



БелВІСА

spi



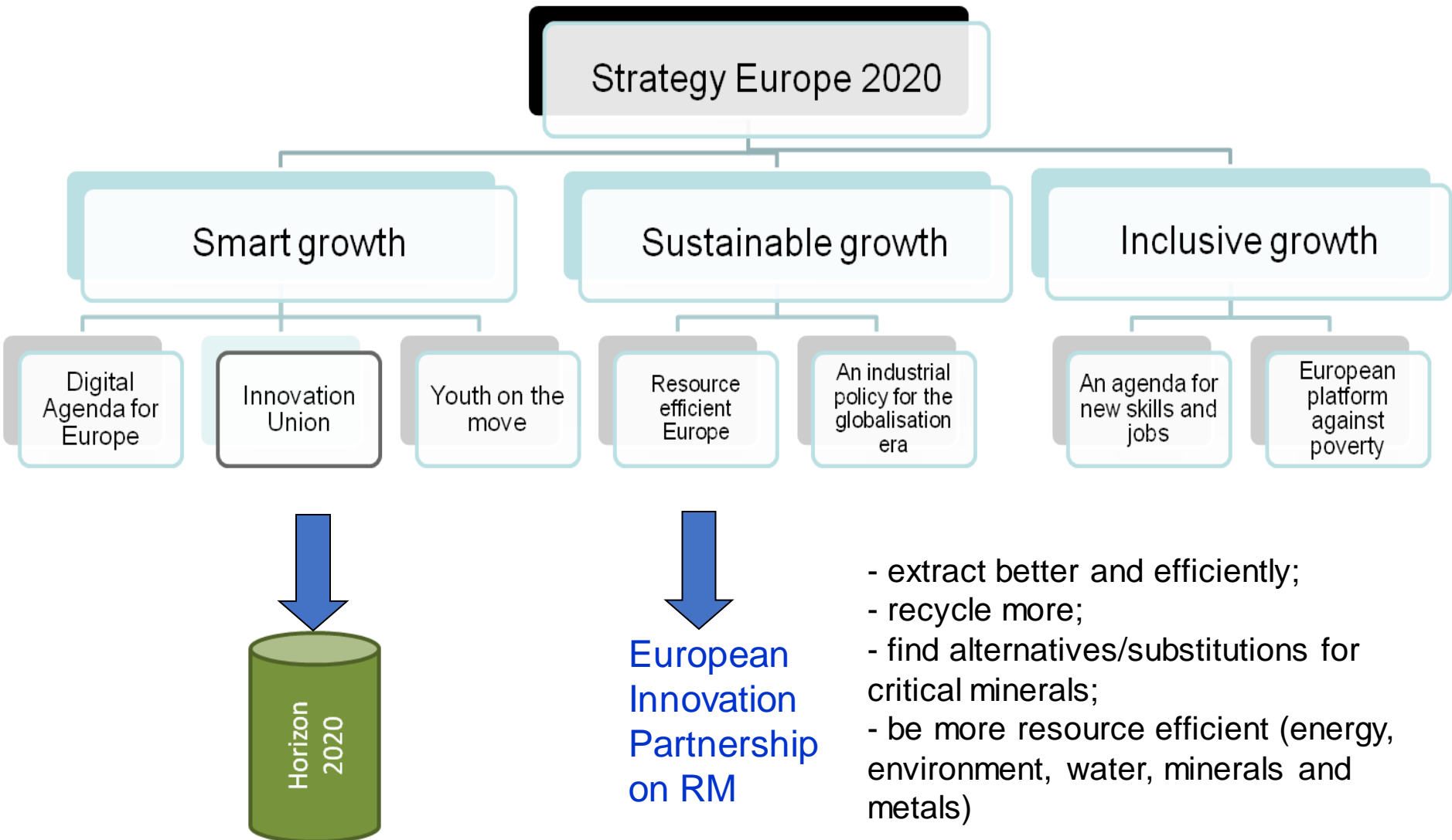
Best practices – EU funded programs; academia industry collaboration.

Henryk Karaś; Chief Specialist in Technology Transfer, Polish Geological Survey - National Research Institute; President of European Technology Platform on Sustainable Raw Materials - ETP SMR (2006-2012)

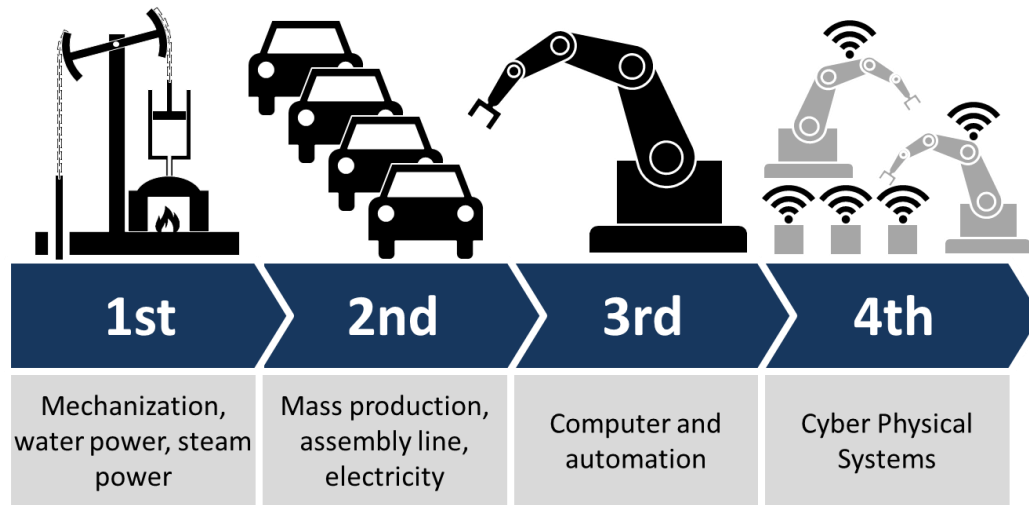
Training for technology managers in EaP countries
“Technology Platforms as an STI Policy Tool in the EaP Countries”

Minsk; 11-13 March 2019

Strategy Europe 2020 (2014-2020).



The Four Industrial Revolutions.



end of XVIII c. beginning of XX c. 70-ties. of XX c.

Picture by; "Christoph Roser at All About Lean.com"

announced in 2011, Germany as Industry 4.0 program, or the fourth industrial revolution,

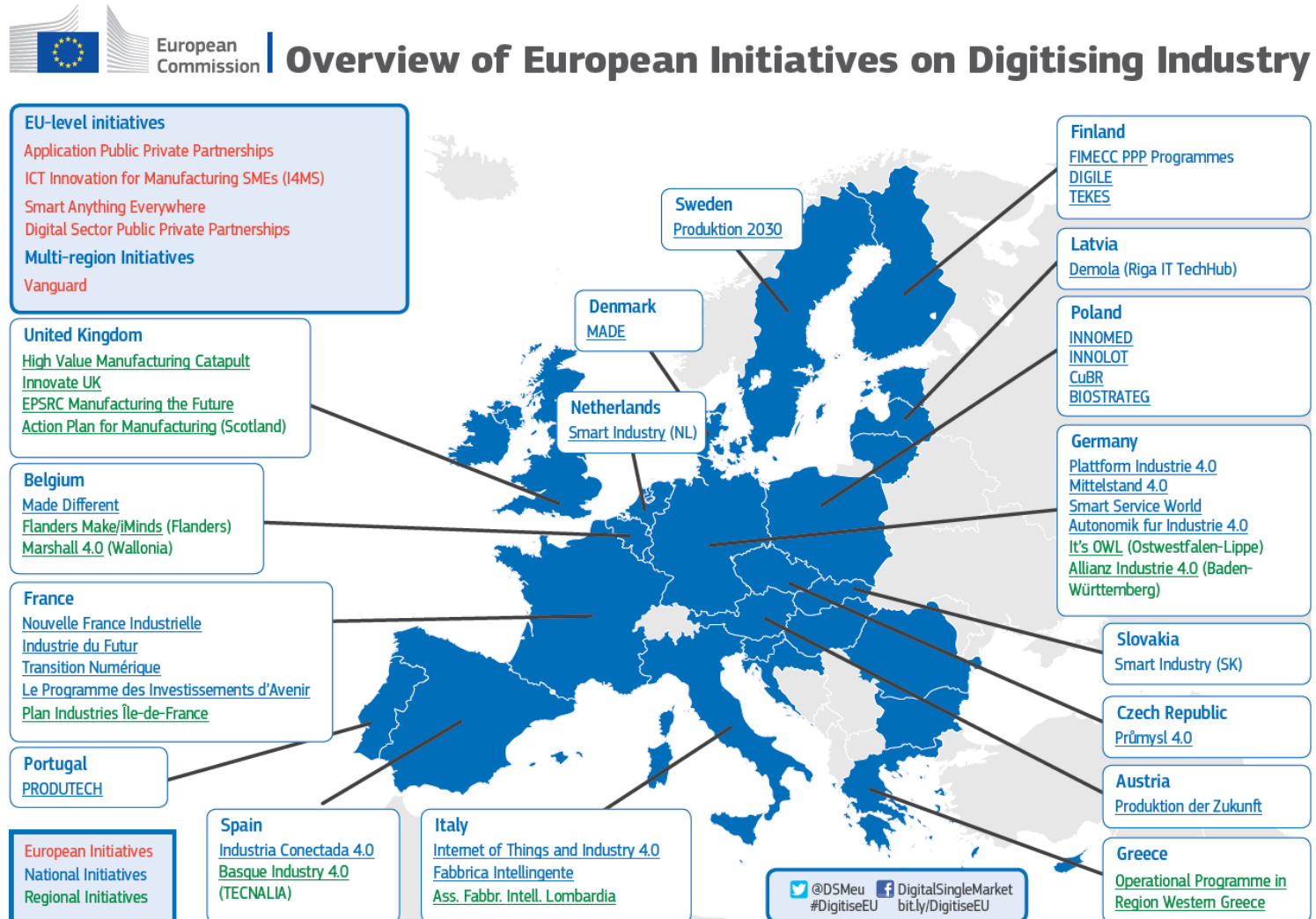


The term "Fourth Industrial Revolution" refers to technologies and concepts of value chain organization. It consists of the intelligent networking of product development and production, logistics and customers.

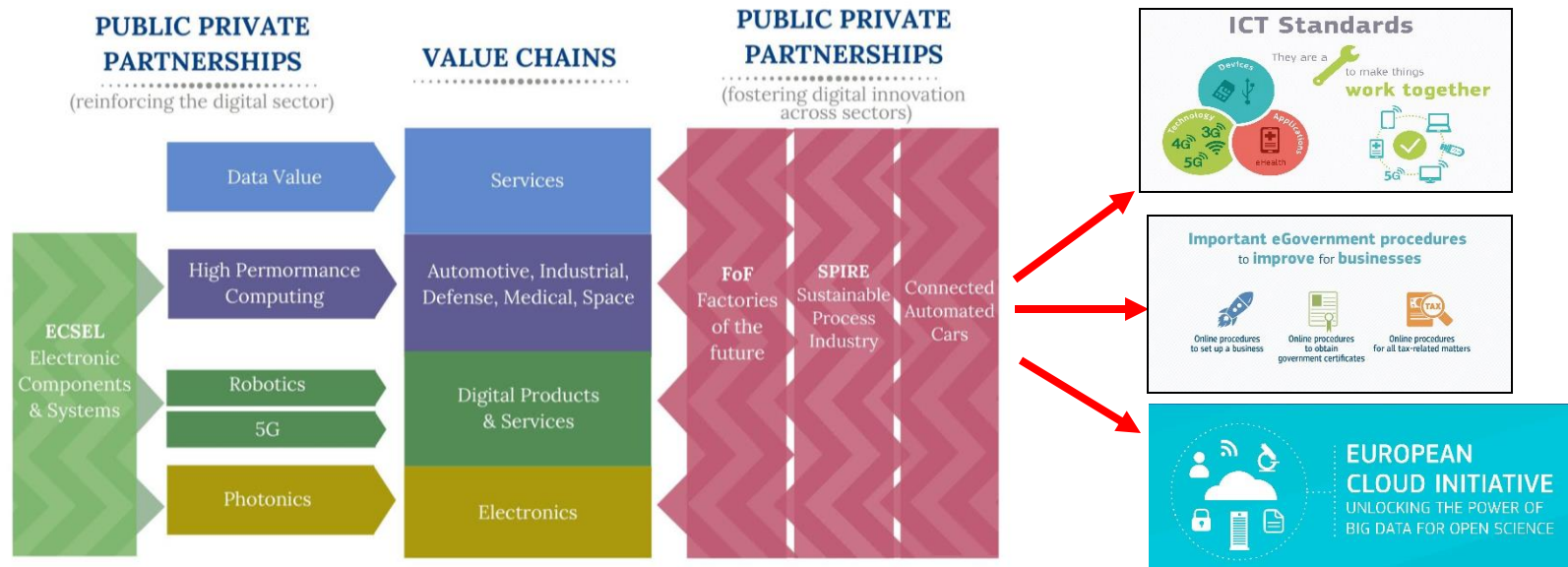
Concept of Industry 4.0 regards it as a series of **disruptive innovations in production and leaps in industrial processes** resulting in significantly higher productivity.

1. A step in digitizing RM sector - entering into European initiatives.

More than 30 national and regional initiatives for digitising industry have been launched across Europe in recent years. With value chains increasingly distributed across Europe, the further digitisation of industry brings challenges that can only be resolved through a collective EU-wide effort.



Ongoing EU initiatives in innovation to speed up digitisation.



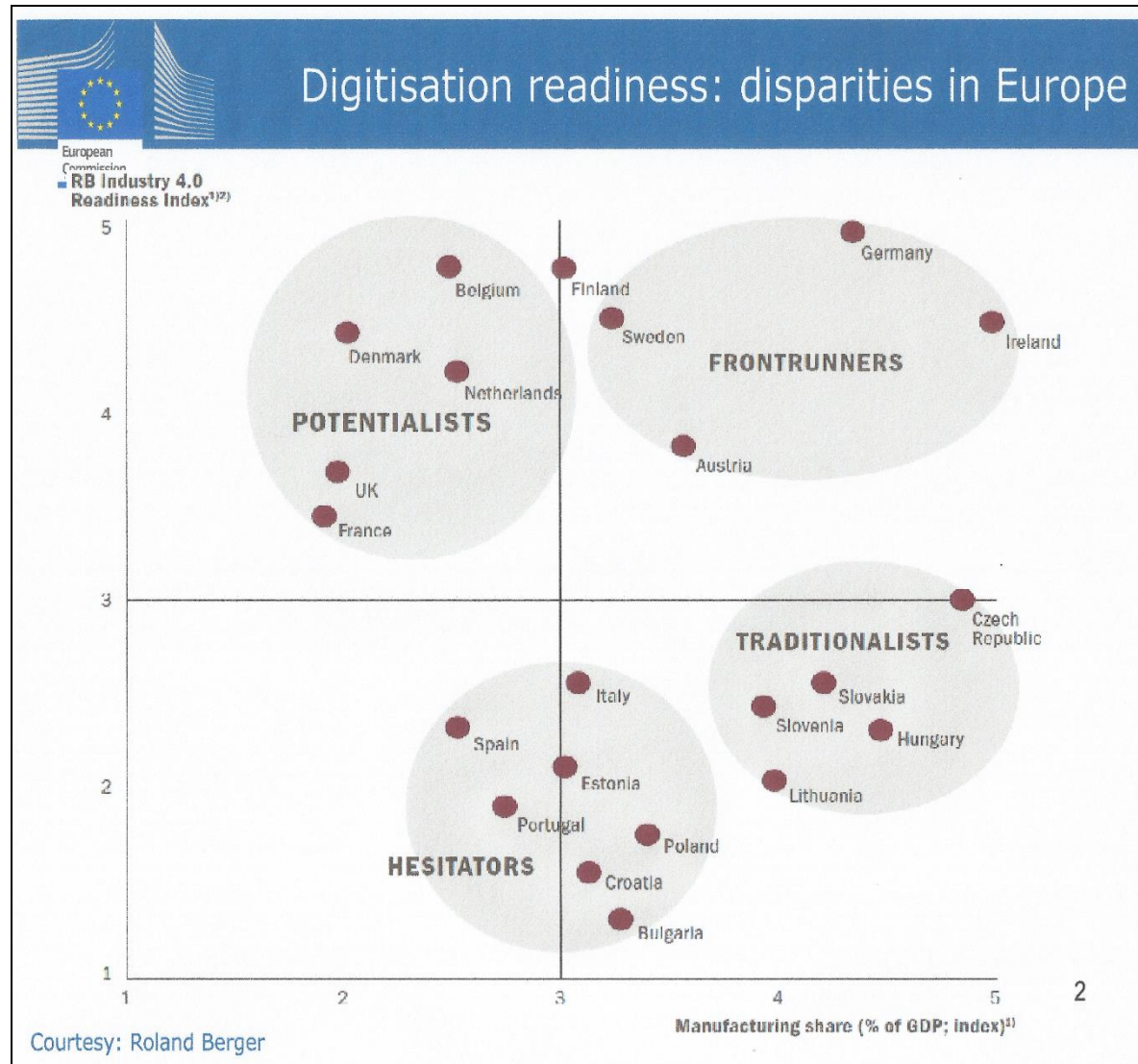
1. **Photonics**: one of the key enabling technologies for our future prosperity and an essential element of many sectors, from energy and health, to everyday products like DVD players and mobile phones;
2. **High Performance Computing** plays a pivotal role in stimulating Europe's economic growth and advancing European science;
3. **Robotics**; a key driver of industrial competitiveness and essential to address key societal challenges in areas such as demographic change, health and well-being, food production, transport and security;
4. **Future internet** aims to advance Europe's competitiveness in Future Internet technologies and to support the emergence of Future Internet-enhanced applications of public and social relevance;
5. **5G** stimulates the development of network internet infrastructure to ensure advanced ICT services for all sectors and users;
6. **ECSEL**; a tripartite PPP in the area of electronic components and embedded software. It is supported with 1.2 bln € from the EU in Horizon 2020, 1.2 bln € from member states and from industry;
7. **Factories of the Future** aims at helping EU manufacturing enterprises, in particular SMEs, to adapt to global competitive pressures by developing the necessary key enabling technologies across a broad range of sectors. It will help European industry to meet increasing global consumer demand for greener, more customised and higher quality products through the necessary transition to a demand-driven industry with less waste and a better use of resources.

Disparities in digitisation level in Europe.

1. **High-tech sectors face severe competition from other parts of the world** and many traditional sectors and small and medium enterprises (SMEs) are lagging behind. There are also large disparities in digitization between EU MS and regions.

2. **About 40% of EU workers have an insufficient level of digital skills.** Source: EUROSTAT, digital skills of the labour force 2015

3. It is expected that rapidly growing demand will lead to more than **800 000 unfilled vacancies in ICT sector by 2020.**

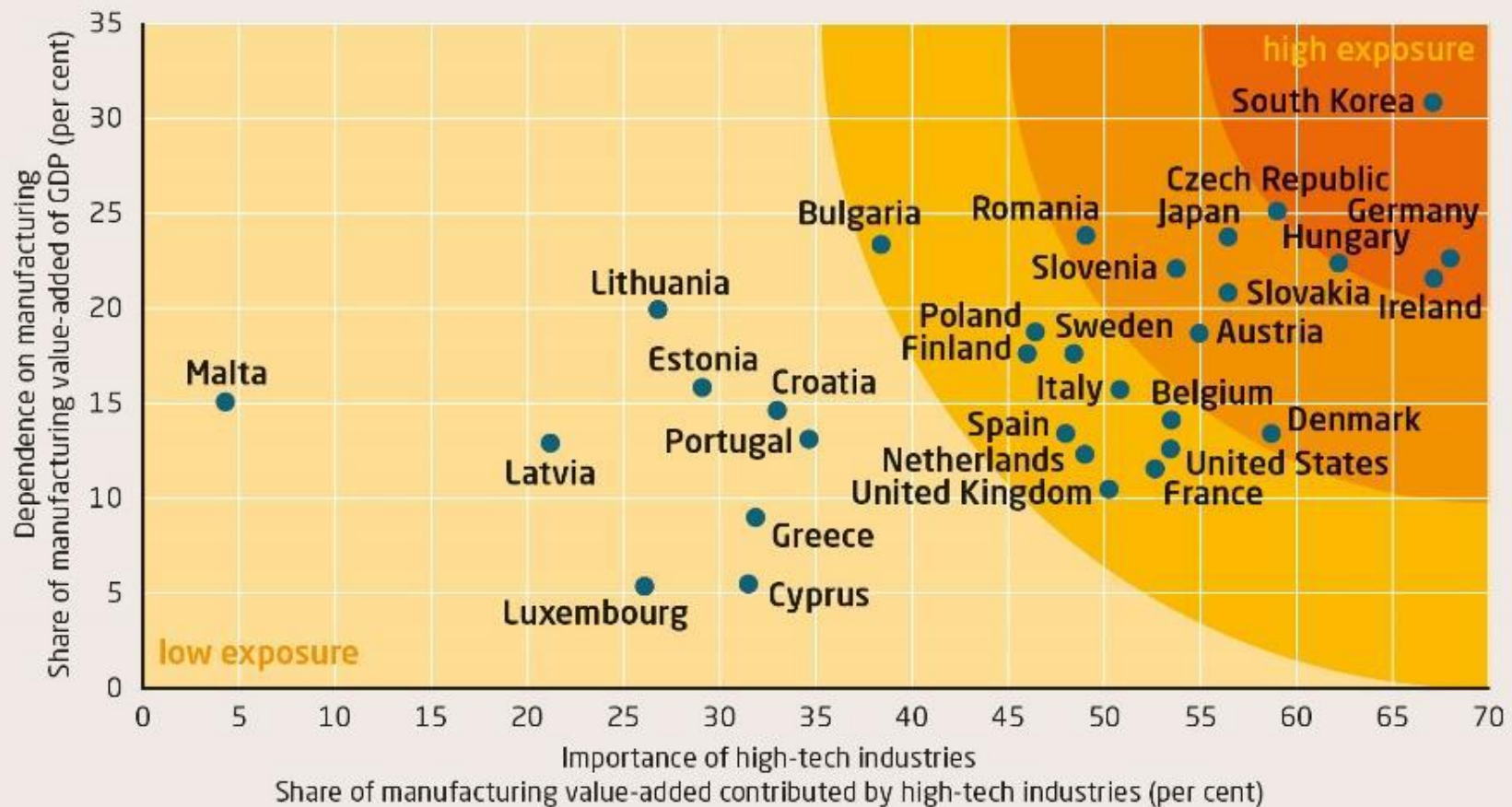


Source: Industry 4.0; Study for ITRE Committee; 2016

Under Pressure: Industrialised countries will feel the heat of Made in China 2025



Vulnerability of select industrial countries to Made in China 2025



Source: MERICS

© MERICS

Vulnerability of selected countries to Made in China 2025.

Source: RE-FINDING INDUSTRY Report from the High-Level Strategy Group on Industrial Technologies *Conference Document 23 February 2018*

Developing an integrated Industrial Digitalisation Strategy (IDS) for the EU (2017-2020).

An EU strategy needs a holistic approach based on the following pillars:

1. European coordination and vision.
2. Setting the right framework conditions (infrastructure, investment, innovation).
3. Emphasizing security as a European specificity in developing new key technologies.
4. Securing European technology leadership and security in industrial digitization: mergers and acquisitions (M&A), cybersecurity, data flows, standardization.
5. Increasing social resilience via skills, education and social innovation.

The EU needs a common strategic approach. 28 separate national strategies, platforms and approaches does not make use of the European added-values, furthers fragmentation and leads to inefficiencies. That's why a European approach with a **European coordinating platform** is crucial to ensure that national strategies are embedded in a larger context taking a European perspective

Place for Robotics in the EU Horizon 2020 innovation programs.

HORIZON 2020 WORK PROGRAMME

5. Leadership in enabling and industrial technologies

i. Information and Communication Technologies (**ICT - SPARC**)

HORIZON 2020 WORK PROGRAMME

5. Leadership in enabling and industrial technologies

ii. Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing (**Factory of the Future - FoF**)

HORIZON 2020 WORK PROGRAMME

12. Climate action, environment, resource efficiency and raw materials

EIP on Raw Materials (SIP).

SPARC – EU largest civilian robotics programme.

euRobotics was founded on 17 Sep 2012 by 35 organisations. By May 2014, euRobotics represented 182 companies, universities and research institutions, ranging from traditional industrial robotics manufacturers to producers of agricultural machinery and innovative hospitals.



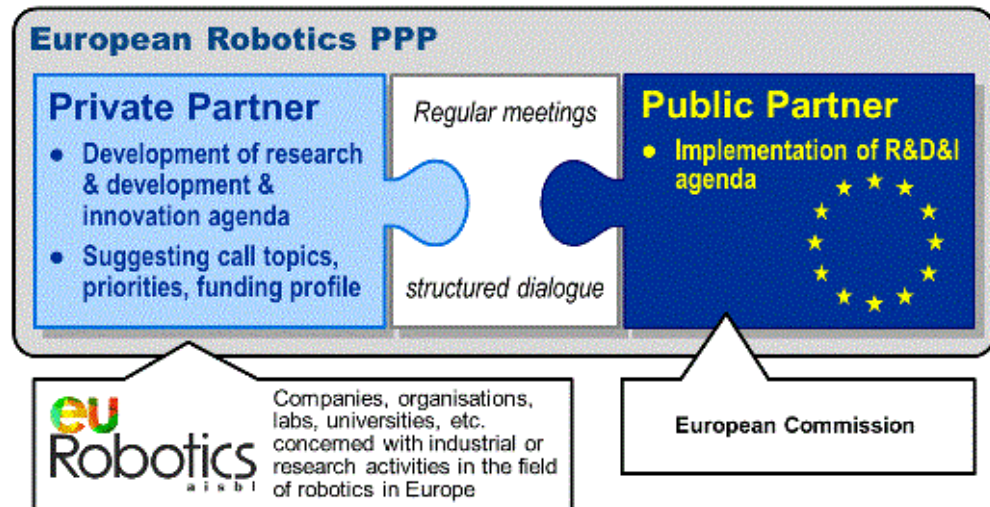
With €700M in funding from the EC for 2014 – 2020, and triple that amount from European industry (€2100M) **SPARC is the largest civilian-funded robotics innovation programme in the world.**

A Roadmap for SPARC.

1. Experts from **euRobotics AISBL** member organisations work in “[Topic Groups](#)”, advise on market domains which would bring maximum results in terms of economy and benefits for the society, and launch [a multi-annual Roadmap \(MAR\)](#). Based on this roadmap, SPARC develops recommendations to the Commission for funding within the area of Robotics under Horizon 2020.
2. SPARC will stimulate an ever more vibrant and effective robotics community that collaborates in the successful development of technical transfer and commercial exploitation.

Ensuring Leadership

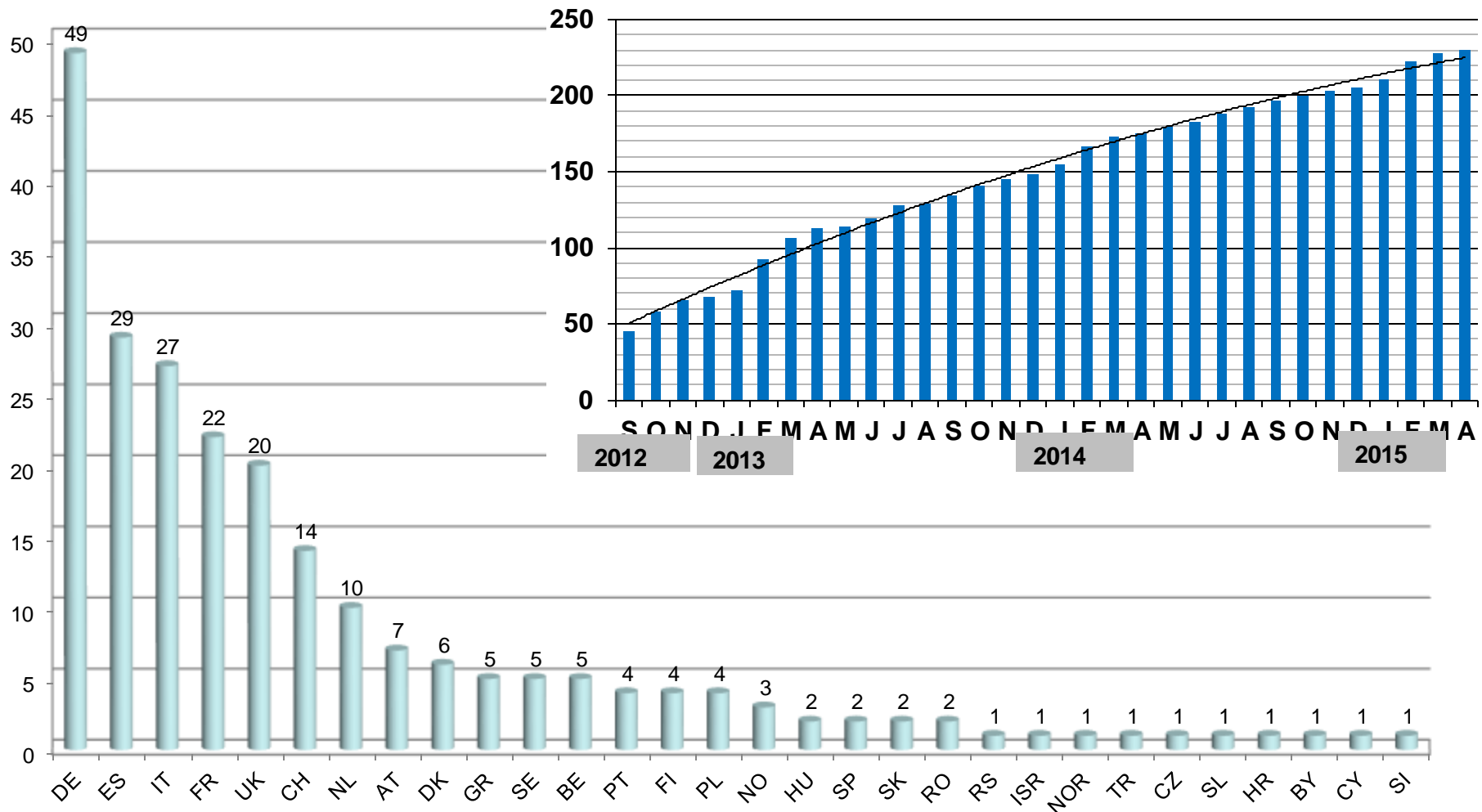
SPARC is a Public-Private Partnership between the European Commission, and European industry and academia to facilitate the growth and empowerment of the robotics industry and value chain, from research through to production.



Current SPARC Topic Groups

- Aerial Robots
- Agricultural Robots
- **AI and Cognition in Robotics**
- **Autonomous Navigation**
- Benchmarking and Competitions
- Bio-Inspired Robots
- Civil Robots
- Education and Training
- Entrepreneurship
- Ethical-Legal-Socio-Economic Issues (ELS)
- Field/Service Robots in unstructured Environments
- Healthcare
- **Industrial Robotics**
- **Logistics and Transport**
- **Maintenance and Inspection**
- **Marine Robotics**
- **Mechatronics**
- Miniaturised Robots
- **Robotics in Mining** ←
- Natural Interaction with Social Robots
- People Transport
- **Perception**
- Physical Human Robot Interaction
- Robot Companions for Assisted Living
- Socially Intelligent Robotics and Societal Applications
- Software Engineering, System Integration, Systems Engineering
- **Space Robotics**
- Standardisation
- **Telerobotics and Teleoperation**
- Construction Robots

Members of the euRobotics AISBL.

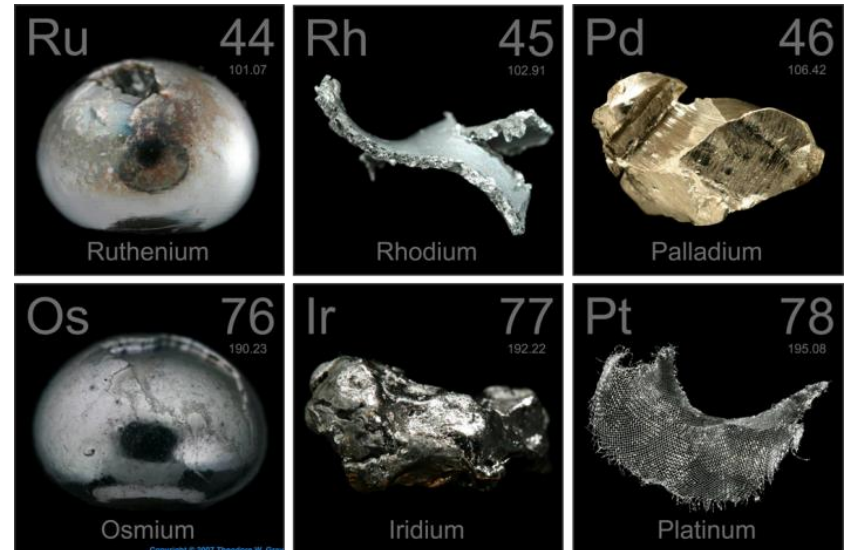


Metals are abundant in **space**

Prospecting and Exploration

Platinum group metals are some of the most rare and useful elements on Earth. They exist in such high concentrations on asteroids that a single 500-meter platinum-rich asteroid can contain more platinum group metals than have ever been mined in human history.

Asteroids contain more common metallic elements such as iron, nickel, and cobalt, sometimes in incredible quantities and often in their pure, non-oxidized metal form.



Planetary subsurface exploration, space mining

Three major directions of technology development

Institutions

1. NASA (National Aeronautics and Astronautics Agency) – USA
2. ESA (European Space Agency).
3. In-situ Resource Utilization (ISRU).
4. National space agencies in many EU member states.

1. Surface construction

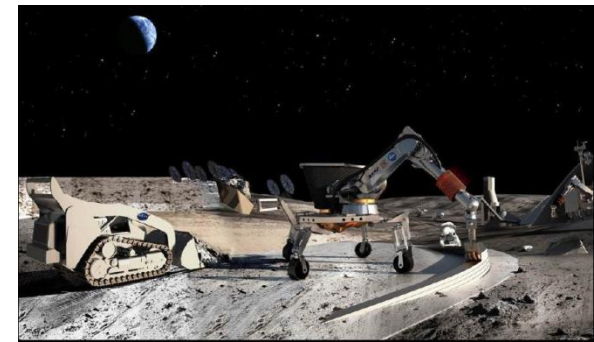
- Site characterization
- Earthwork and ground improvement
- Foundations and lateral support
- Building with regolith

2. Surface and subsurface robots development

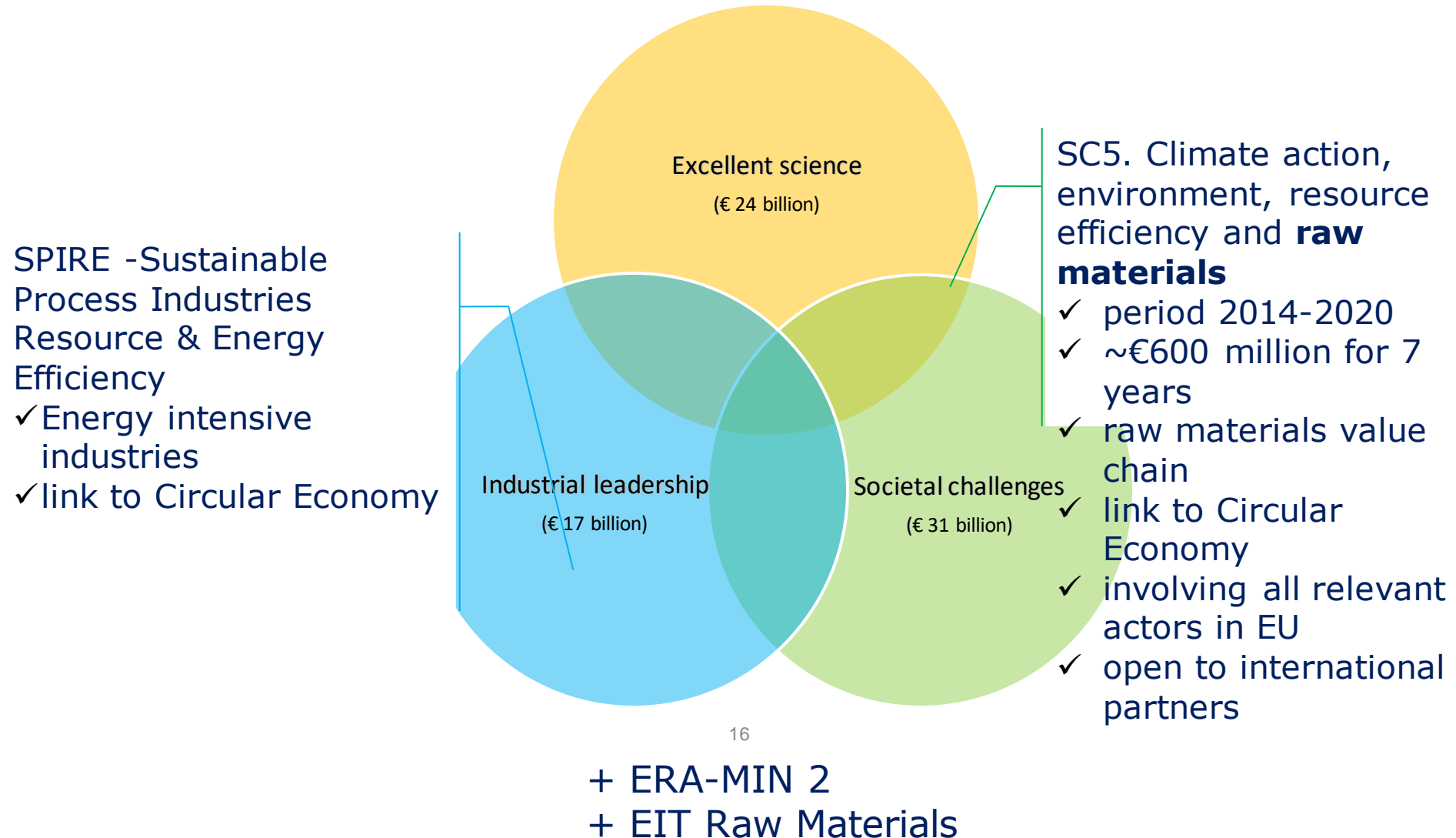
- Rovers, hoppers, locomotion problems
- Drills, penetrometers, „bigger” devices

3. Mining

- Mineral Resource Classification
- Generic resource extraction
- Resource assessment
- Resource acquisition
- Resource beneficiation
- Mine site management



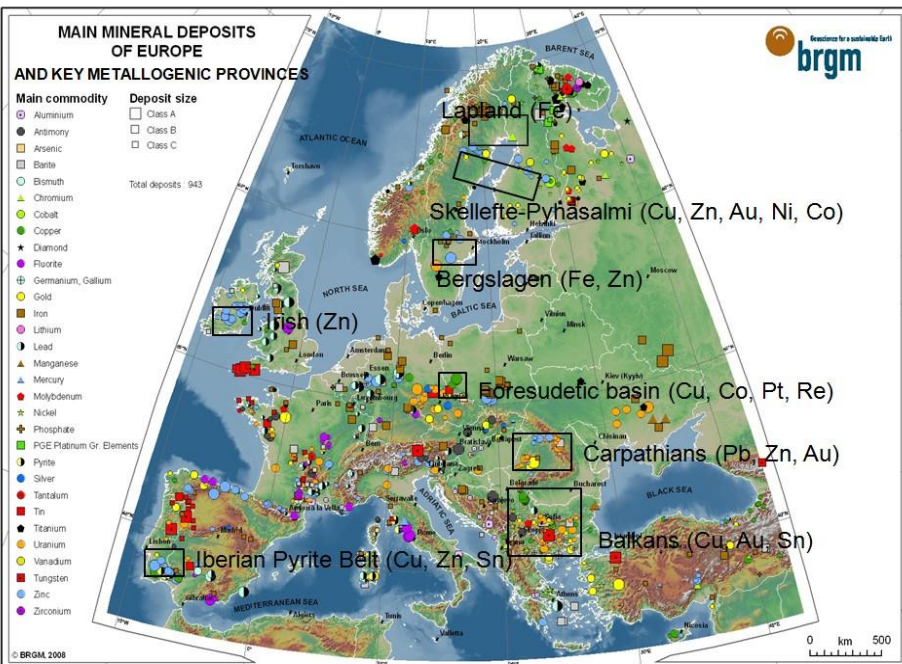
Horizon 2020 – Raw Materials Strategy



EU Commission priorities in RM 2015-2019.

1. Jobs, Growth and Investment - *circular economy and green growth*
3. Energy Union - *transition to a low-carbon economy (renewables, electricity market, transport...)*
4. Internal Market - *unlock the full potential of the single market - a renewed EU Industrial Policy Strategy*
6. Trade policy to harness globalisation - *economic diplomacy - raw materials chapters in FTAs*
9. A stronger global actor - *international cooperation and development*

Europe – two pillars of safe supply in raw materials.



1																	2
H																	He
3	4											5	6	7	8	9	10
Li	Be											B	C	N	O	F	Ne
11	12											13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
55	56	*	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
87	88	**	104	105	106	107	108	109	110	111	112	113	114	115	116	(117)	118
Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh	(Uus)	Uuo

* Lanthanides	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
** Actinides	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

<1%

1-10%

>10-25%

>25-50%

>50%

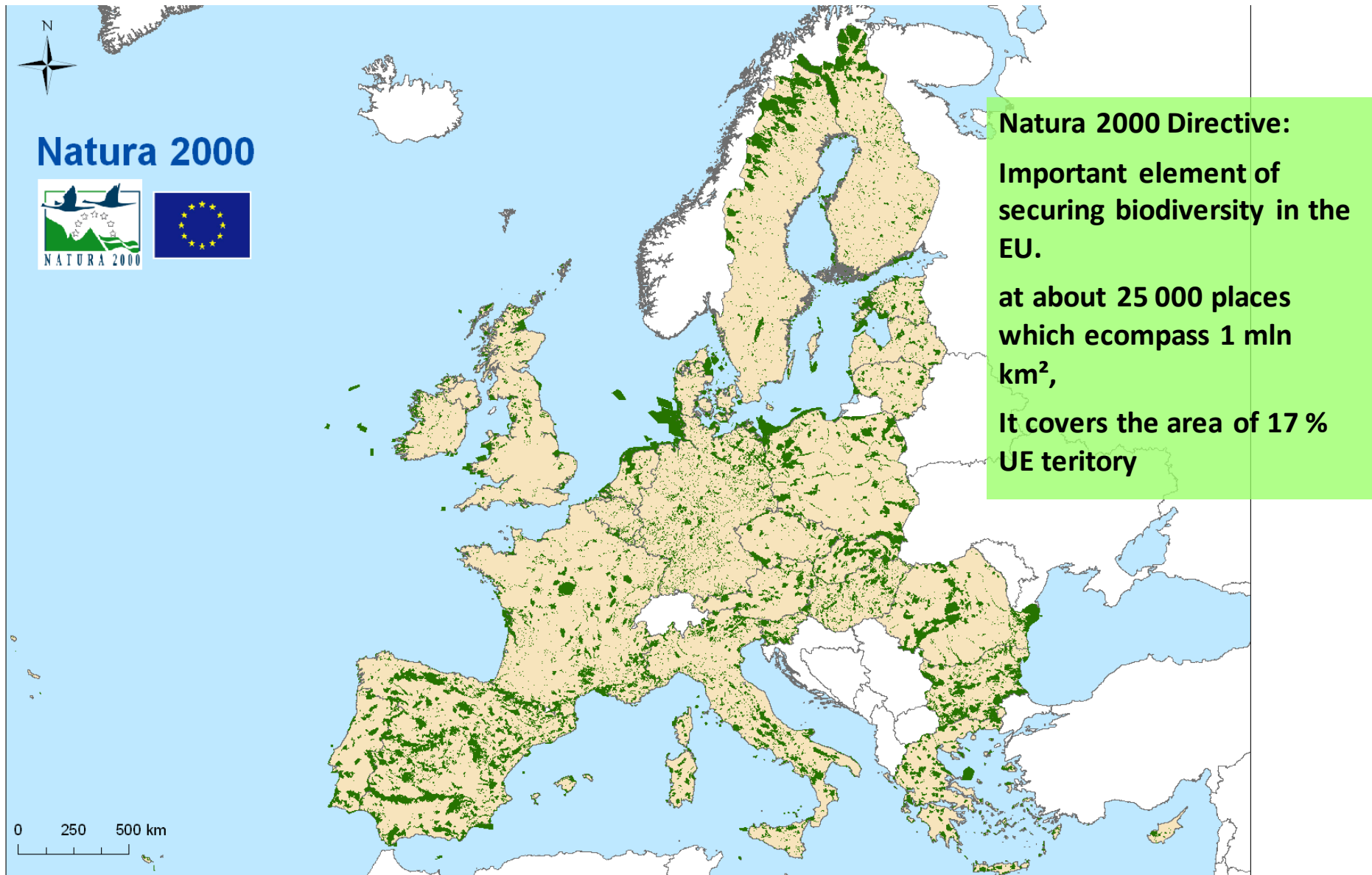
UNEP/EU Working document, Project Ref: LIFE08 ENV/UK/000208, March 2011

1. Mining is a key approach to tap Europe's unexploited minerals at a depth of 500–1500 metres, including **critical raw materials**, with estimated value of about €100 billion. Europe also hosts **several world class mining equipment providers**.

2. **Recycling** is another key way for reducing European demand for non-EU raw materials.

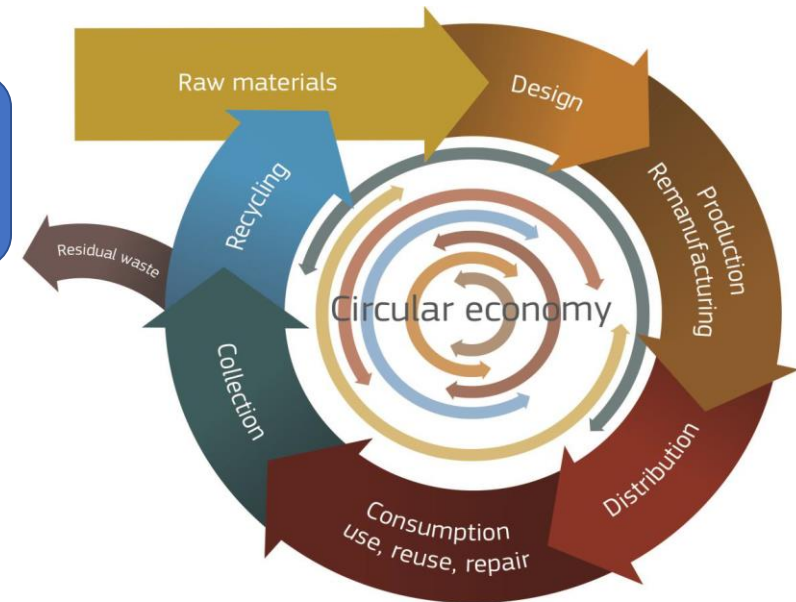
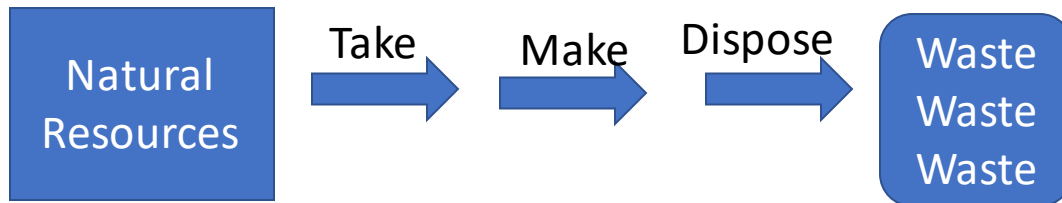
In 2012 each EU citizen generated at about 17 kg of WEEE/year. It is assumed that in the year 2020 this amount will increase up to 24 kg/person.

Institutional constraint in EU: access to land in EU Nature 2000 Directive.



RM - Circular Economy.

From a Linear Economy...



... to a Circular Economy

EU Action Plan – Guiding principles on Circular Economy – 2015. (1)

1. Production: Objectives

1. Promote innovative and resource efficient production processes.
2. Give incentives to the design of products that are easier to repair, recycle and disassemble to recover valuable materials.

Key actions:

1. Promotion of sustainable production and sourcing.
2. Promotion of best practices for waste management and resource efficiency in industrial sectors and mining.
3. Promote reparability, durability, recyclability; Ecodesign requirements.

2. Waste management:

1. Revised legislative package on waste with ambitious 2030 targets for municipal waste and packaging waste.
2. Work with MS, including to avoid over-capacities in residual waste treatment (incineration).
3. Ensure that EU Cohesion Policy contributes to EU waste legislation, guided by the EU waste hierarchy.
4. Promote industry-led voluntary certification of treatment facilities for key waste streams.

EU Action Plan – Guiding principles on Circular Economy – 2015. (2)

3.Single Market for secondary raw materials.

4.Construction & demolition.

5.Critical Raw Materials Key actions

- Reports on critical raw materials and the circular economy.
- Take account of CRMs in measures under the Ecodesign Dir.
- Improve exchange of information between manufacturers and recyclers on electronic products.
- European standards for material-efficient recycling of complex end-of-life products.
- Sharing of best practice for the recovery of critical raw materials from mining waste and landfills.
- Encourage action by Member States (proposal on waste).

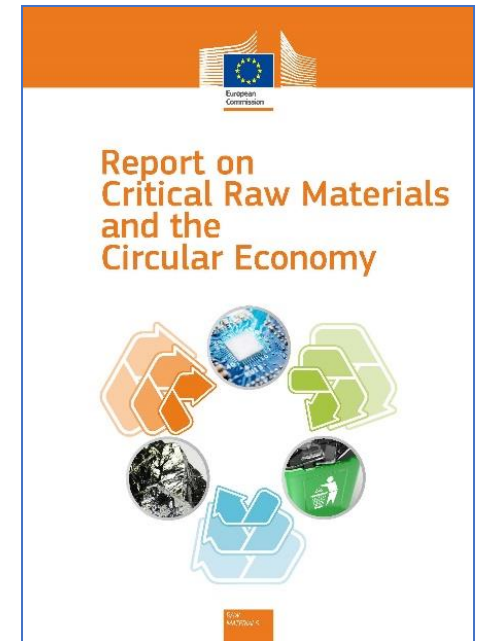
6.Biomass & bio-based products

Report on CRMs in Circular Economy

Objectives:

- To help EU Member States implement the new provisions on critical raw materials in the EU Waste Framework Directive
- Provide information, data sources and identify best practices and possible further actions

Issued in January 2018 (SWD(2018)36), taking into account the 2017 list of 27 critical raw materials



Key Sectors:

- Electric and Electronic Equipment
- Automotive
- Batteries
- Renewable Energy
- **Defense equipment**
- Chemicals & Fertilizers

Military technologies that would be impossible without supply of some basis and RE metals.

Three pillars of EU defense programme - building stage.

- Opening of European Defence Fund
- Supporting the investments in military sector.
- Fostering European Defence industry.

Modern military technology relies on use of many critical metals including REE.



Military technologies which use REE metals

- Communications & Surveillance
- Jet Engines & Aircraft Parts
- Global Positioning Systems
- Air & Sea Navigation
- Satellite Technology
- Radar & Sonar
- Night Vision
- Stealth Technology
- Laser-Based Weapons
- Mine Detectors
- Missile Defence Systems
- Electronic Countermeasures
- Weapon Detection
- Missile Guidance & Smart Bombs
- Range Finders

LRAs at the core of circular economy.



ACR+ Network for local & regional authorities

- +/- 90 members
- 23 countries
- > 1000 LRAs



Convenant members 2022 RMC- CE.



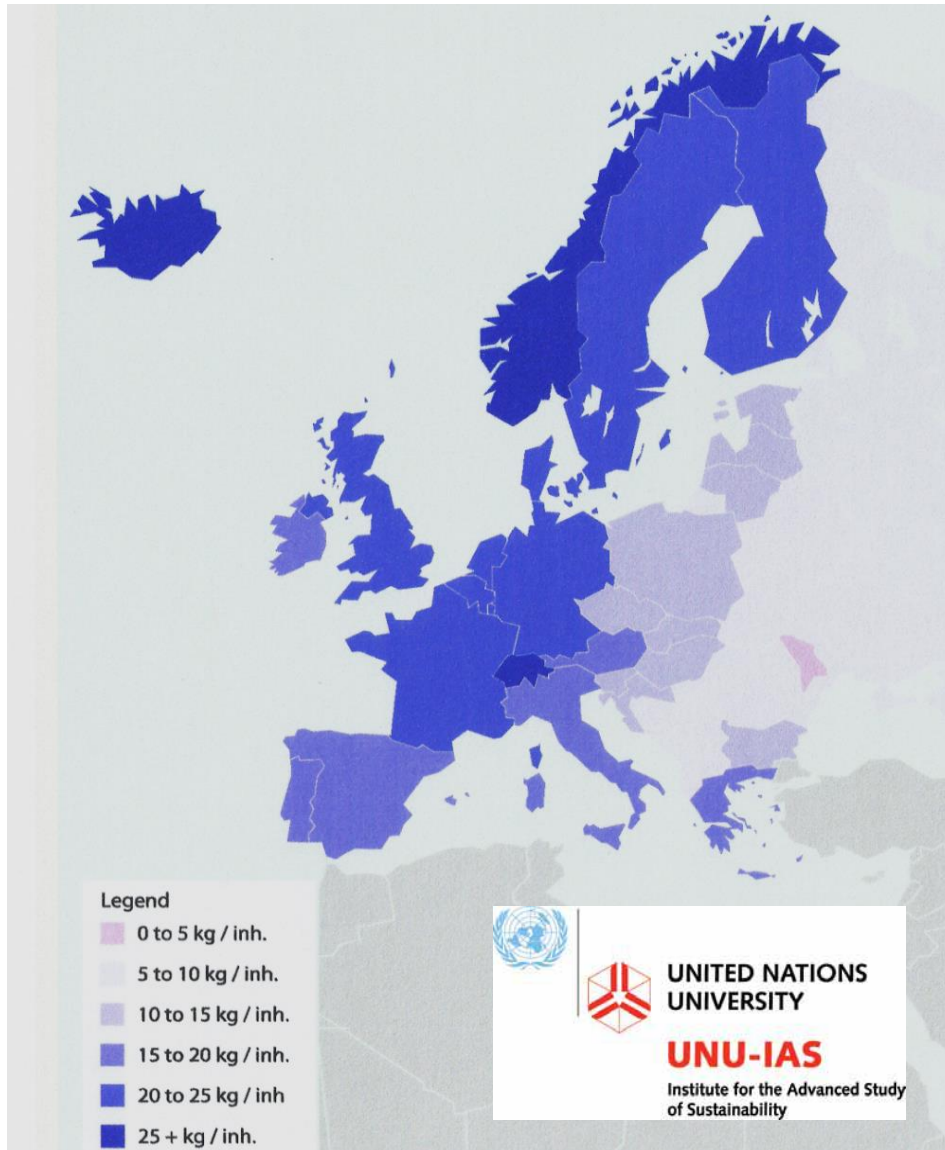
Members: Regions and cities.

1. Alsace, France
2. Bretagne, Francia
3. Ile de France, France
4. Lapland, Finland
5. Lombardy, Italy
6. Norrbotten, Sweden
7. Rhône Alpes, France
8. Athens, Greece

Associated organisations.

1. The Association of Cities and Regions for Recycling and Sustainable Resource Management (ACR+)
2. Assembly of European Regions (AER), Europe
3. Eco-Union, Spain
4. European Partners for the Environment (EPE), Europe
5. Institut de l'économie circulaire, France
6. The Regional Environmental Center for Central and Eastern Europe (REC), Hungary
7. State Geological Institute of Dionýz Štúr, Slovakia
8. StEP Initiative – Solving the E- Waste Problem,
9. United Nations University, Germany.
10. United Nations Environment Programme (UNEP).

Domestic e-waste generated in Europe.



1. In Europe, the total e-waste generation was 11.6 Mt in 2014. The European countries with the highest e-waste generation in absolute quantities are: Germany (1.8 Mt), the UK (1.5 Mt), France (1.4 Mt) and Russia (1.2 Mt).

2. The European Union is one of the few regions in the world where there is uniform legislation regarding the collection and processing of e-waste. This is formulated in the WEEE Directive (2012).

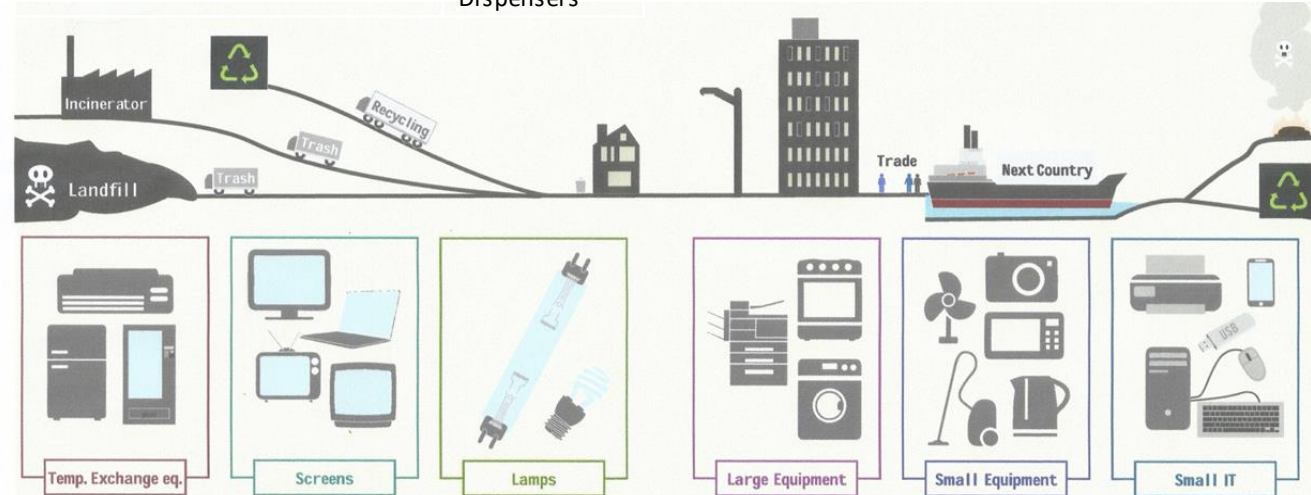
3. The successor of the WEEE Directive will come into force in 2019. In here, one of the targets is to **collect 85 % of generated e-waste**. In practice, most Member States do not reach that collection level yet.

4. Finally, the **e-waste can be exported for reuse**. Although this has a higher priority in the waste treatment hierarchy, **these exports can lead to improper recycling** in the destination countries.

Definitions of e-waste (WEEE).

Table 1. e-waste categories according to the EU directive on WEEE:

No.	Category	Label
1	Large household appliances	Large HH
2	Small household appliances	Small HH
3	IT and telecommunications equipment	ICT
4	Consumer equipment	CE
5	Lighting equipment	Lighting
6	Electrical and electronic tools (with the exceptions of large-scale stationary industrial tools)	E & E tools
7	Toys, leisure and sport equipment	Toys
8	Medical devices (with the exception of all implanted and infected products)	Medical equipment
9	Monitoring and control instruments	M & C
10	Automatic dispensers	Dispensers



Focus on WEEE recycling and other waste management framework conditions in S.C. 5 H2020 programme for 2016-2017 .

II.4.1 Eco-design Directive.

II.4.2 Product life extension strategies and circular business models.

II.4.3 Critical raw materials in product and waste flows.

II.5.1 Qualitative targets.

II.5.2 Landfill and incineration bans.

II.5.3 Waste collection systems and Extended Producer Responsibility (EPR) schemes.

II.5.4 Innovative approaches for reuse and recovery of end-of-life consumer products.

II.6.1 Waste shipment inspections.

II.6.2 Certification for end-processing/recycling facilities.

II.7.1 European standards for treatment of WEEE.

II.7.2 End-of-waste criteria.



Main flaws in EU WEEE recycling.

Poor collection



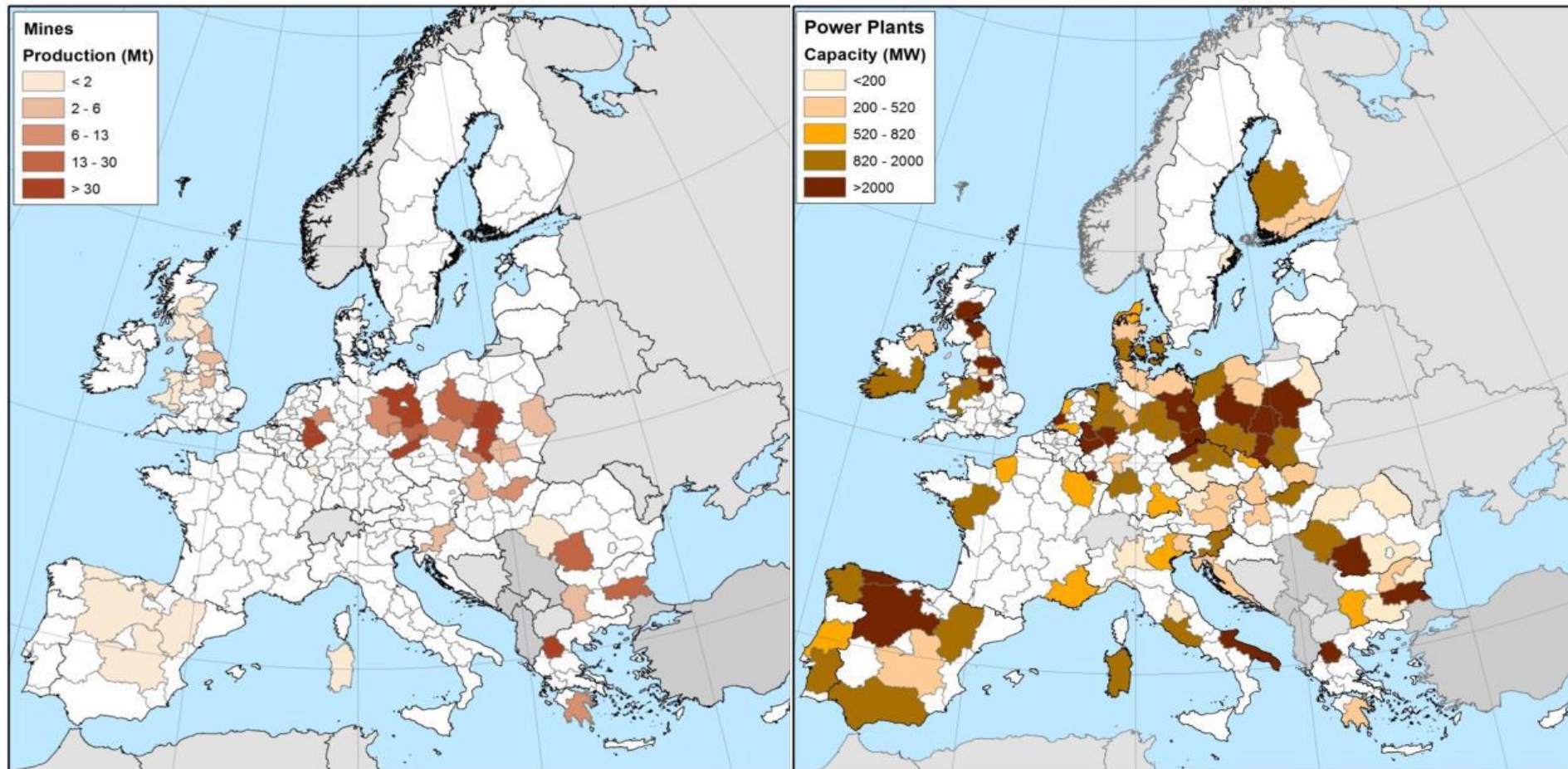
Deviation of collected materials \Rightarrow dubious exports \Rightarrow backyard treatment



Climate change and carbon leakage: Energy-intensive industries and the EU's decarbonisation roadmap.

- Does decarbonisation inevitably mean de-industrialisation?
- What action can the EU take in order to efficiently safeguard the international competitiveness of its energy-intensive industries?
- Can the EU create a genuinely level playing field, while adhering to its climate goals and principles? And at what cost?
- Can European Energy Intensive Industries turn to greener energy sourcing in a reliable and affordable manner within the internal energy market?

Coal regions in EU during transformation period.



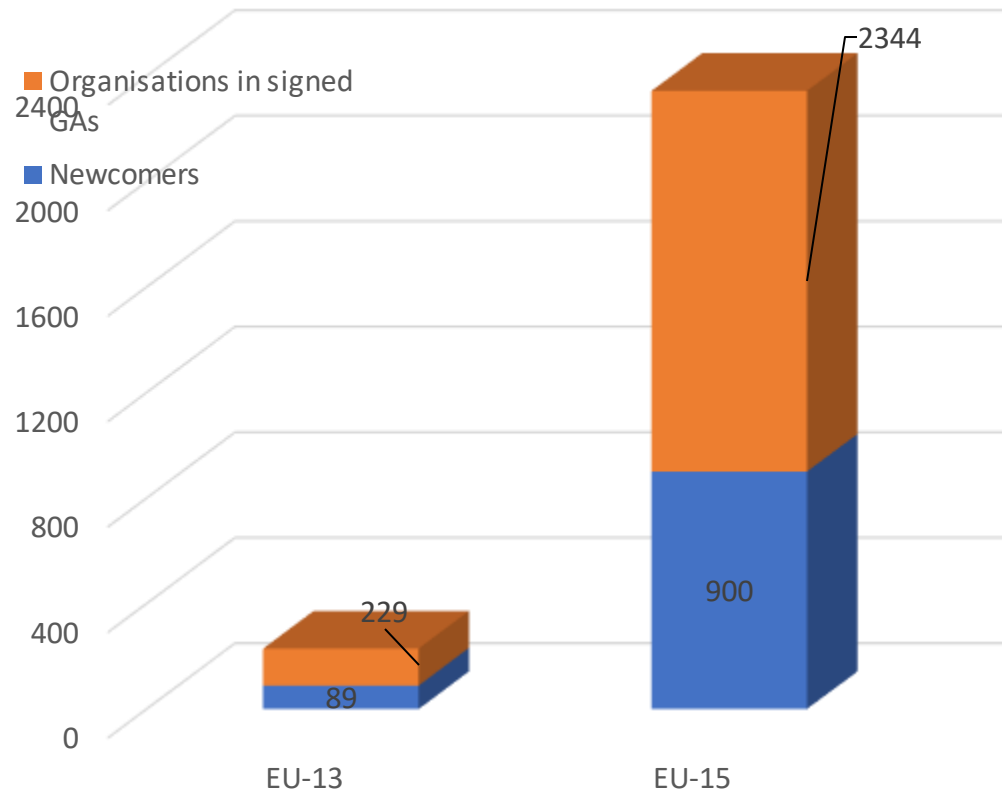
EU regions with active brown and hard coal mines.

EU regions with coal power plants

Source: The European Commission's science and knowledge service Joint Research Centre High Level Event Smart Specialisation Platform on energy (S3PEnergy); 2018

Activity: Involvement of EU-15 (old members) and EU-13 (new members) countries in H2020 programme.

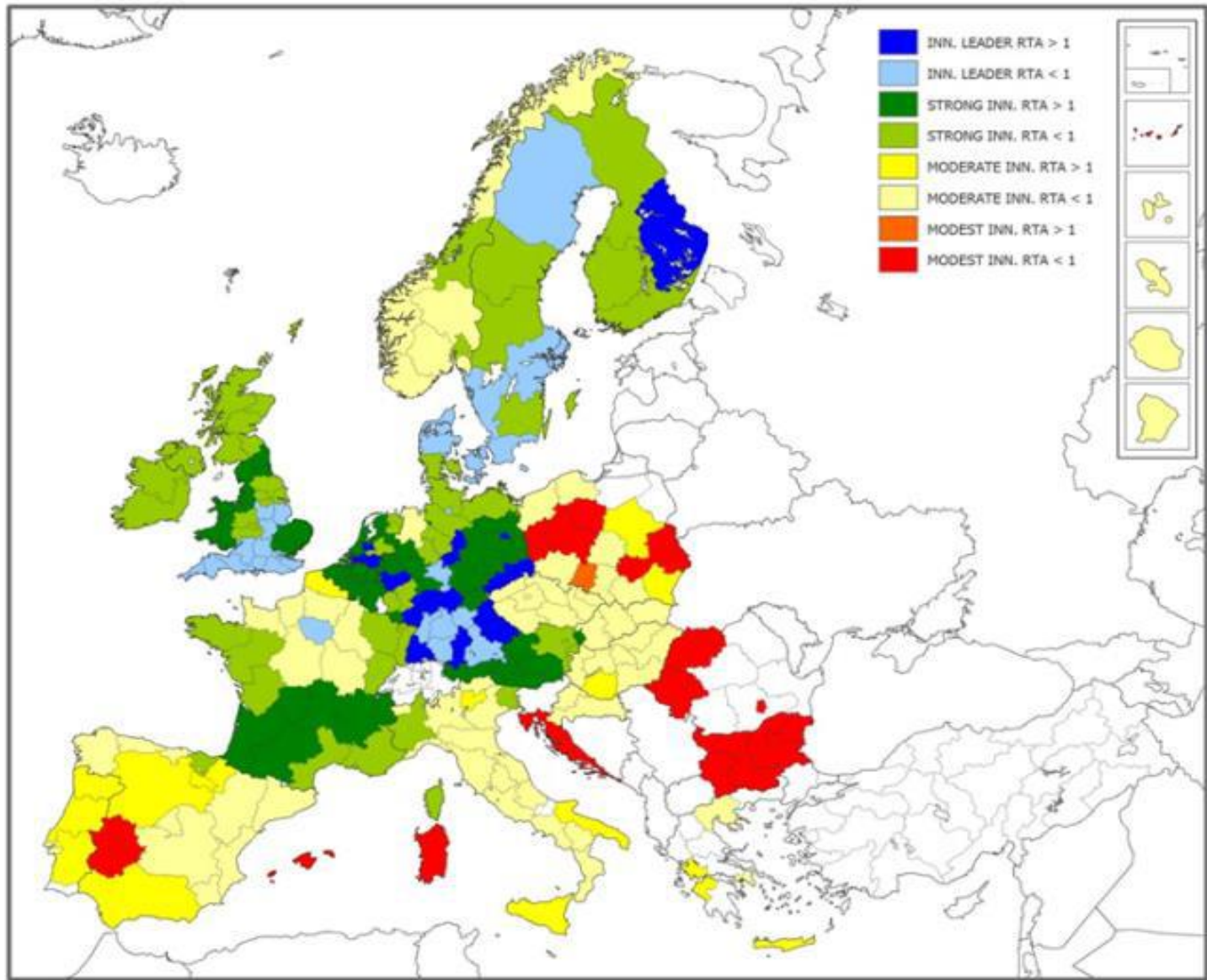
The striking difference for the 13 countries that joined the EU relatively recently. Out of a total number of 2,573 programme participants from the 28 Member States, only 89 are from the EU-13.



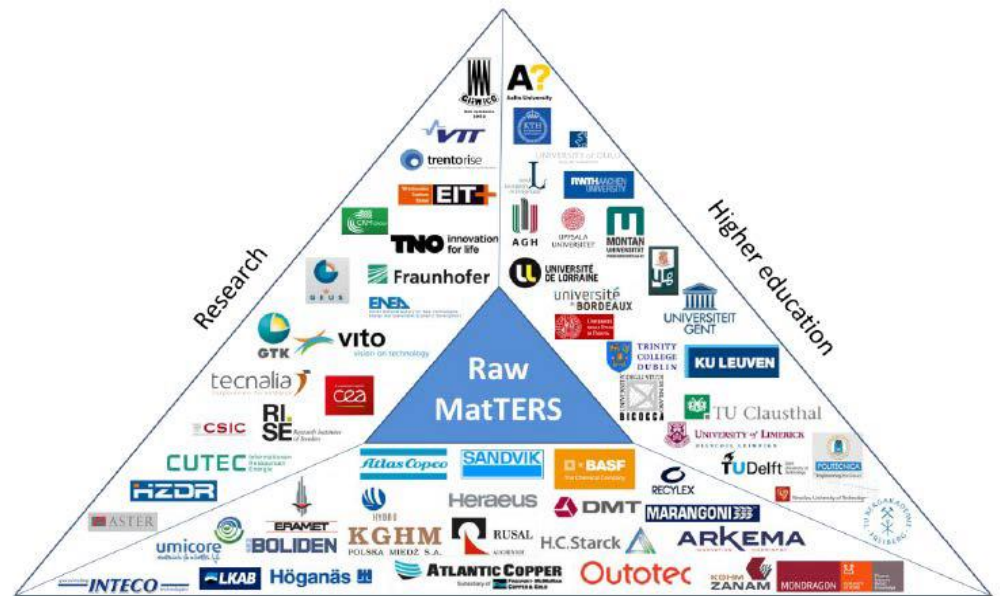
EU should establish incentives to promote the involvement of EU-13 participants; designing call topics suitable for potential participants from the EU-13; engaging citizens, national and regional stakeholders and policy makers. Such measures may form a part of future EU Work Programmes, but can be also be deployed by Member States and regions.

Newcomers in EU-13 and EU-15 Source: CORDA data

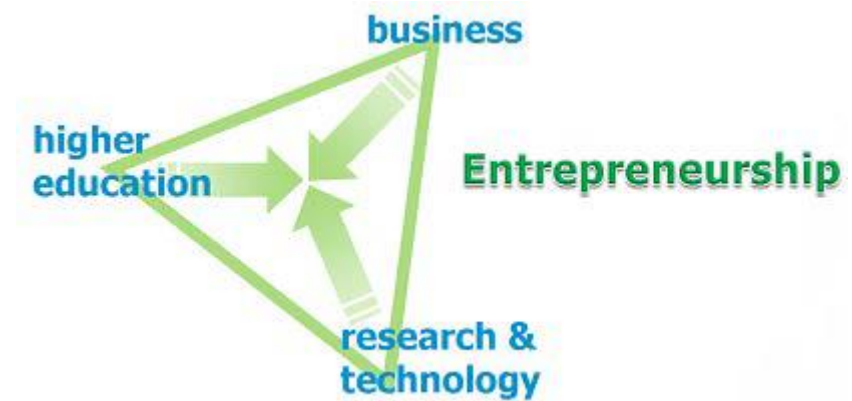
EU - Regional Innovation Scoreboard 2016.



Regions with a positive specialization in KETs are located everywhere in the EU.



European Institute of Innovation and Technology (EIT). It is the first EU-initiative bringing together the three sides of the “knowledge triangle”: business, higher education institutions and research centers



EIT Raw Materials



Knowledge and Innovation Community (KIC)

>120 partners, 23 countries
€400 million budget (2015-2021)

- HQ: Berlin, Germany
- Northern CLC: Luleå, Sweden:
- Eastern CLC: Wroclaw, Poland
- Southern CLC: Rome, Italy
- Western CLC: Metz, France
- Central CLC: Leuven, Belgium
- Baltic Sea CLC: Espoo, Finland

36

Regular calls every year



EU – Main innovative research areas /INVESTMENTS.

Cluster partners implement and participate in many national and international projects.

In 2014 European Institute of Technology (EIT) **established a new (KIC – Knowledge and Innovation Community) in the area „Raw Materials”**, which they are carried out research in the field of raw materials.

There are 9 entities associated in the Cluster.

1. IATI - HIGHWAY INSTITUTE OF TECHNOLOGY AND INNOVATION
2. ENVITECH
3. INCA NETWORKS
4. PLATFORM EUROPEAN CLUSTER COLLABORATION (ECCP)
5. UNET
- 6. EUROPEAN TECHNOLOGY PLATFORM ON SUSTAINABLE MINERAL RESOURCES**
7. KIC INNOENERGY - EUROPEAN DEVELOPMENT PROJECT SUPPORTING INNOVATION IN THE FIELD OF ENERGY
8. PROMETIA - MINERAL PROCESSING AND EXTRACTIVE METALLURGY FOR MINING
9. RECYCLING INNOVATION ASSOCIATION

Thank you!

Critical raw materials for the EU:

http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en

Methodology for establishing the EU list of critical raw materials:

<https://publications.europa.eu/en/publication-detail/-/publication/2d43b7e2-66ac-11e7-b2f2-01aa75ed71a1/language-en/format-PDF/source-32064602>

Report on critical raw materials and the circular economy :

<https://publications.europa.eu/en/publication-detail/-/publication/d1be1b43-e18f-11e8-b690-01aa75ed71a1>

Raw Materials Information System:

<http://rmis.jrc.ec.europa.eu/>

EU Raw materials, metals, minerals and forest-based industries:

https://ec.europa.eu/growth/sectors/raw-materials_en

EIP on Raw Materials:

<https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en>

Horizon 2020 - raw materials and calls:

<https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/index.html>

Henryk Karaś, Chief Specialist in Technology Transfer; PGI-PRI; Warsaw

+48 22 4592 515 ;

mobile +48 695 025 938

h.karas@pgi.gov.pl