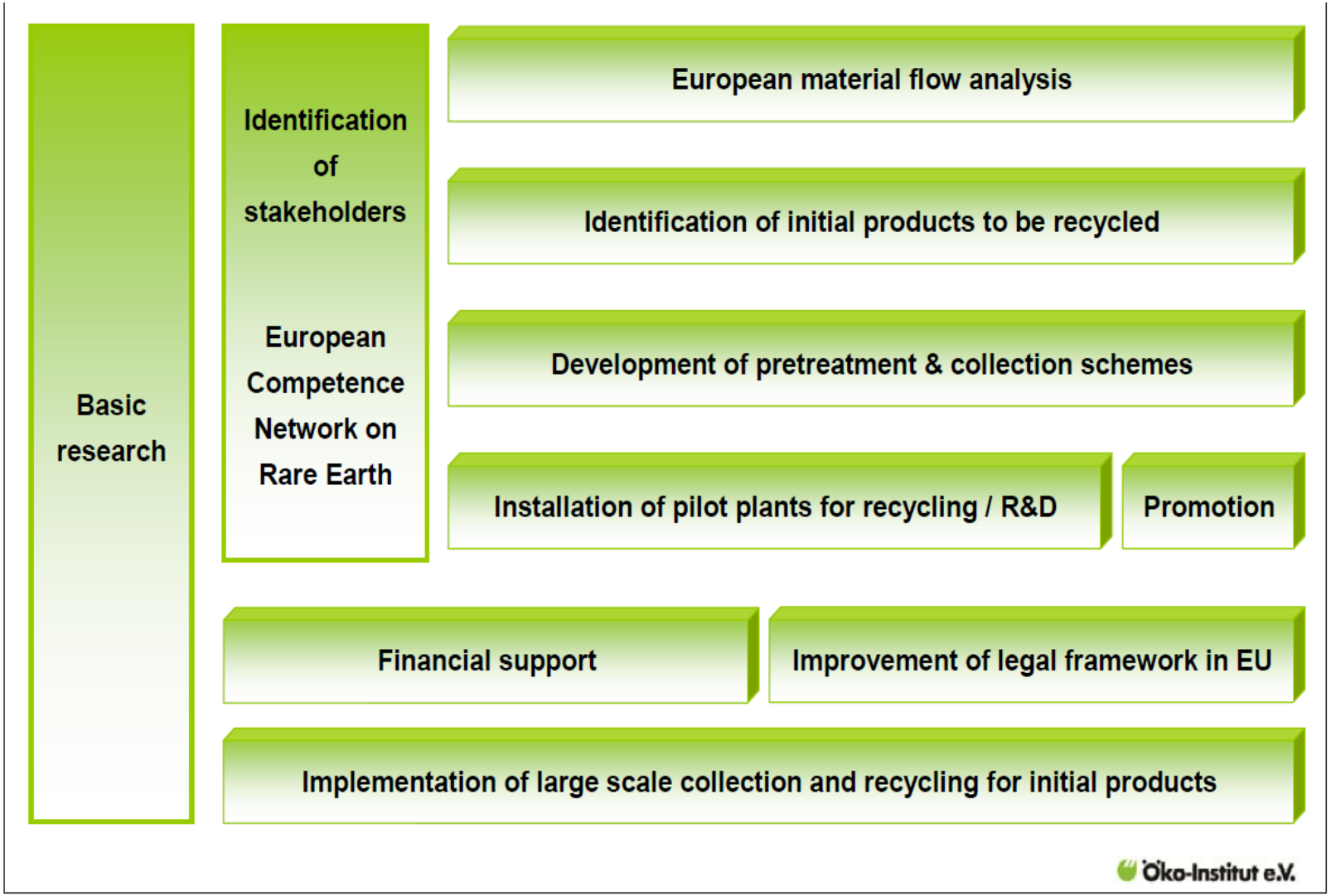
Spykman 1944 – Eurasian Rimland



Raw Material Initiative of the EU

- The EU has a critical dependency on REE
- The problem was not realized before 2005
- 2007 “coherent political approach with regard to raw material supplies”
- 2008 EU Commission presents the Raw Material Initiative
- Of 41 analyzed minerals and metals 14 were regarded as critical
- Criticism – resource efficiency is missing
- 2011 updated RM strategy – fair supply from the world market, promotion of sustainable supply and improved resource effiency

Strategy for the development of a European rare earth recycling scheme



Japan‘s RE Recycling Strategy – Urban Mining

- High dependency for REE and Wolfram of Japan from China. 2010 Embargo pushed the REE strategy on the agenda. Highest priority in Japanese Foreign Policy.
- The high problem pressure even increased after Fukushima.
- Japan has a bill requiring consumers to recycle used electronics containing rare earth and critical metals since 2012.
- The federally-sponsored move illustrates the priority Japanese officials are giving to mineral policy, a focus that contrasts sharply with the RE strategies of other industrialized countries.

Summary

- REEs are central for a green energy future
- The EU/German strategy is rather neo-colonial
- The use of REE must be organized in a “real sustainable” way, not causing “sustainable problems” in other countries and in the future
- Urban Mining – the Japanese strategy – is the more sustainable way to go

Reference

Lutz Mez & Behrooz Abdolvand: Neue Ressourcenpolitik – nachhaltige Geopolitik? Staatliche Initiativen des globalen Nordens zur Sicherung von kritischen Rohstoffen am Beispiel der Seltenen Erden, in: Kritische Metalle in der Großen Transformation, ed. by Exner, Held & Kümmerer, Springer-Verlag Berlin Heidelberg 2016, pp. 141-160

Thank you for your attention!

PD Dr. Lutz Mez
Berlin Energy Consultants

lutz.mez@fu-berlin.de
http://www.berlin-ec.com