

-GROWTH-



Mineral resources in Greece Assessment & Outlook



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6th International Forum – Mineral Resources in Greece

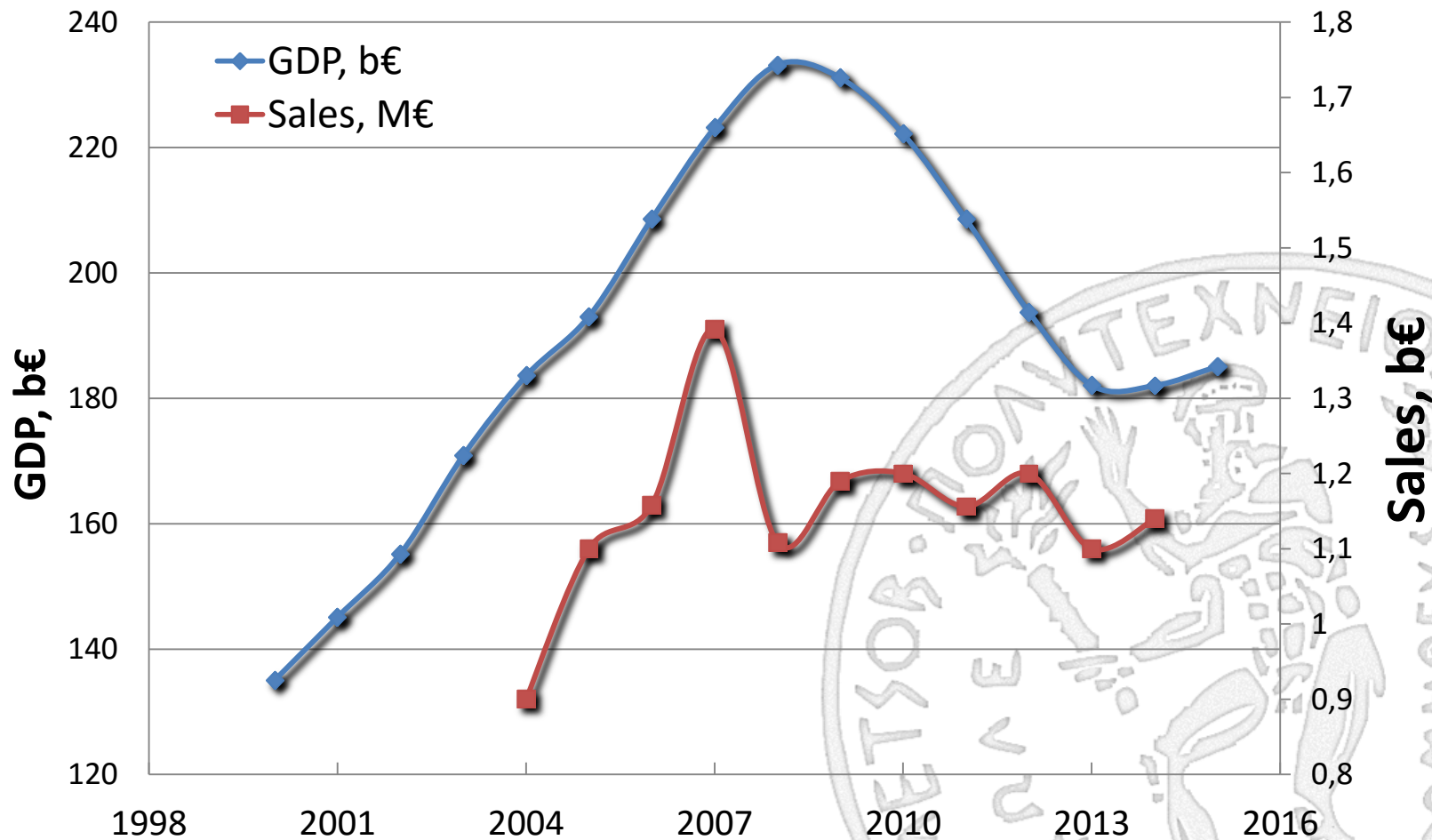


Mineral Wealth

What is the future

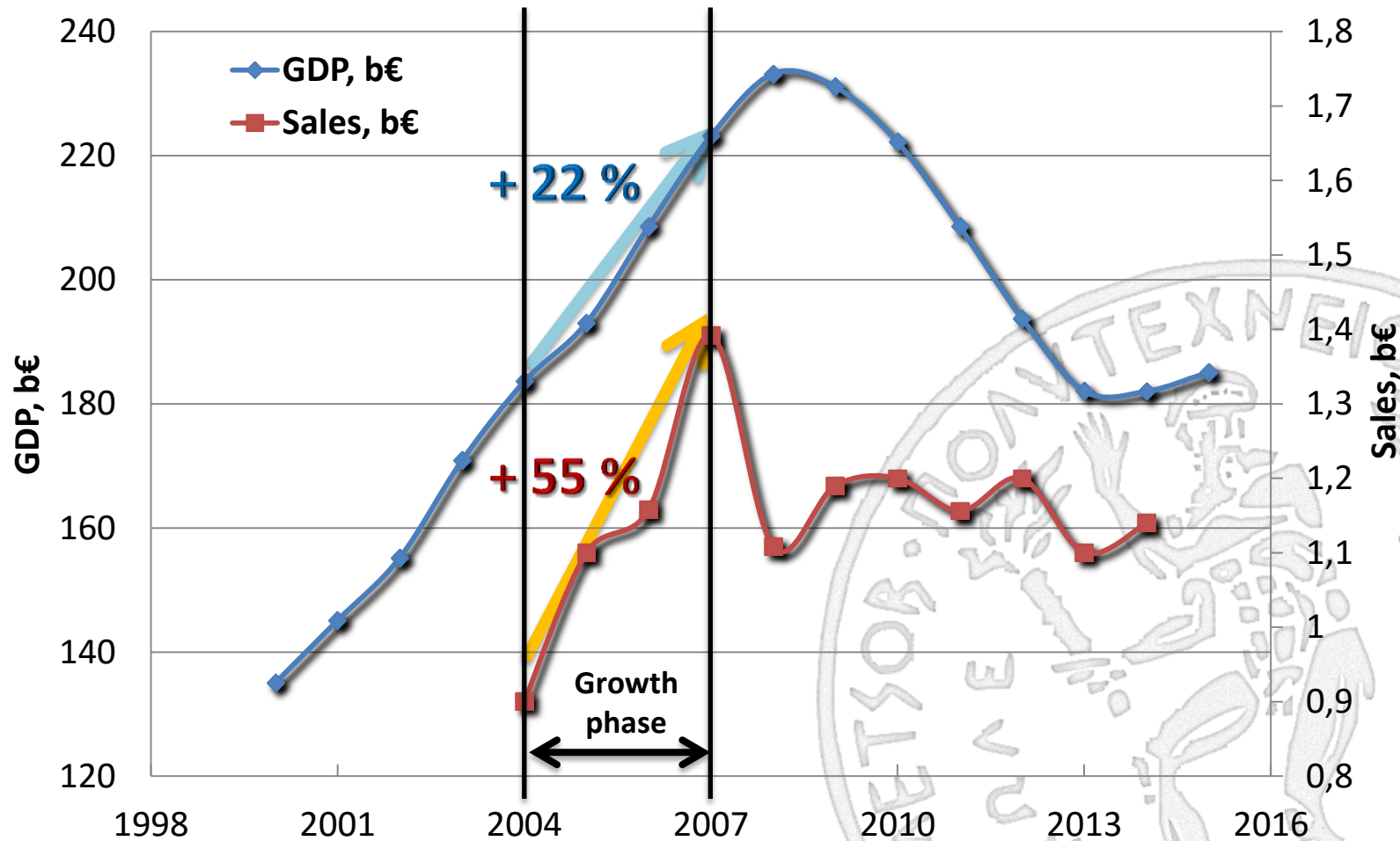


GDP evolution and RM sales

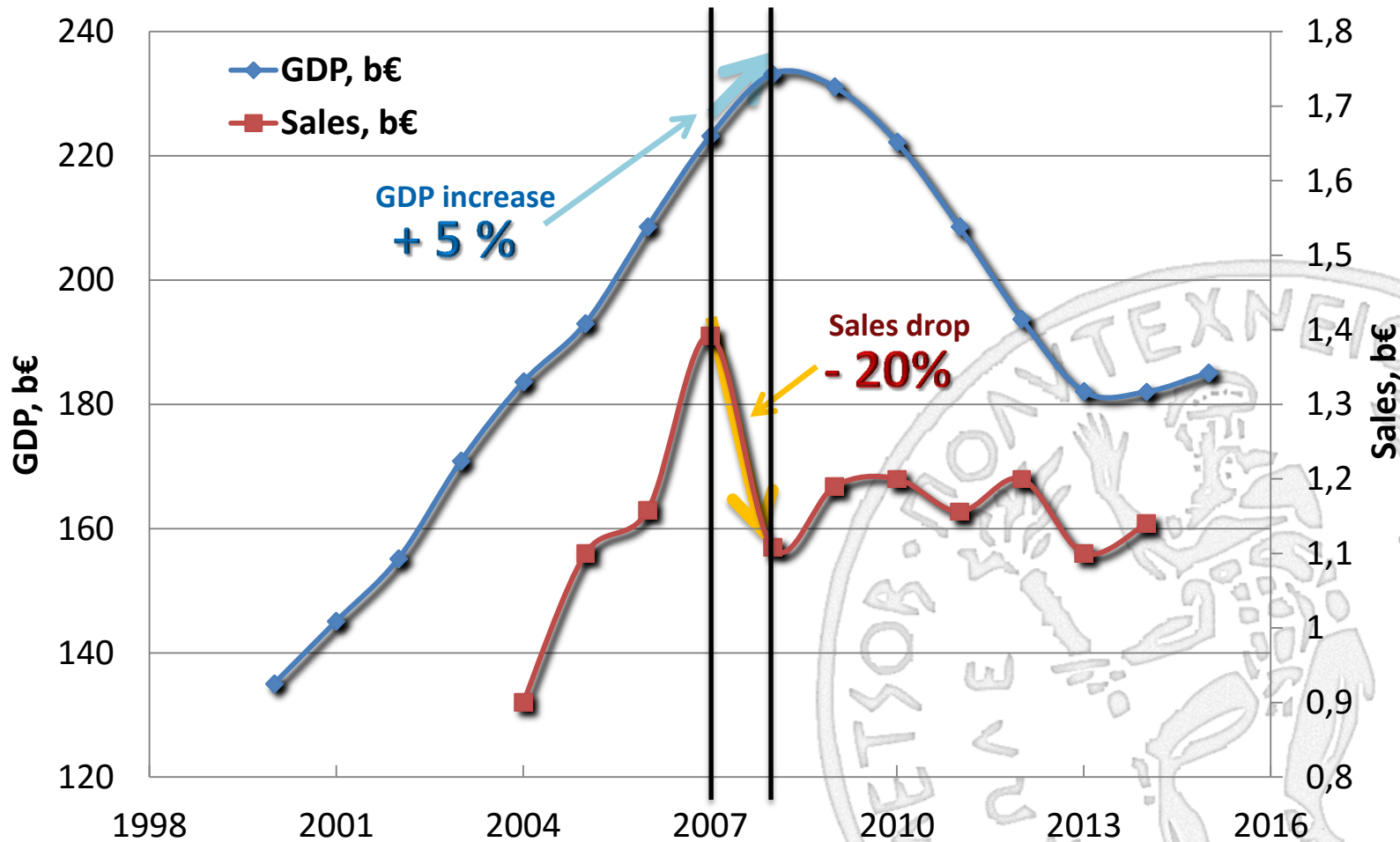


➔ Three distinct phases

GDP evolution and RM sales

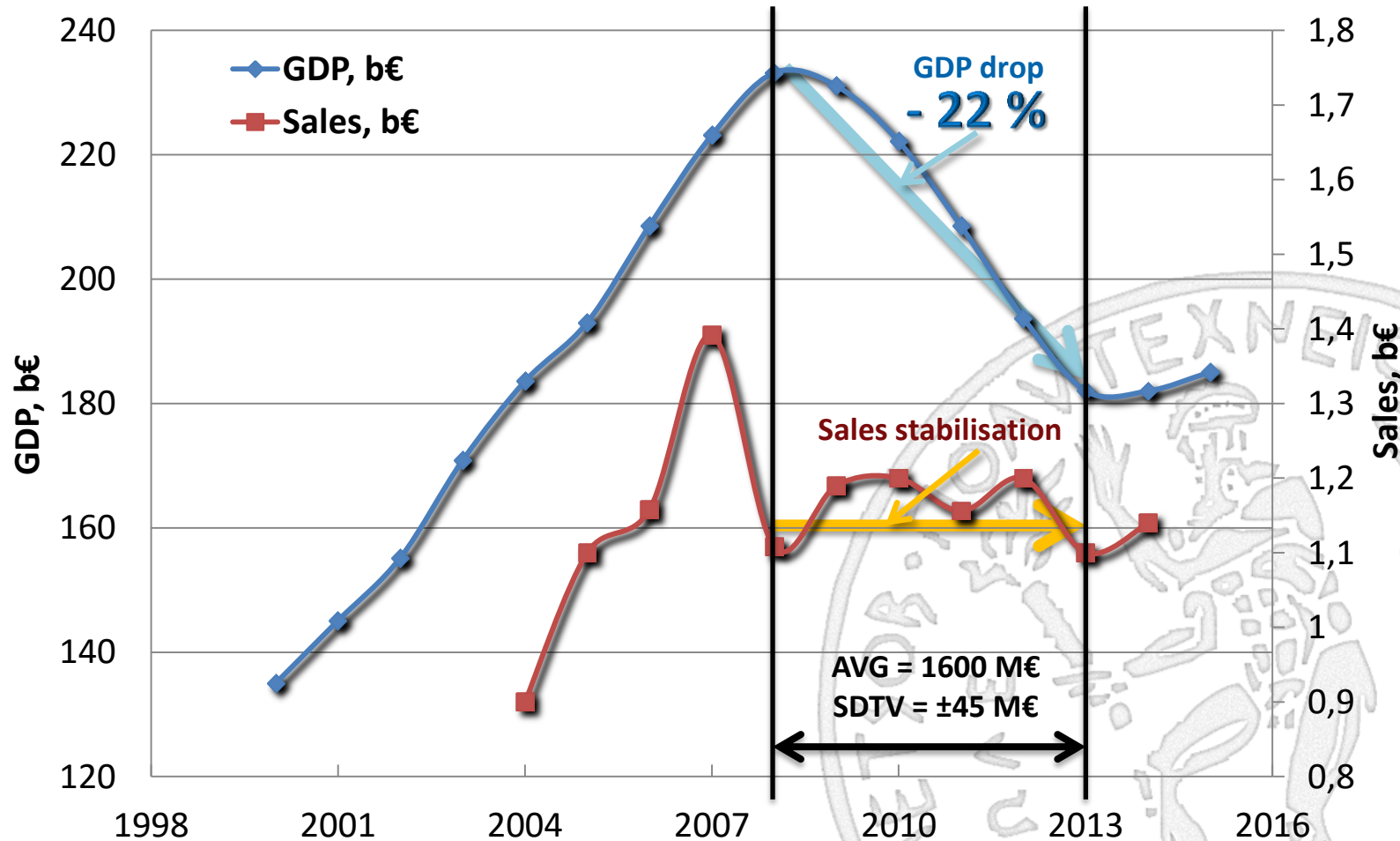


GDP evolution and RM sales



Why sales dropped between 2007-2008?

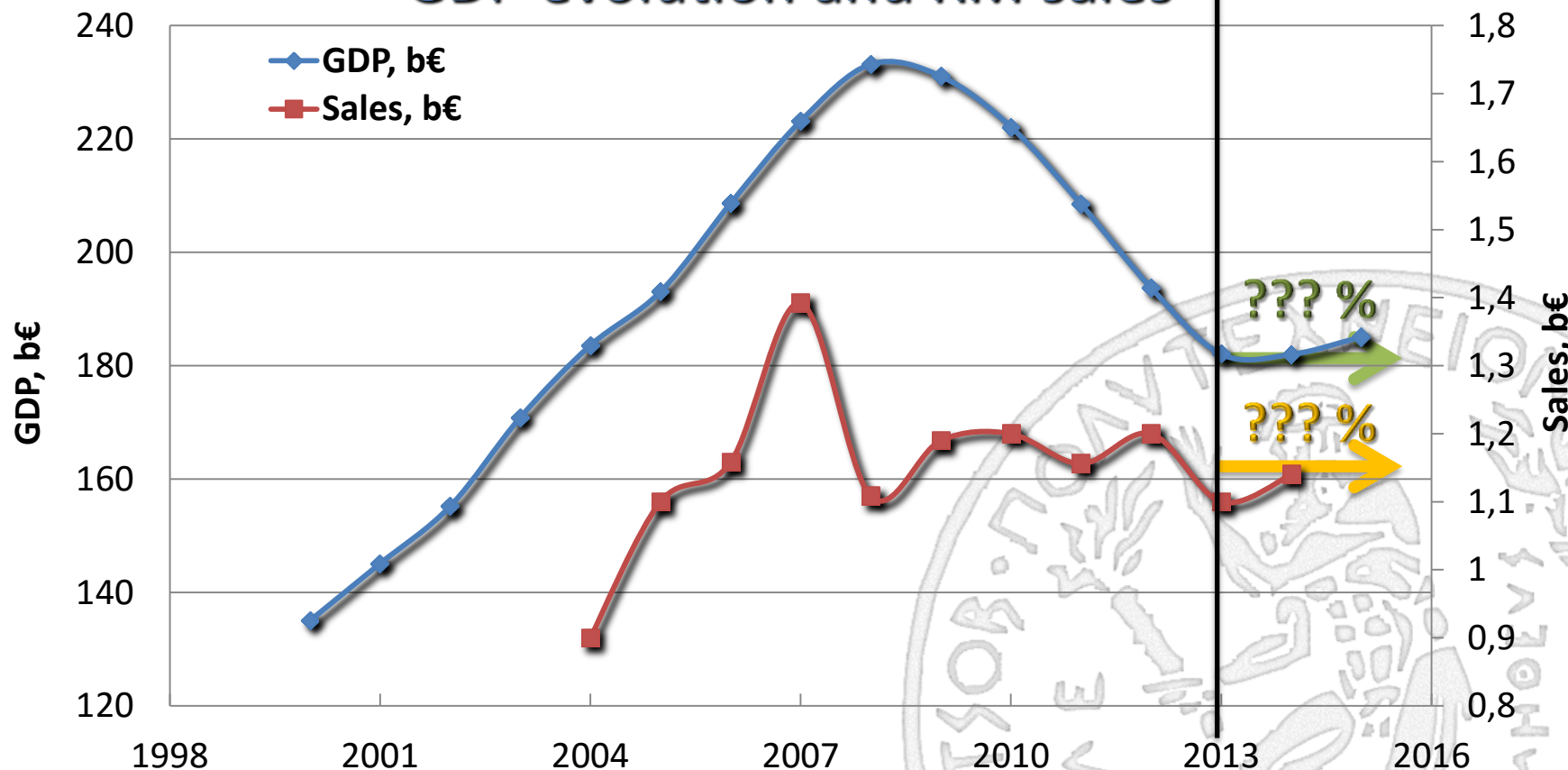
GDP evolution and RM sales



Why sales remain practically constant after 2008, while GDP drops significantly?

Important questions

GDP evolution and RM sales

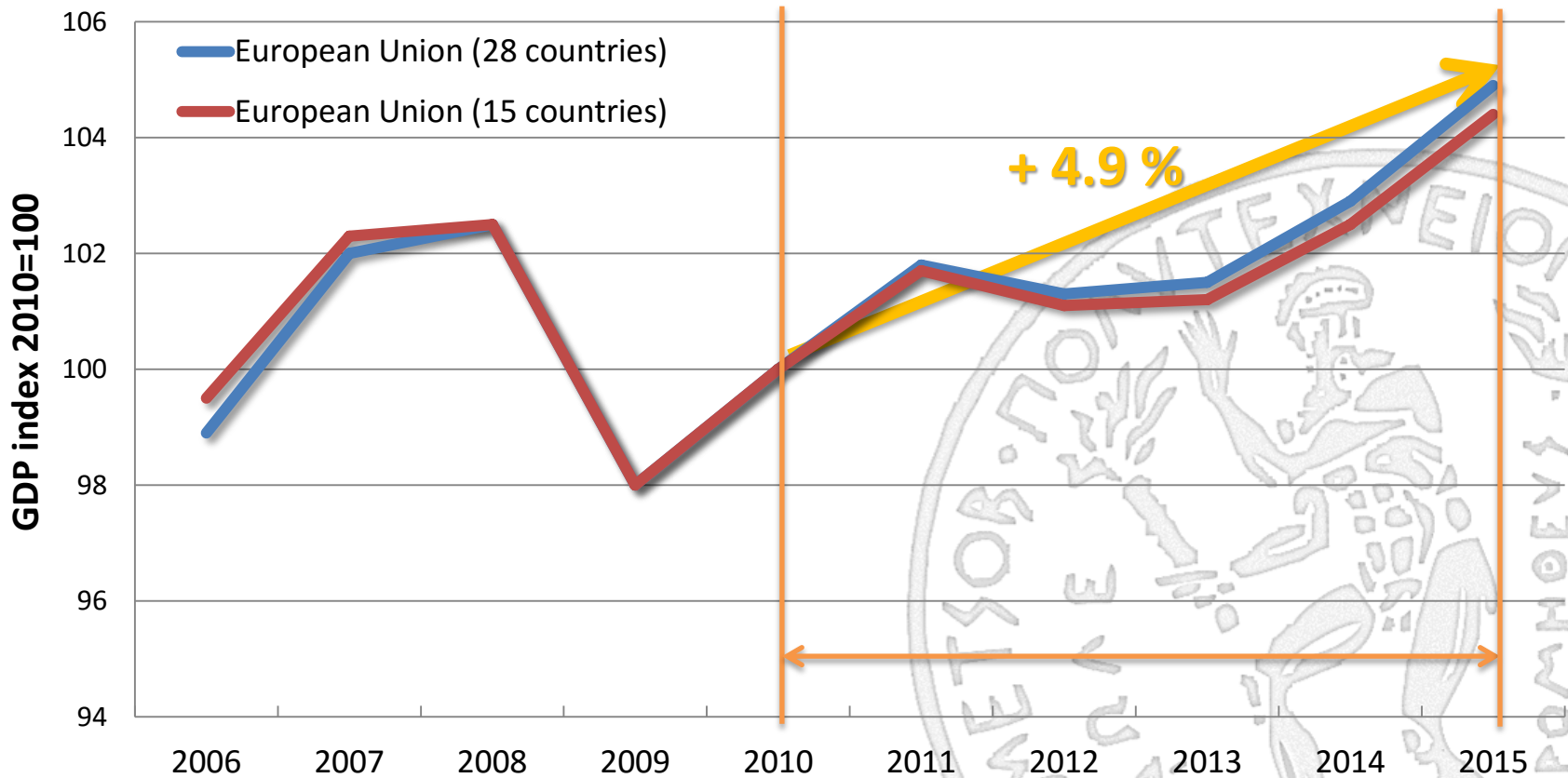


Factors that will shape the future

- 1. GDP evolution**
- 2. Evolution in prices and sales of Raw Materials**

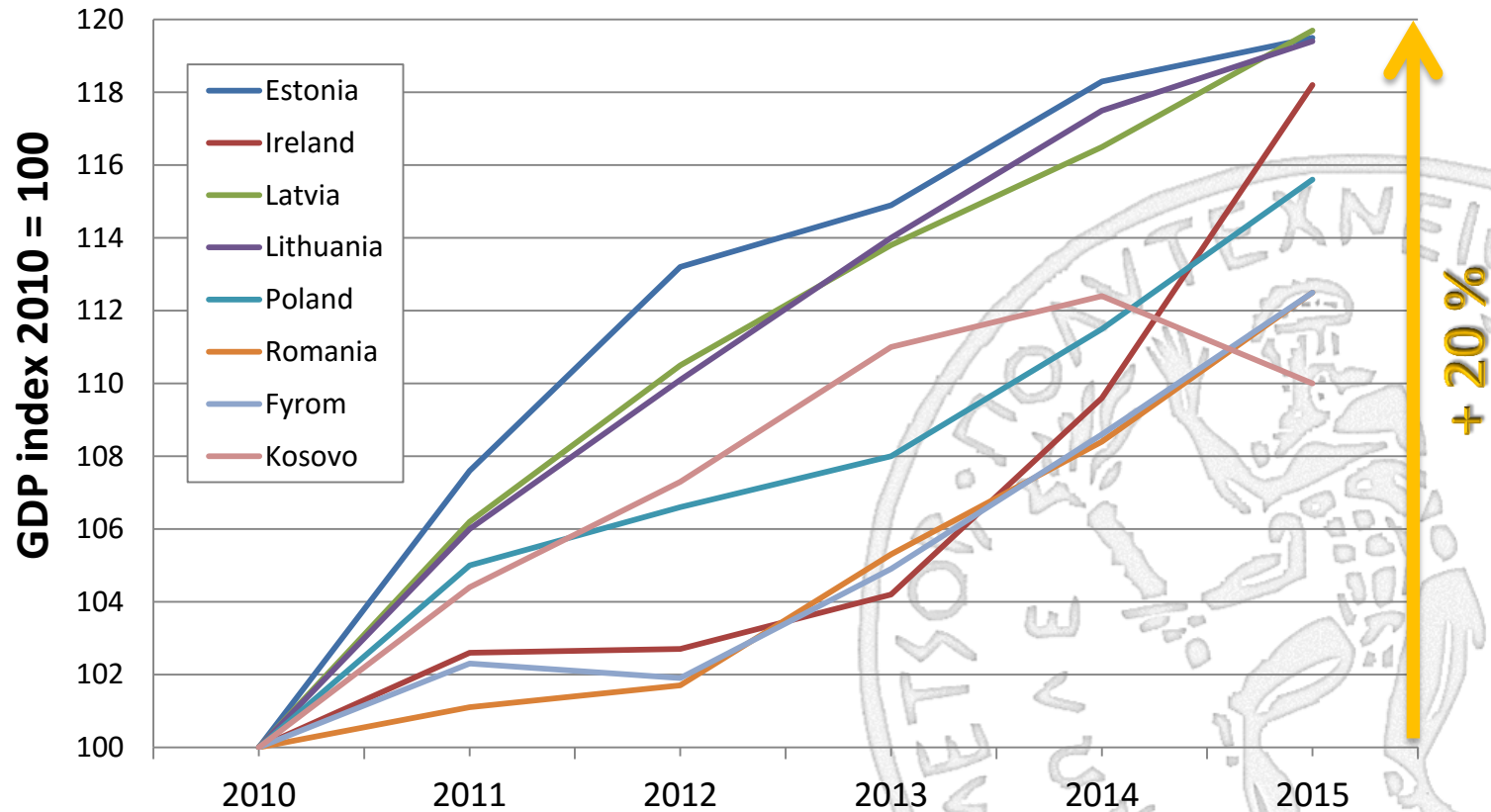
GDP evolution in EU

Changes in the total GDP of EU Member States
(based on values of 2010=100)



GDP evolution in EU

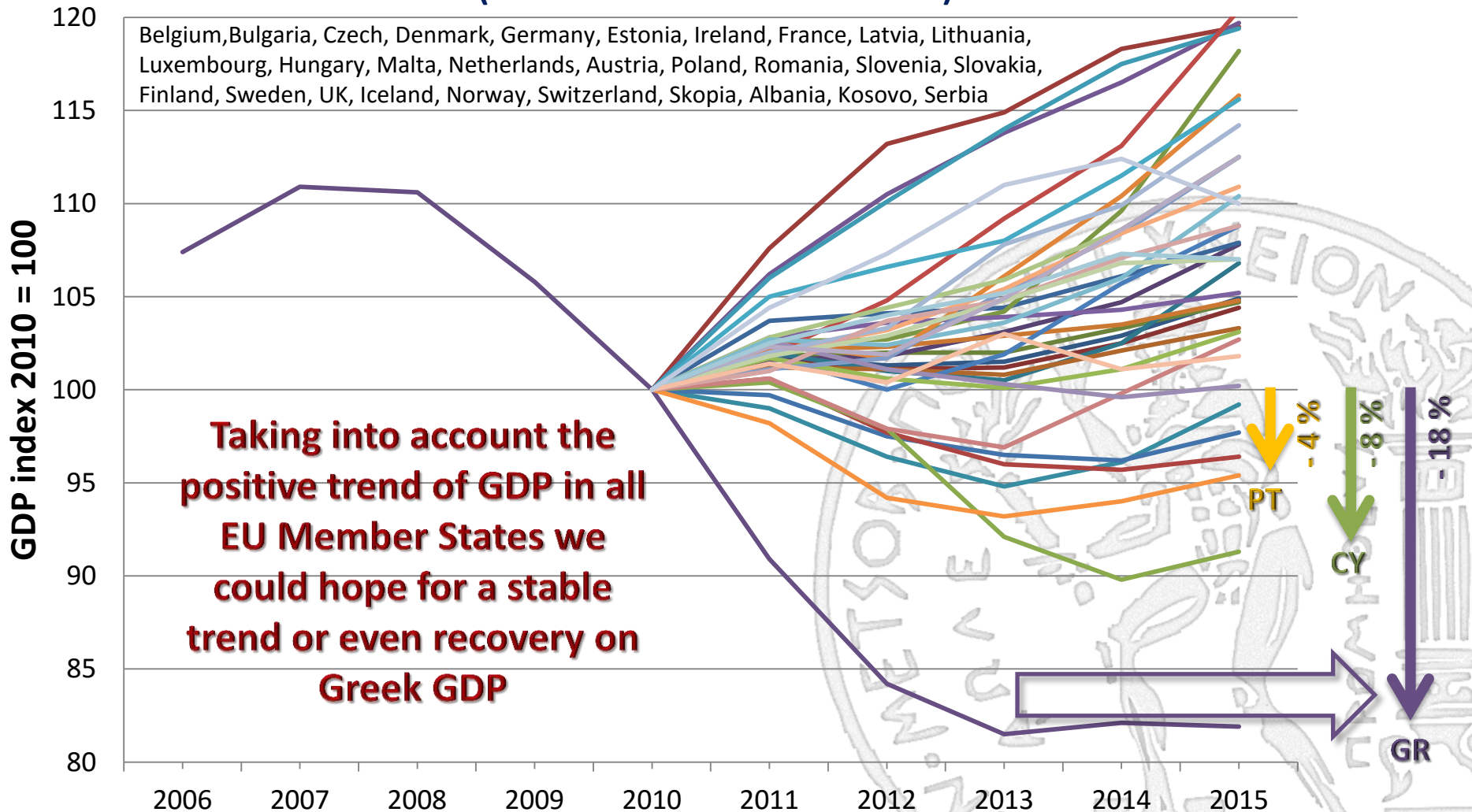
EU Member States with GDP growth higher than 10% (based on values of 2010=100)



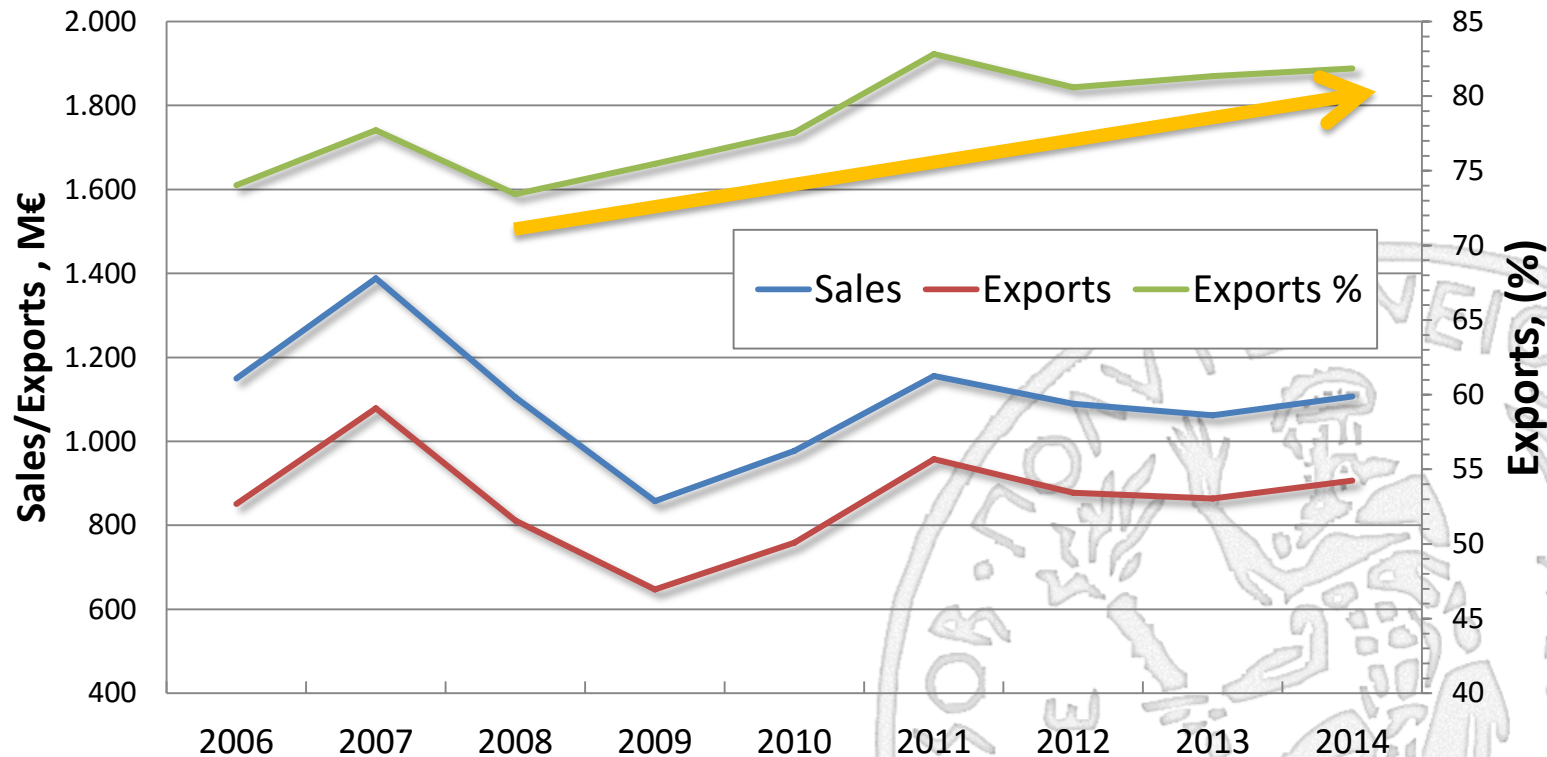
but

Changes in the GDP of EU Member States

(based on values of 2010=100)

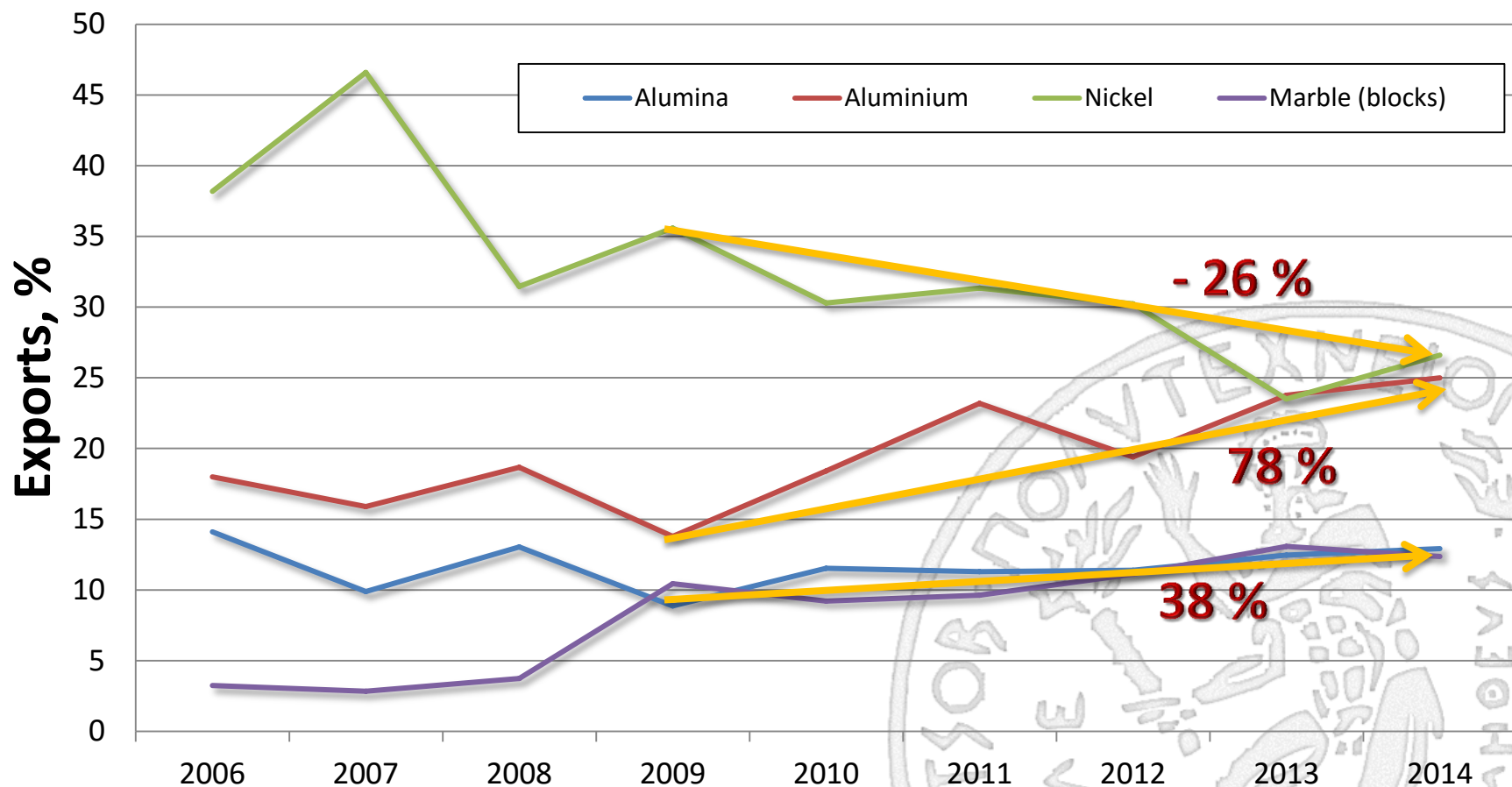


Why the contribution of RM sector to the Greek GDP remains constant over time;



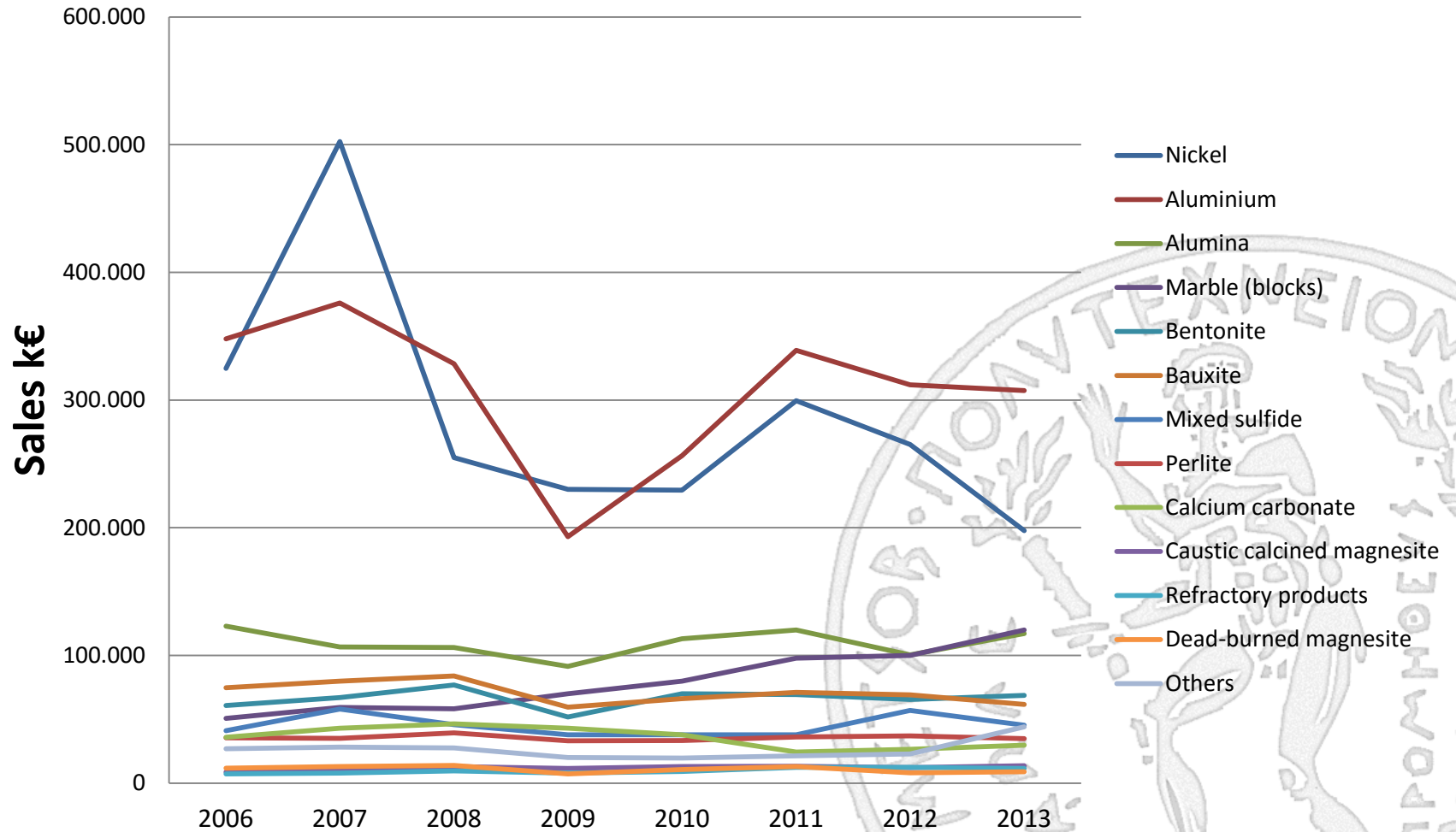
More than 80% of the sales are exports and therefore are not significantly affected by the purchasing capacity of the domestic market

A more detailed analysis

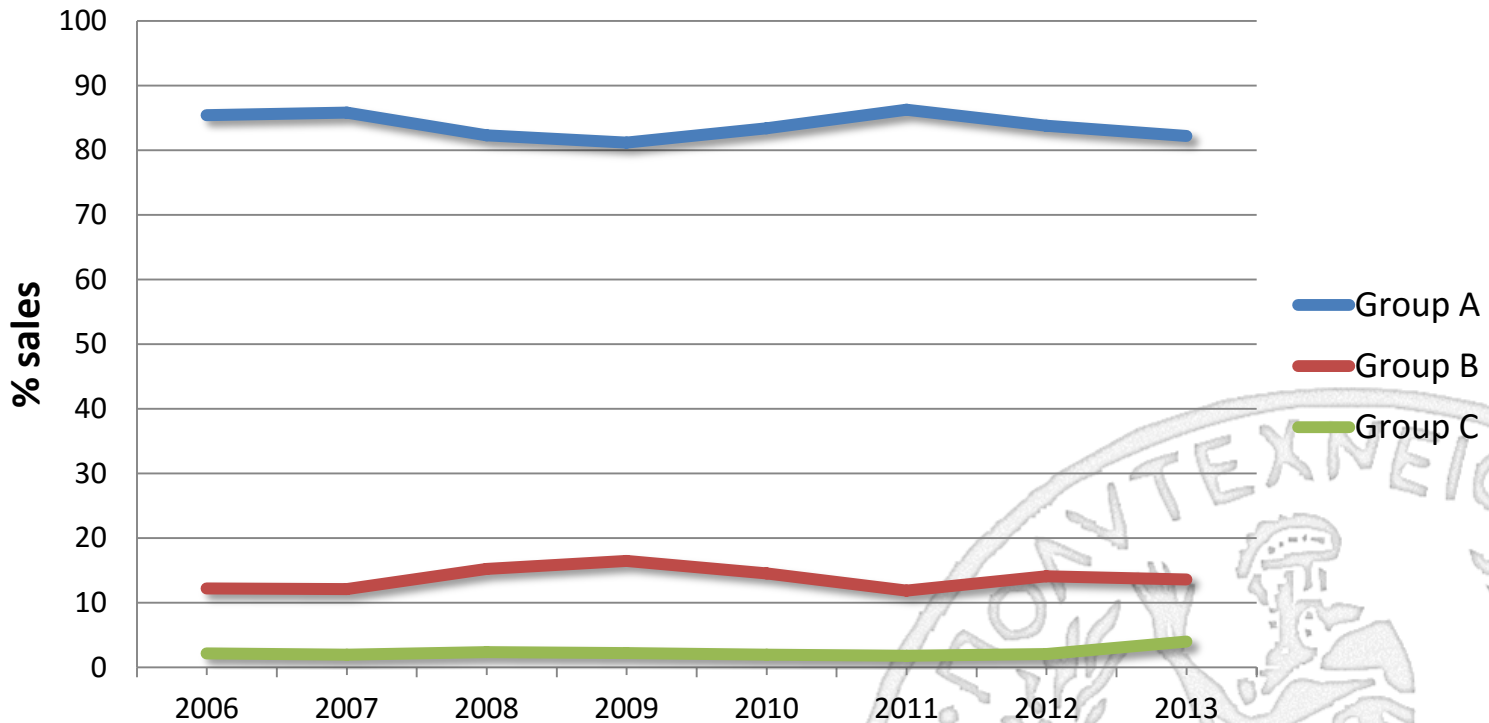


The decrease in FeNi exports was balanced by the increase in Aluminium, Alumina and Marble exports

Sales per Raw Material



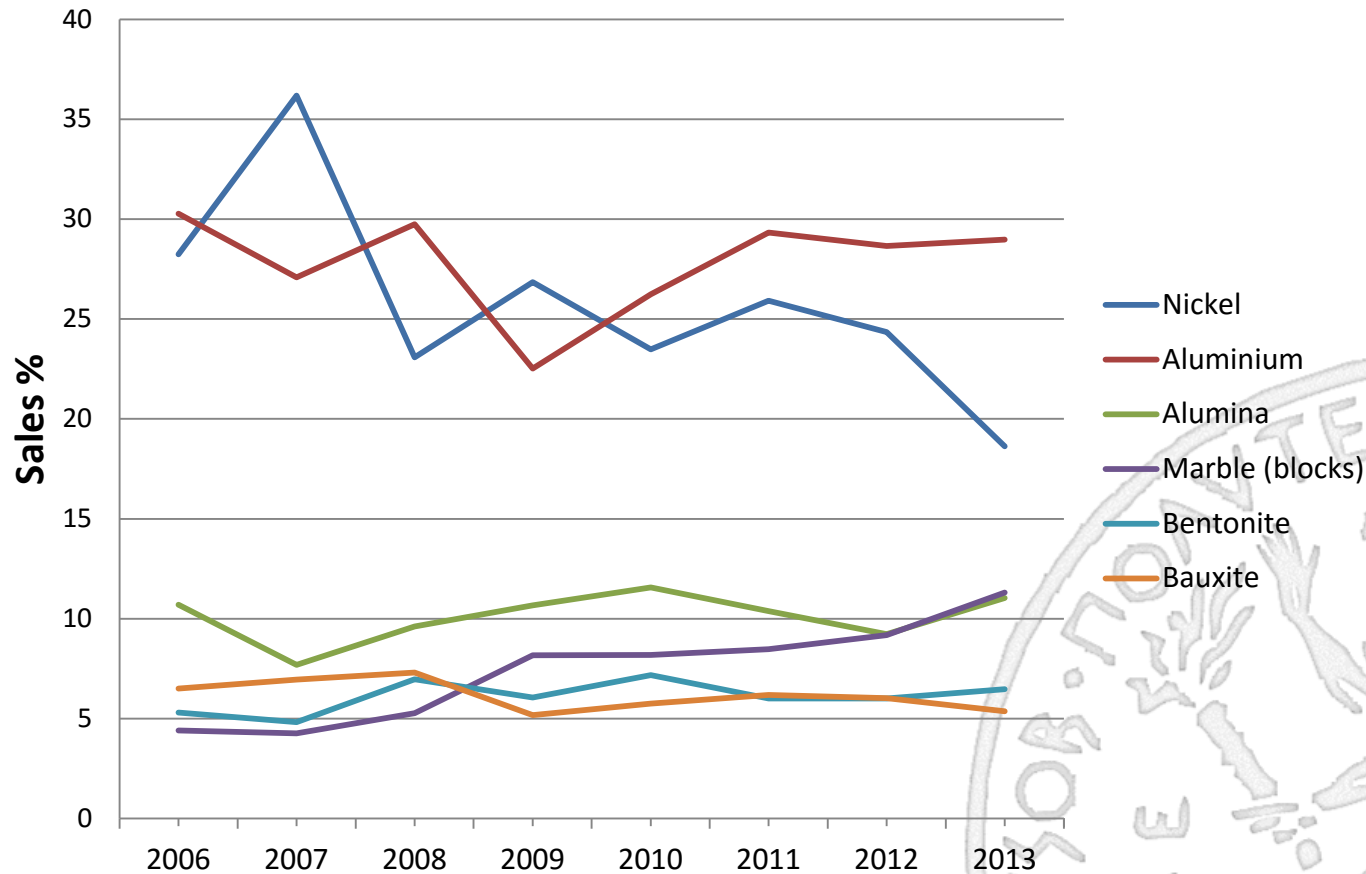
% sales per Raw Material



FeNi, aluminium, alumina, marble, bentonite, and bauxite represent more than 80% of total sales

Group A	Group B	Group C
60 - 300 M€	10 - 45 M€	1 - 5 M€
FeNi	Mixed sulfides	Attapulgit
Aluminium	Expanded perlite	Limestone
Alumina	Calcium carbonates	Gypsum
Marble (blocks)	Caustic calcined magnesite	Pumice
Bentonite	Dead-burned magnesite	Magnesite
Bauxite	Refractory products	Olivine
		Raw perlite
		Fumed silica
		Quartz
		Huntite

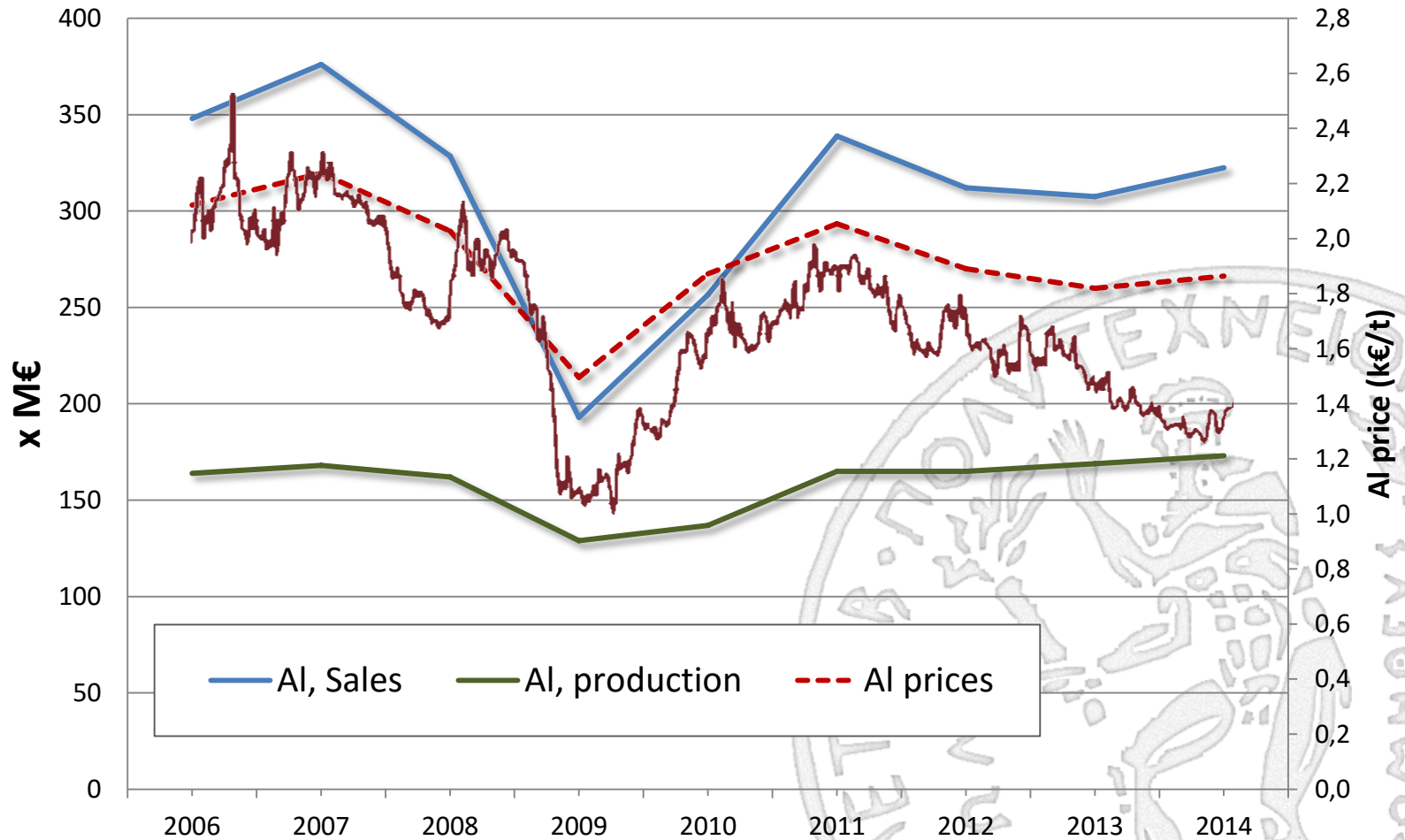
% sales per Raw Material of group A



FeNi, aluminium and marble, play a vital role in the volume of total Raw Material sales

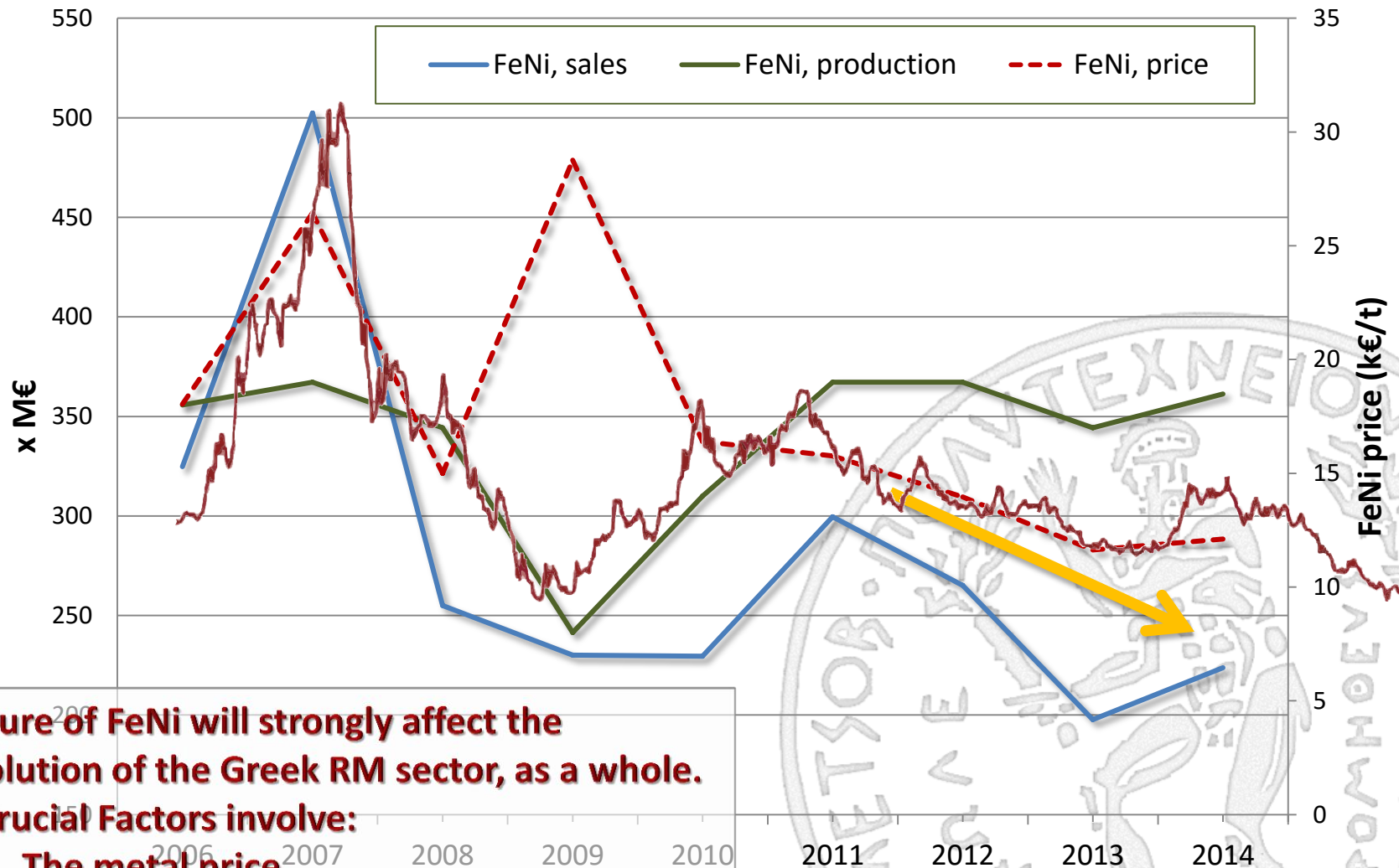
Group A
60 - 300 M€
FeNi
Aluminium
Alumina
Marble (blocks)
Bentonite
Bauxite

Aluminum production-sales-prices



Since 2010 all factors are almost stable

FeNi production-sales-prices

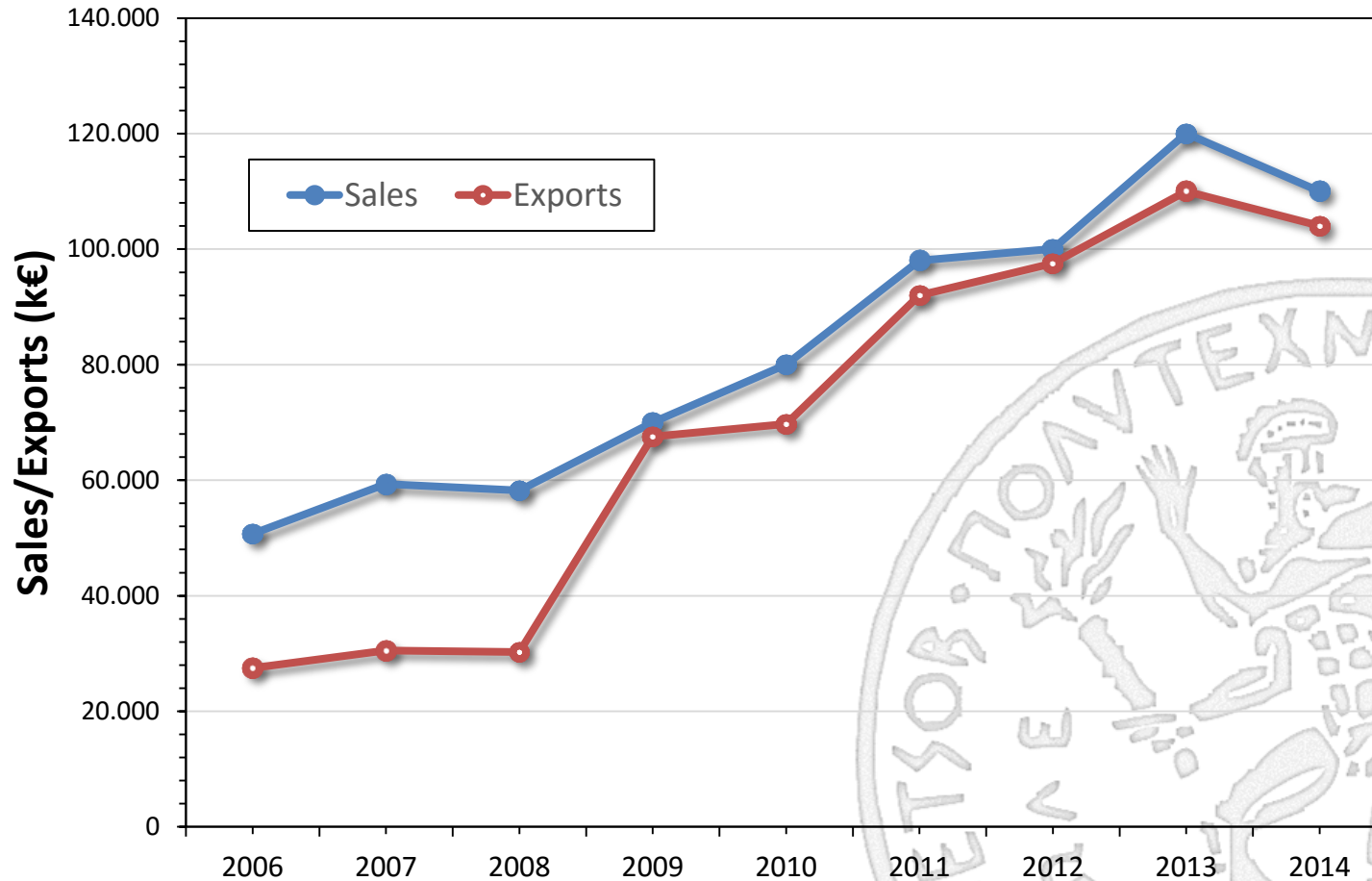


Future of FeNi will strongly affect the evolution of the Greek RM sector, as a whole.

Crucial Factors involve:

- **The metal price**
- **Production cost**
- **Deposits quality**

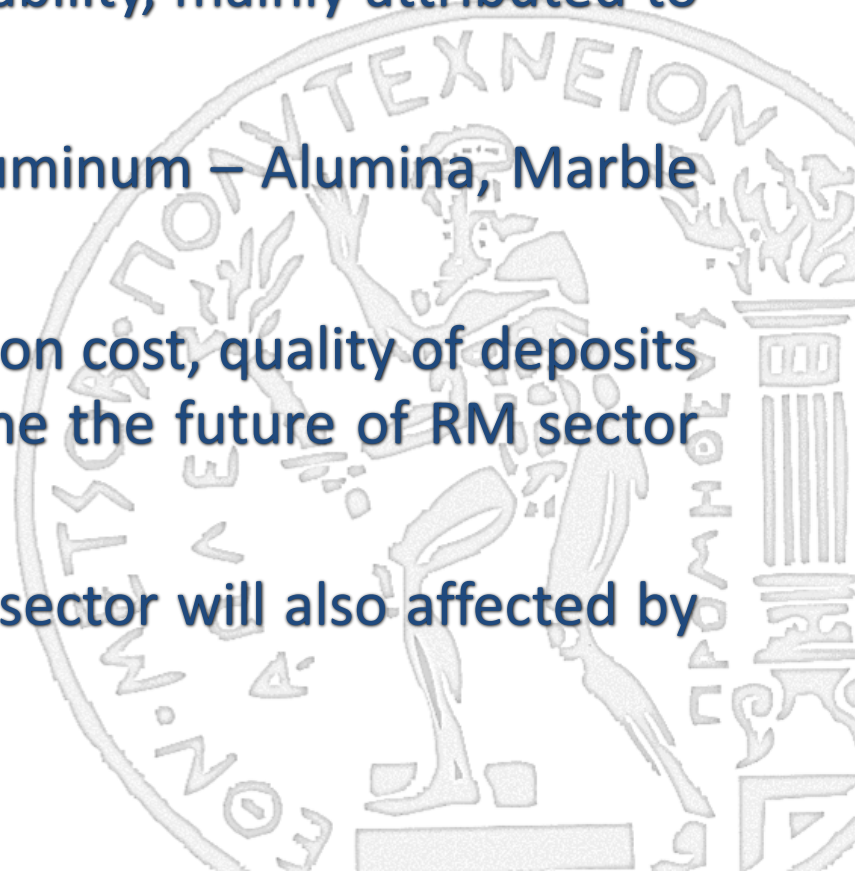
Marble sales-exports



Steady Growth - Closing the Gap

The Greek RM Sector

- ✓ The RM sector (Greek Mining Association Companies) reports steady sales of about **1.6 b€** (± 45 M€) per year
- ✓ In spite of the dramatic drop of GDP. The turn over of the RM sector shows remarkable stability, mainly attributed to the developed exports
- ✓ Main contributors are: FeNi, Aluminum – Alumina, Marble production
- ✓ Metal prices evolution, production cost, quality of deposits will be the main factors to define the future of RM sector in Greece
- ✓ The evolution of the Greek RM sector will also be affected by the realization of new projects



Future Projects



Olympias project

Pb, Zn, Au, Ag, 6.4 b€ total value

Skouries project

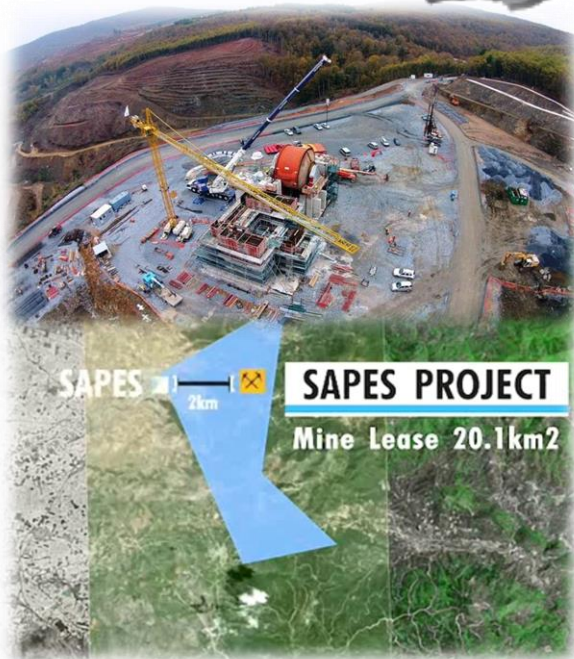
Cu, Au, 8.6 b€ total value

Sappes project

Au, Ag, 0.8 b€ total value

Perama project

Au, Ag, 1.8 b€ total value



**Expected income under full
exploitation**

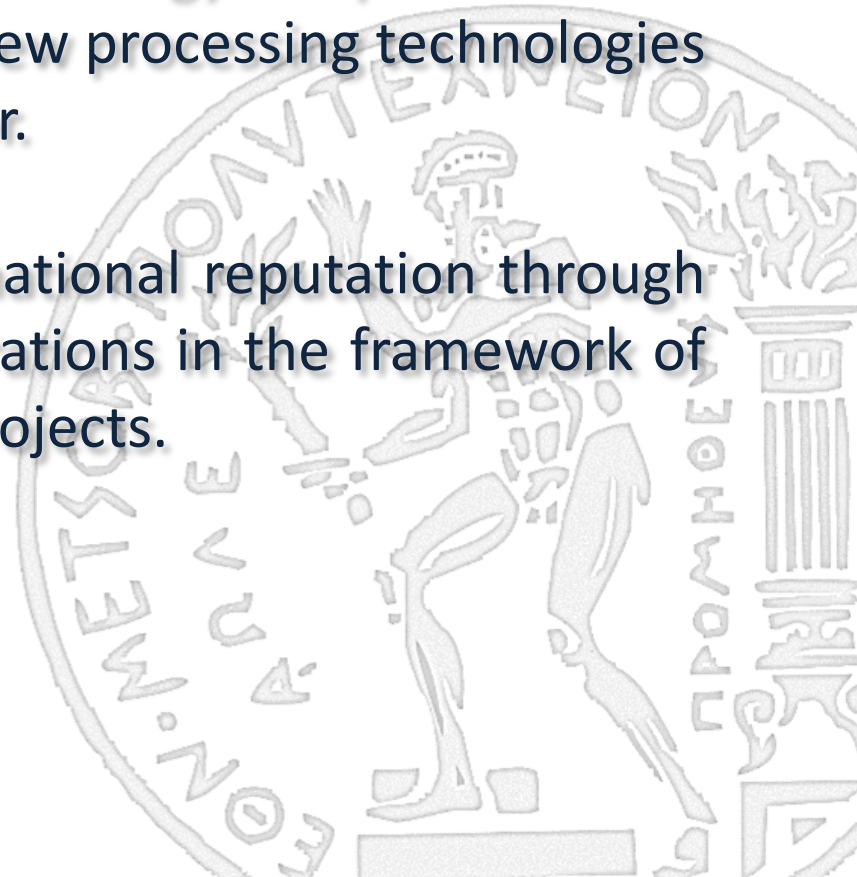
more than 500 M€ per year

New opportunities and technologies

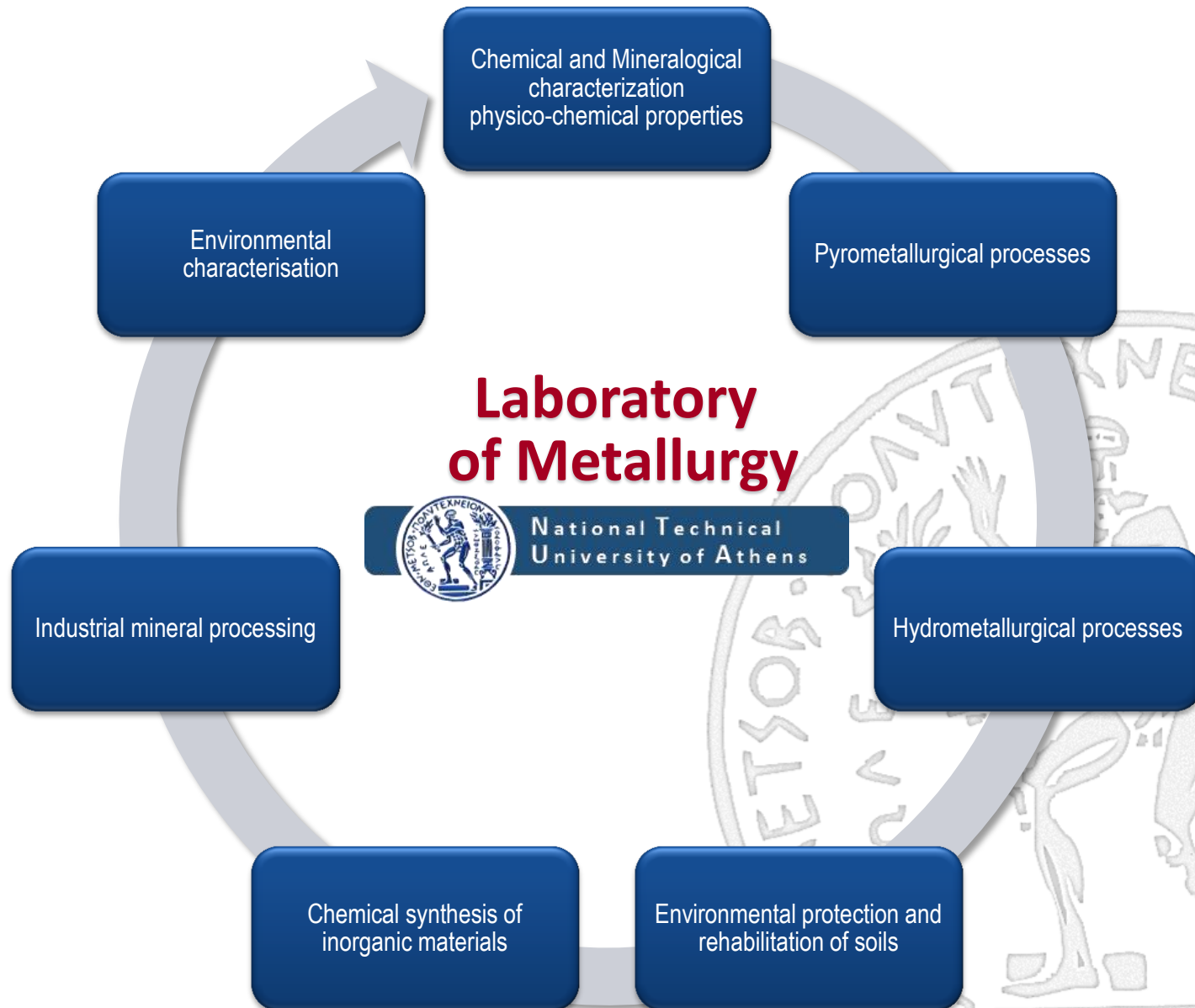


In the field of new technological development the Laboratory of Metallurgy is specialised on the development of new processing technologies in raw materials sector.

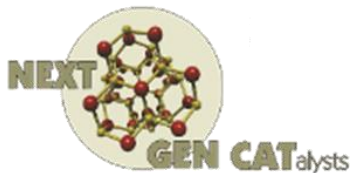
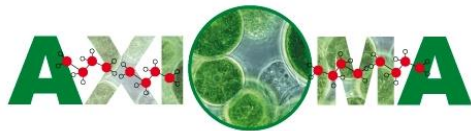
Lab has gained international reputation through its successful collaborations in the framework of European Research projects.



Lab. of Metallurgy - Activities

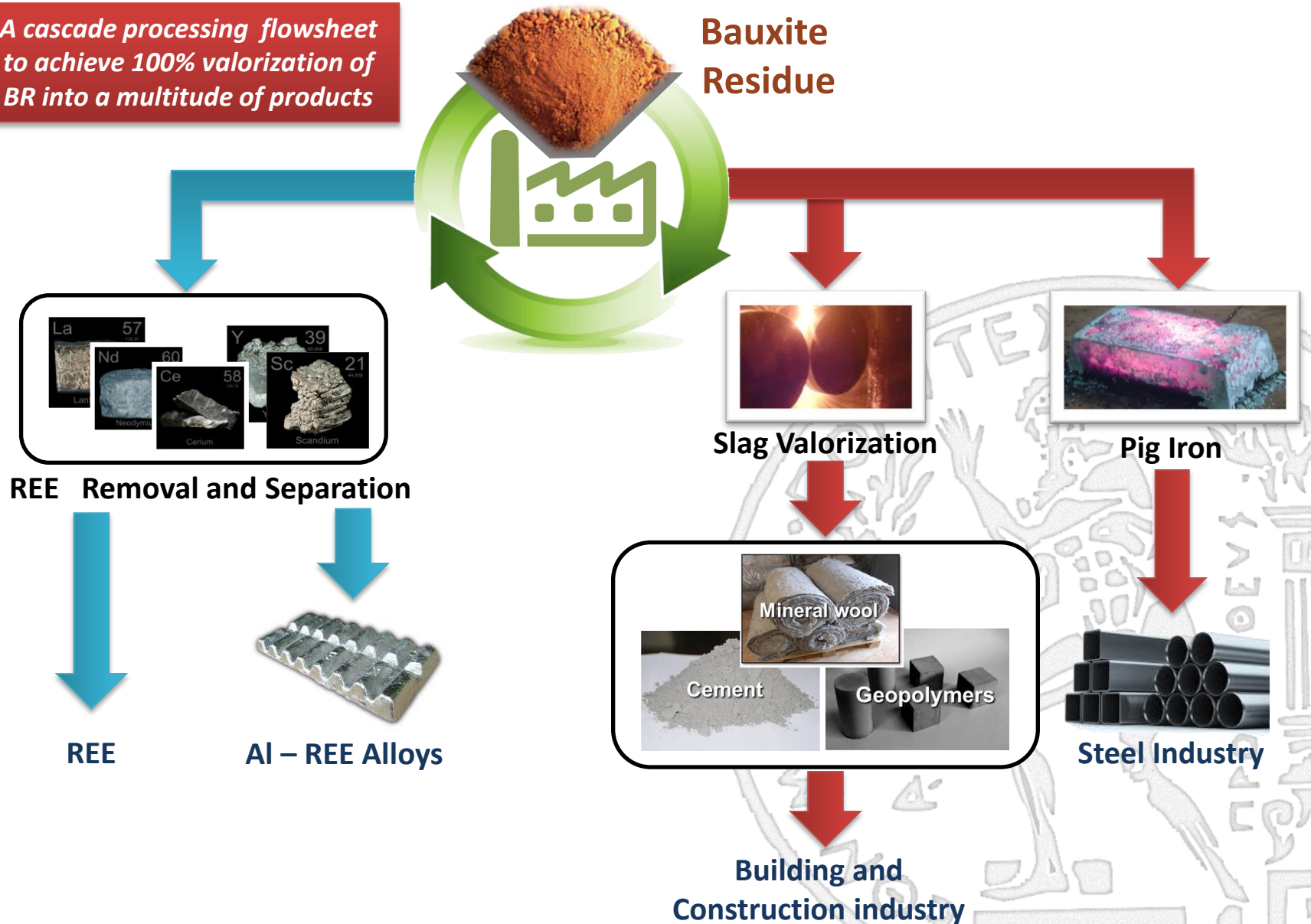


Lab. of Metallurgy – Research projects



Lab. of Metallurgy - New holistic approach in BR valorisation

A cascade processing flowsheet to achieve 100% valorization of BR into a multitude of products

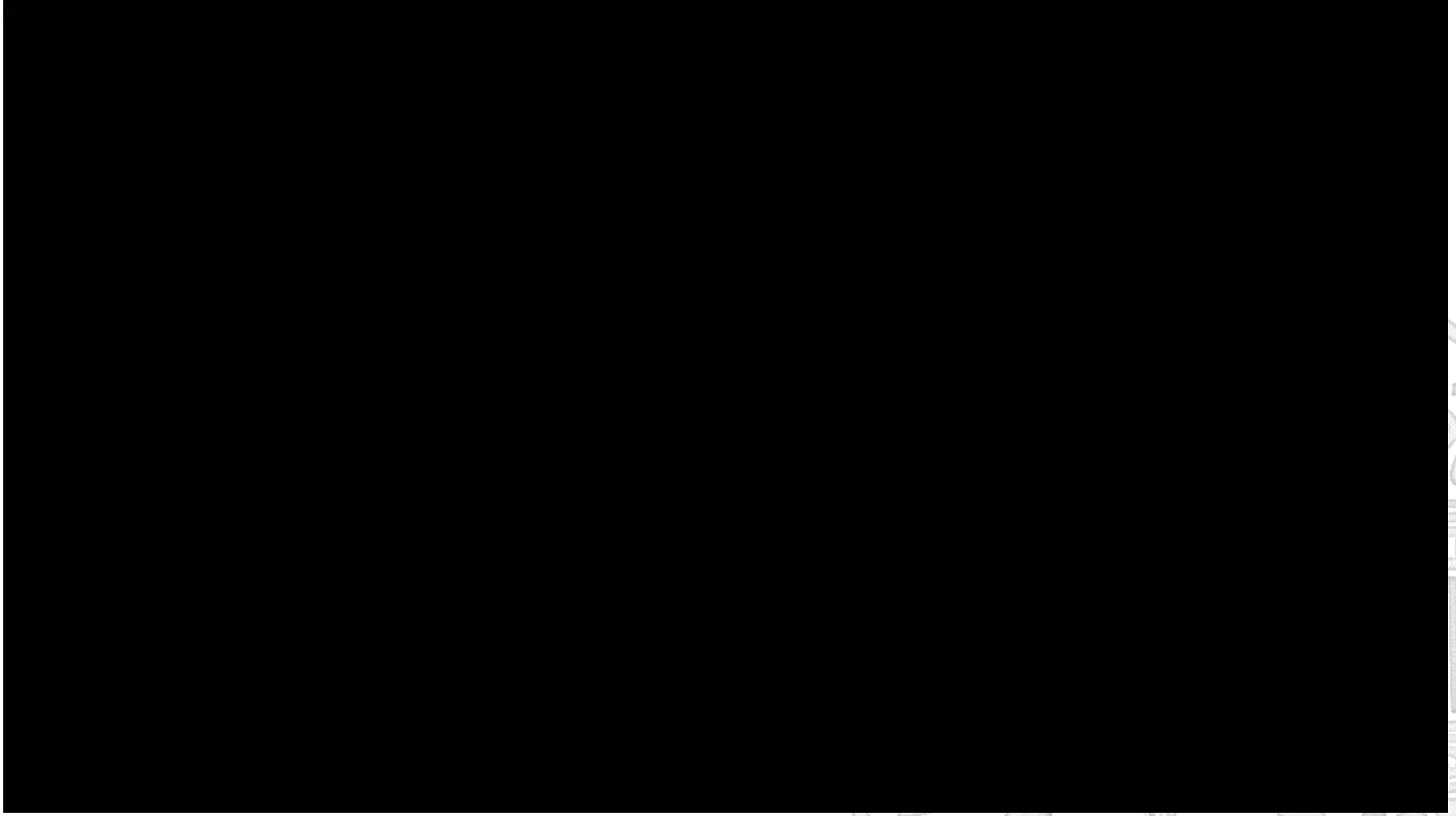


Lab. of Metallurgy - BR valorisation

**From lab to pilot
to industrial scale**

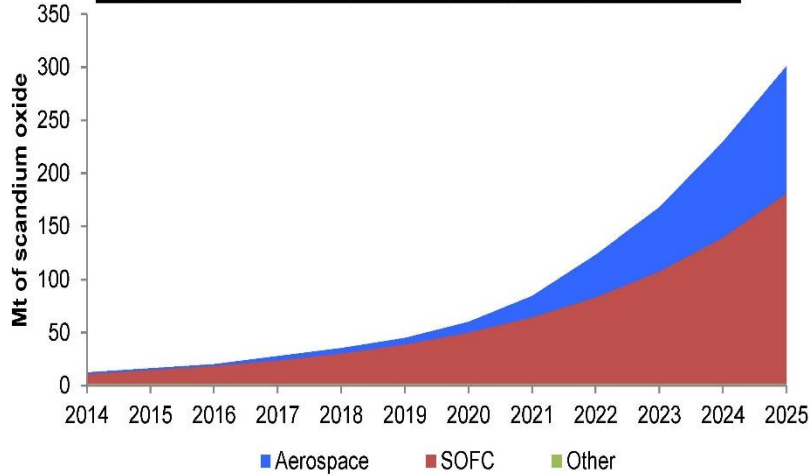


Lab. of Metallurgy - BR valorisation

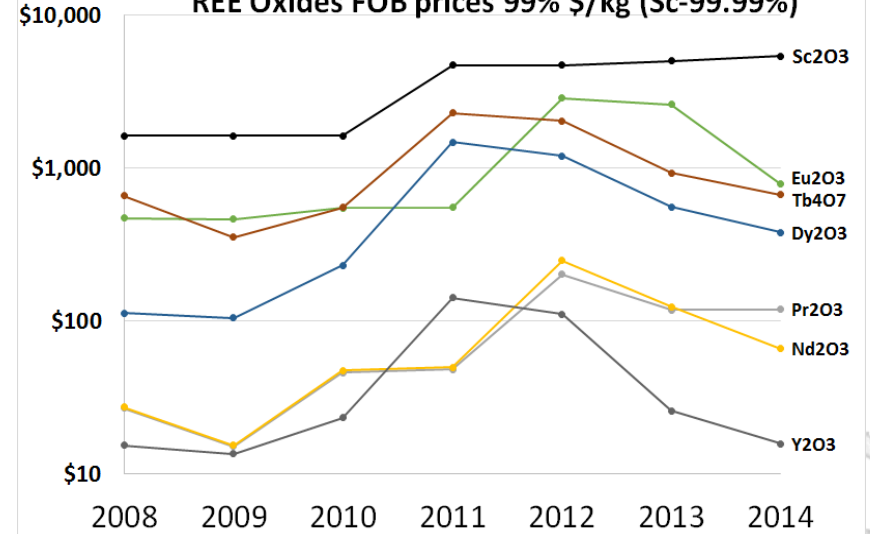


Lab. of Metallurgy - BR valorisation

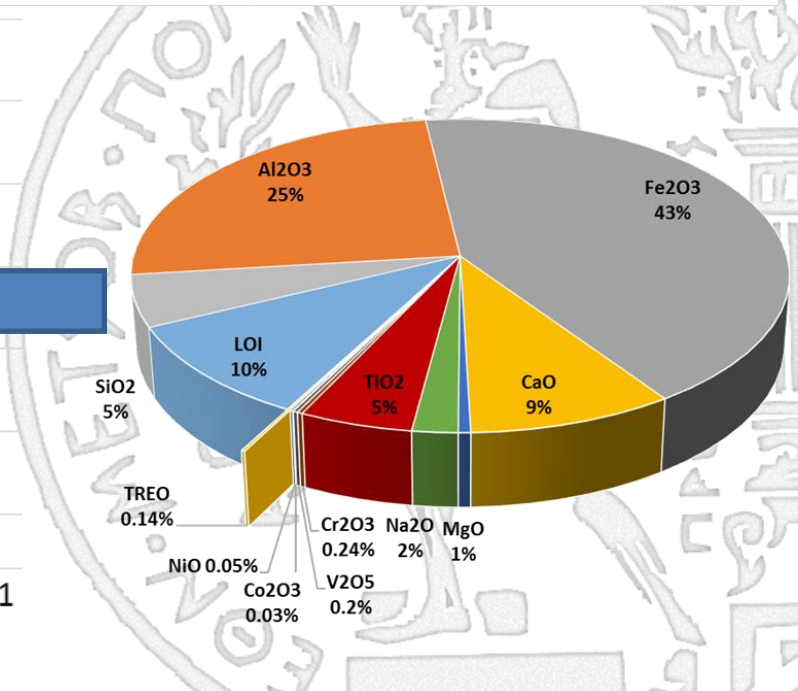
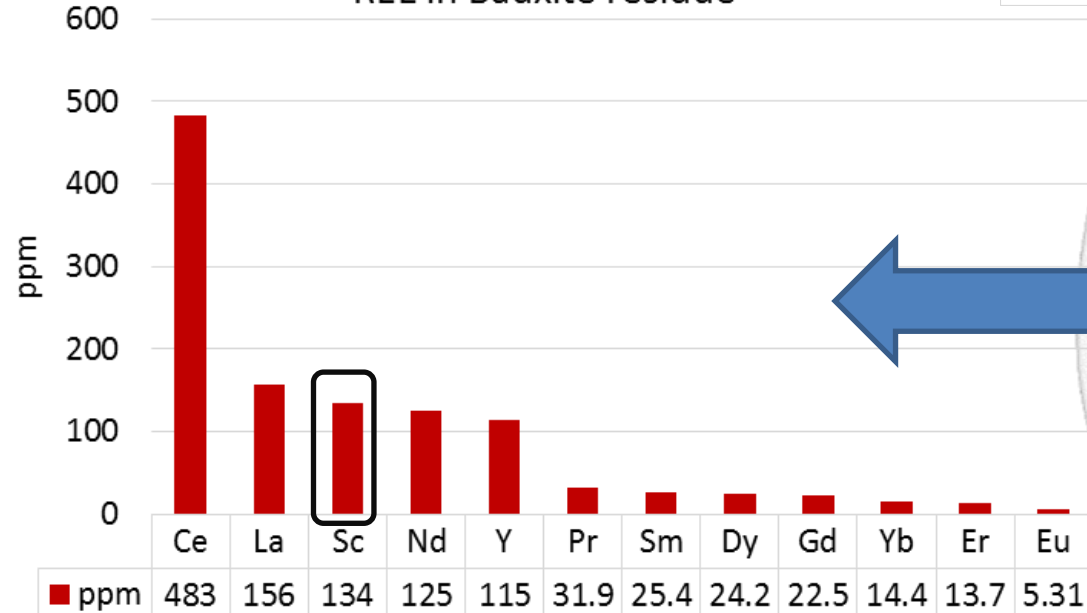
Forecast scandium consumption, 2014-2025 (t ScO)



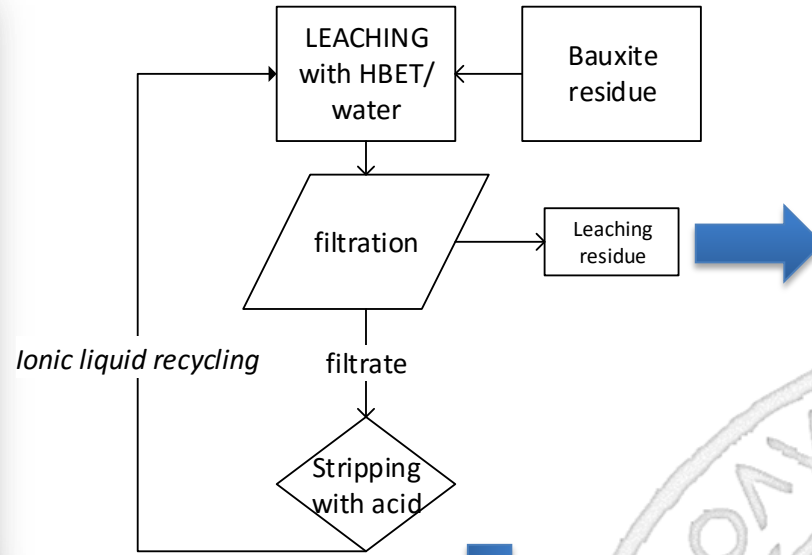
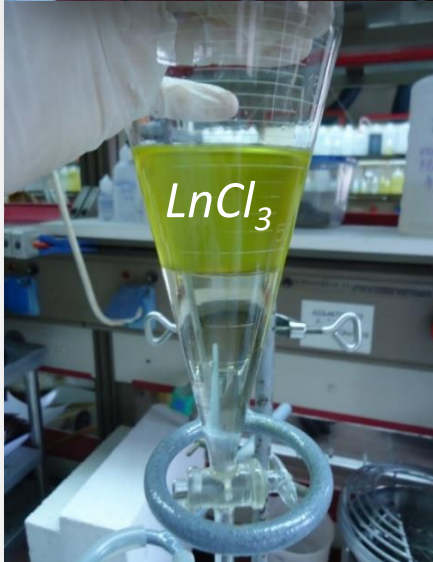
REE Oxides FOB prices 99% \$/kg (Sc-99.99%)



REE in Bauxite residue



Lab. of Metallurgy - REE extraction from BR with ILs

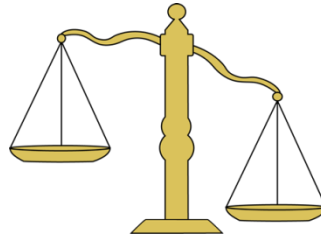


Chem. Comp. (%)	
SiO ₂	6.54
Al ₂ O ₃	12.27
Fe ₂ O ₃	56.11
CaO	0.06
TiO ₂	7.51
Cr ₂ O ₃	0.28
NiO	0.11
ZrO ₂	1.37
Other	7.92
LOI	7.82

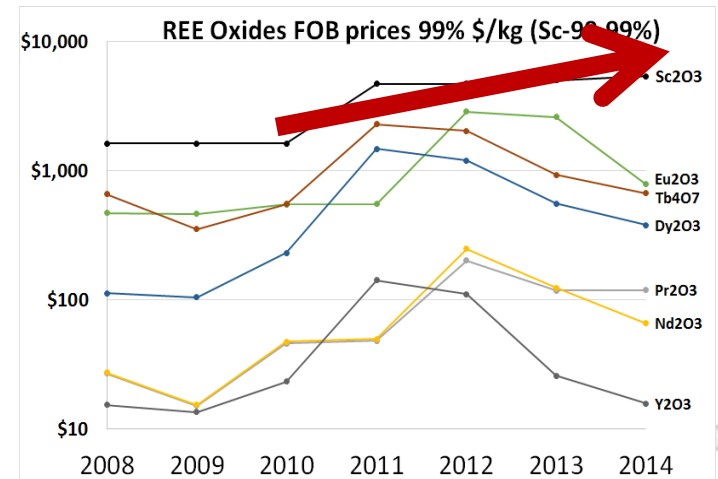
Recovery of 60-80% BR's REE



From EURARE to SCALE proposal



Taking into account the remarkable increase in Scandium prices
The high Scandium content of BR and also the availability of the necessary technologies

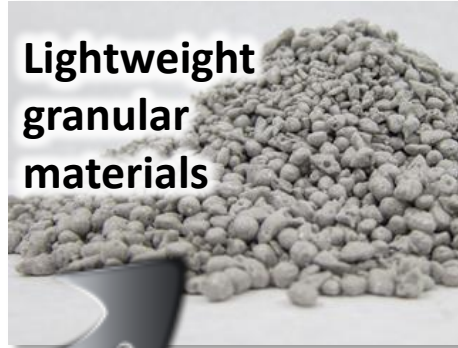


A new proposal concerning the exploitation of Bauxite Residues for the production of Scandium Has been submitted for funding to the EC Under the frame of HORIZON 2020 with Aluminium of Greece Coordinator and the Laboratory of Metallurgy partner

Lab. of Metallurgy - Wastes valorization pathways

- Industrial wastes (Fly ash, GGBFS, Ferronickel slag)
- Mineral Wastes (Perlite, Bentonite)
- Industrial By-products
- Recycled materials

Lightweight granular materials



Bulk Insulation



Cryogenics



Boards/Panels



Blocks/Bricks



Binders



European
Rare Earth
RESources

ERES 2014 – 1st Conference on European REE deposits

- Organised by NTUA/EURARE at Milos
- 70 presentations, more than 150 participants

ERES 2017 – 1st Conference on European REE deposits Santorini **28-31 May 2017**



<http://eres2017.eresconference.eu/>