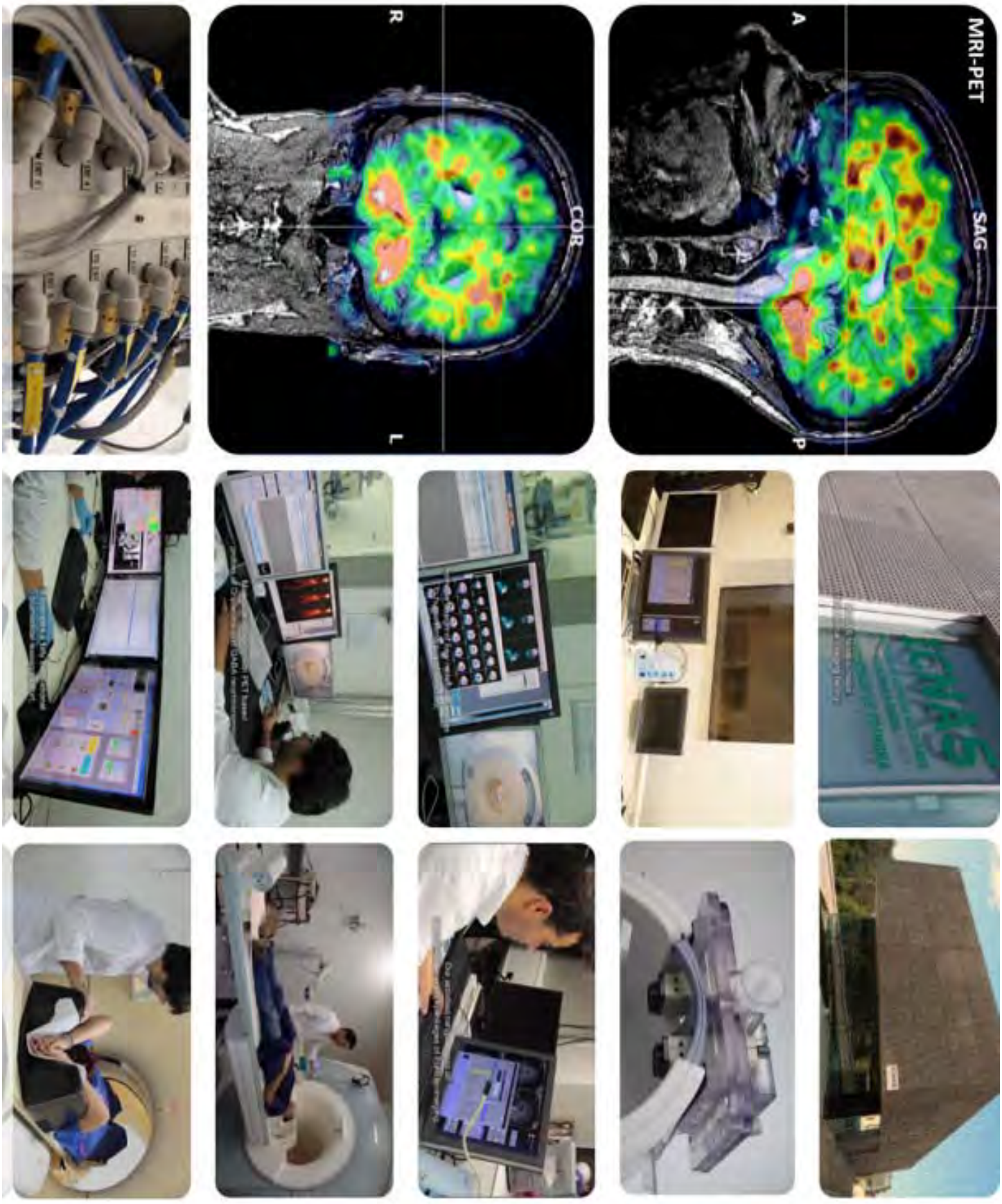
Light - *Designed by Nature, Transformed by Science*

http://www.esa.int/spaceinimages/Images/2015/04/Europe_at_night

…KNOWLEDGE asymmetries and the collective ambition for economic growth:

Shaping the future of research?



A case study: cancer diagnosis and treatment…

The case of "EU Cancer Core": Future directions

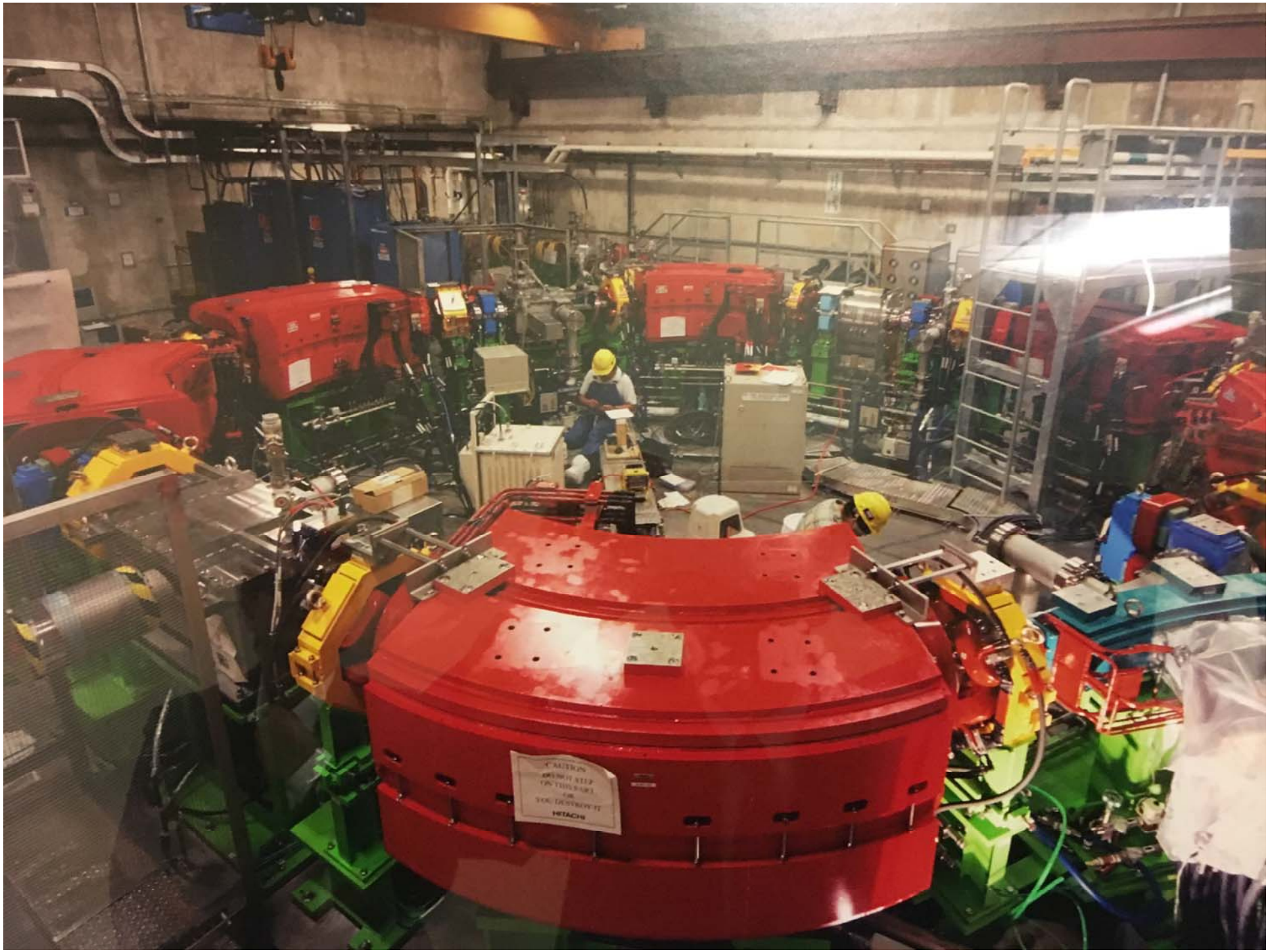
A mission oriented approach to cancer in Europe for 2030

(source: Celis & Pavalkis, Molecular Oncology, Nov, 2017)

To achieve a long term survival of 3 out 4 cancer patients

The issues:

Where?...How?


HITACHI

Particle therapy centres in Europe - 2015

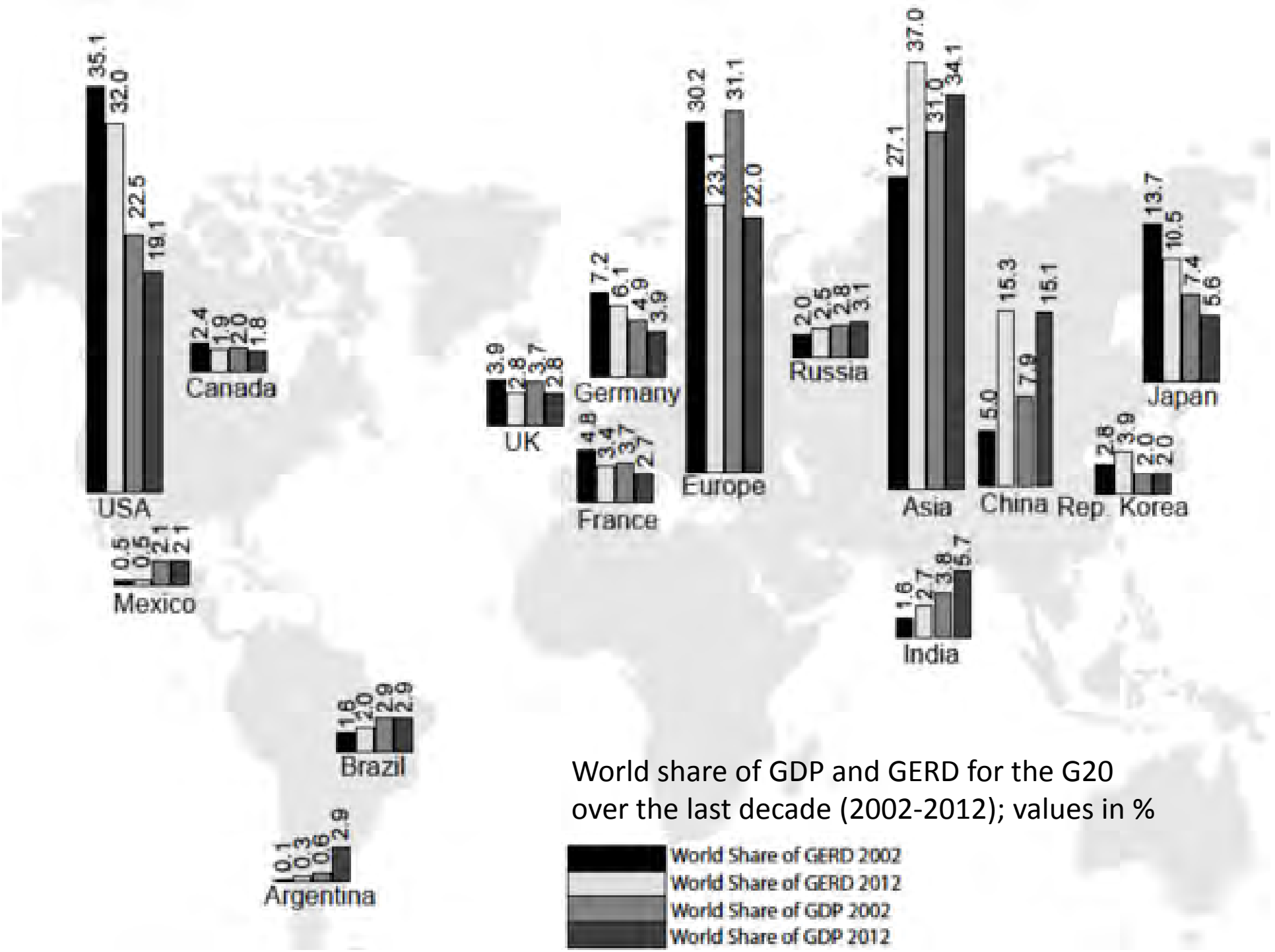
Source: PTCOG, October 2015

The Questions Today…

After many years hit by recession and economic and budgetary problems:

- Which is the evolving path of R&D funding?

- Which policies to foster knowledge towards long-term growth?



World share of GDP and GERD for the G20 over the last decade (2002-2012); values in %

Cumulative R&D expenditure, 30 years, per RESEARCHER

(thousands U.S. Dollars 2005 constant prices and PPP)

Source: OECD Statistics.

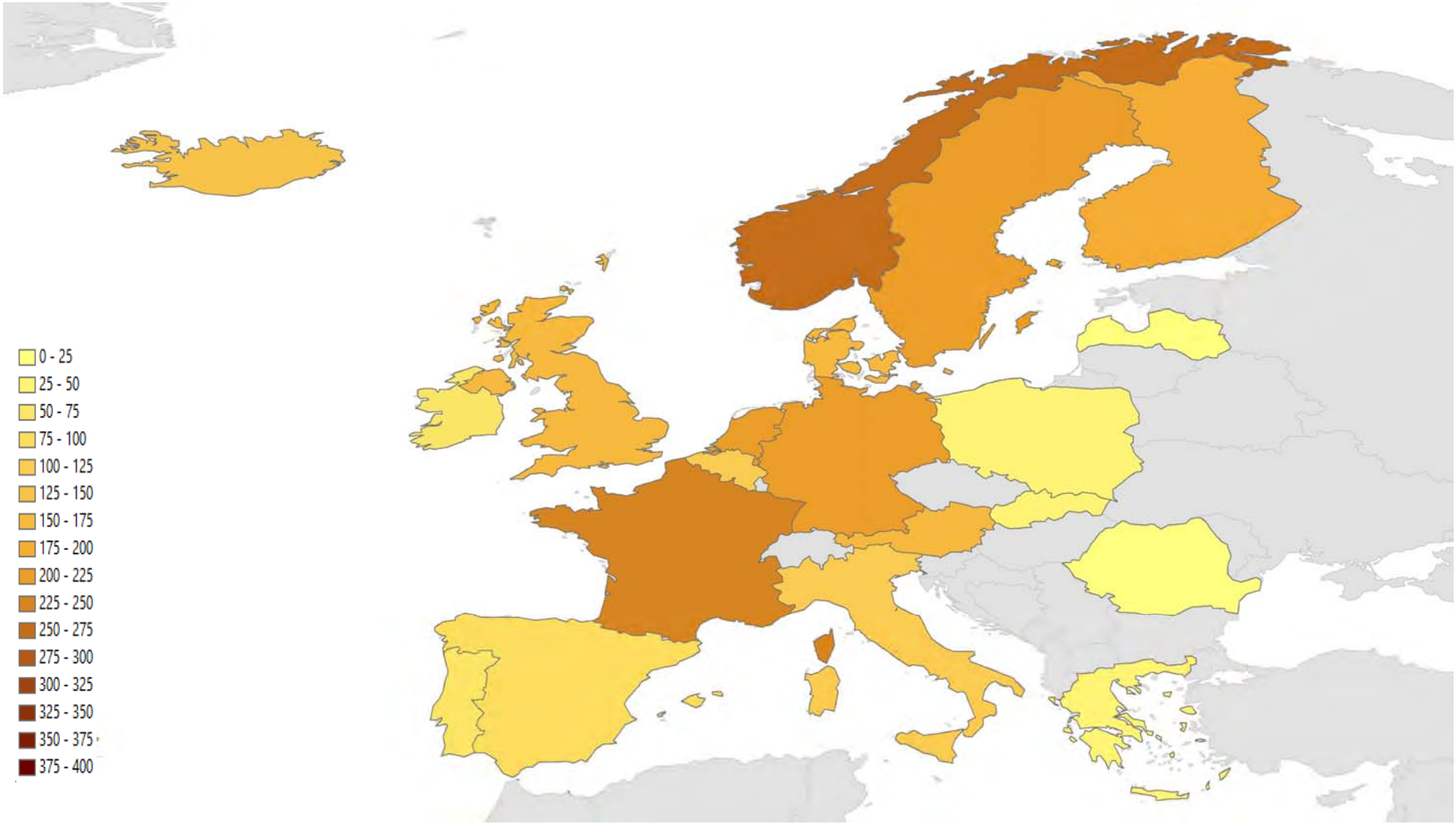
Undoubtedly **there was considerable progress** in Science, Technology and Higher Education.

...But Europe, as a whole, **has met neither its goals nor its promises in this area**.

Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 1995

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

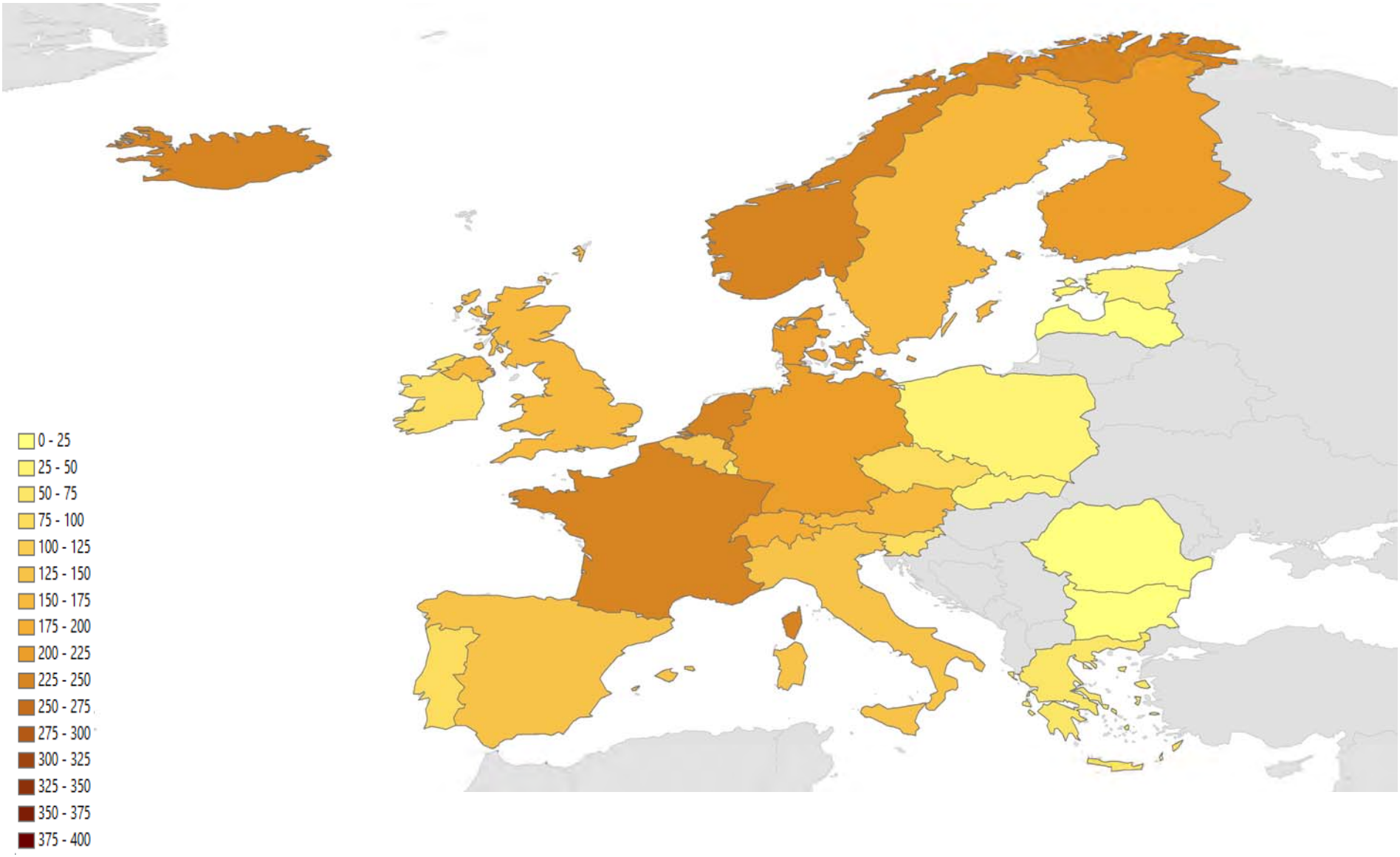
Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 2000

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

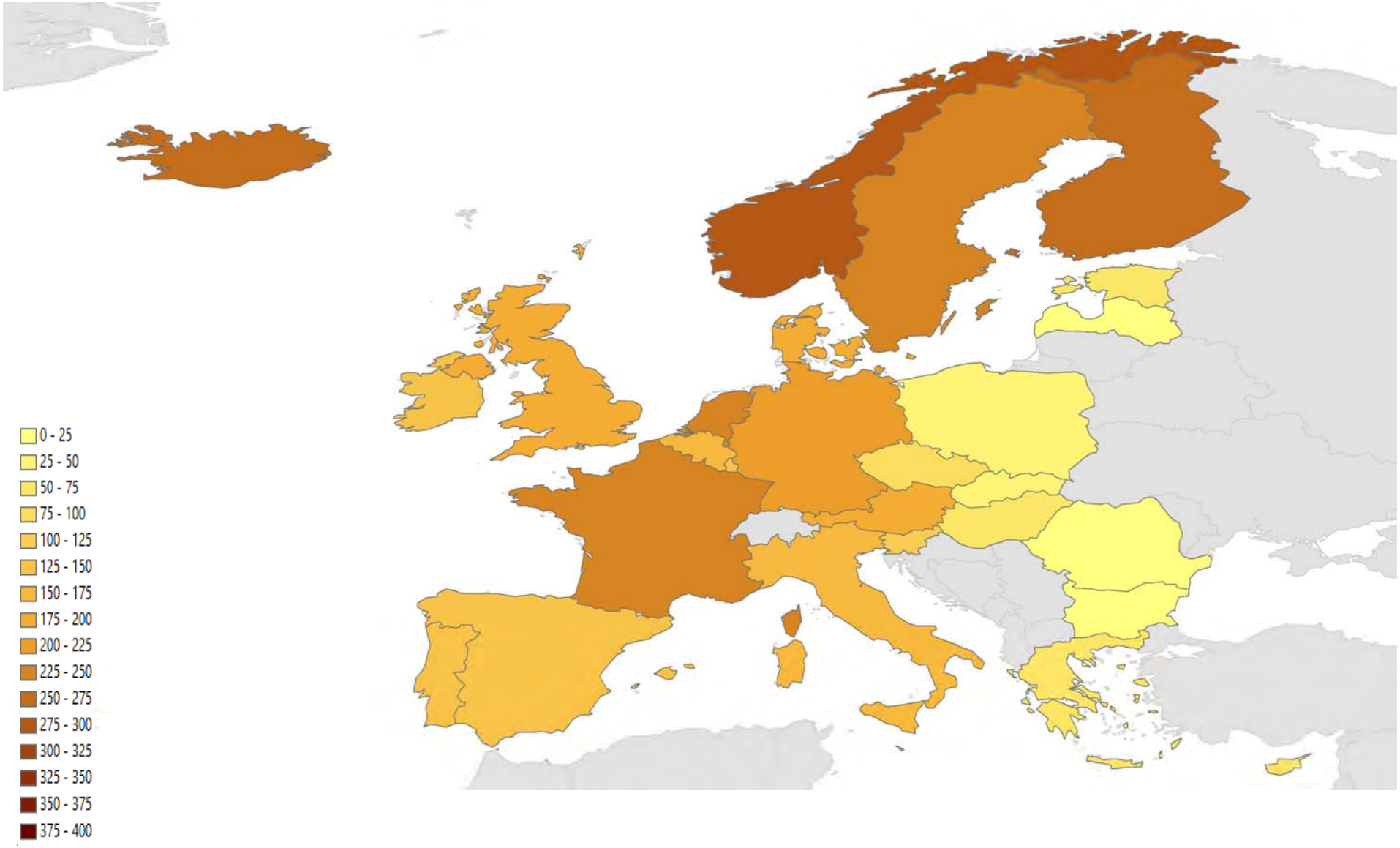
Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 2005

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

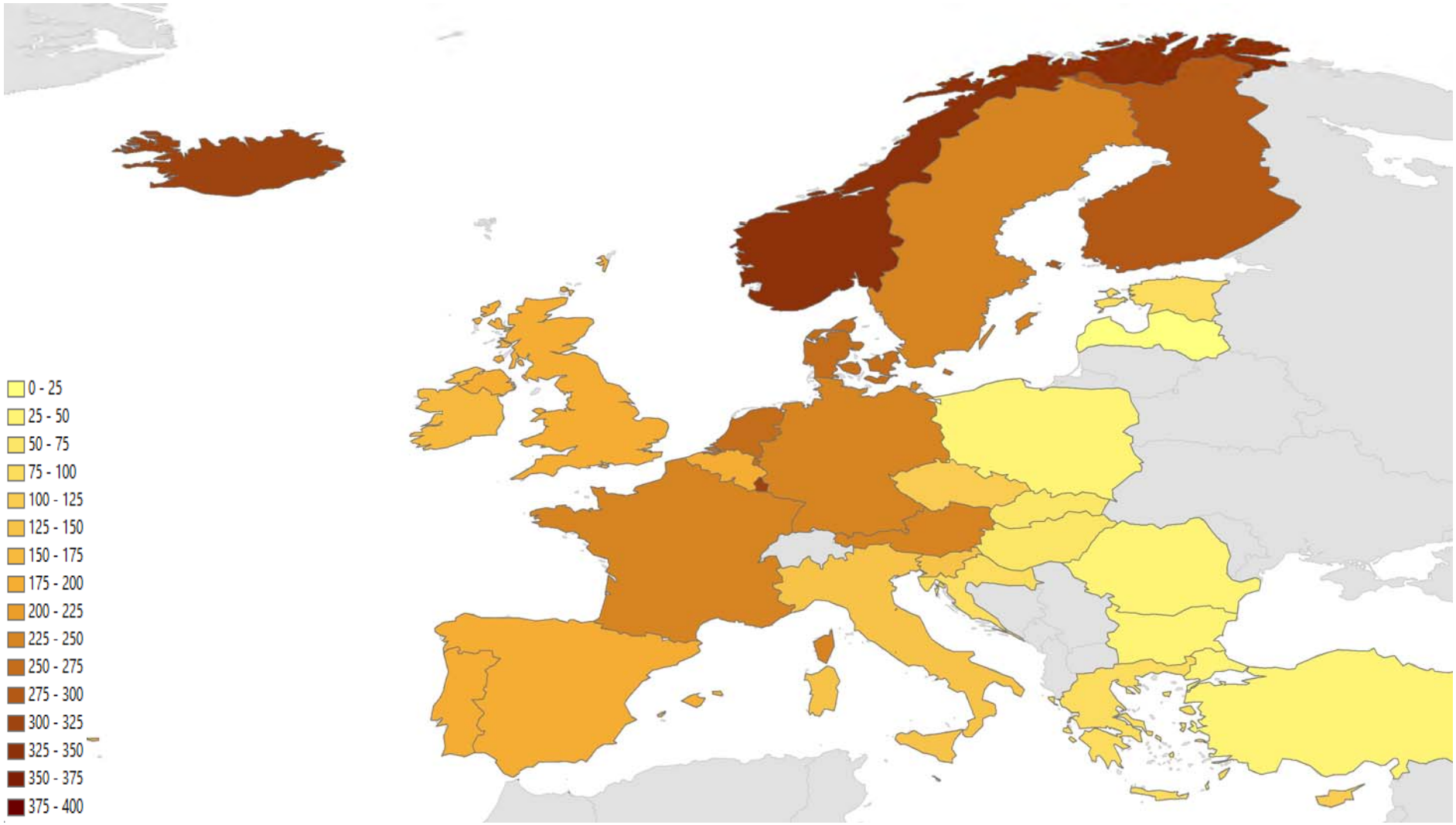
Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 2009

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

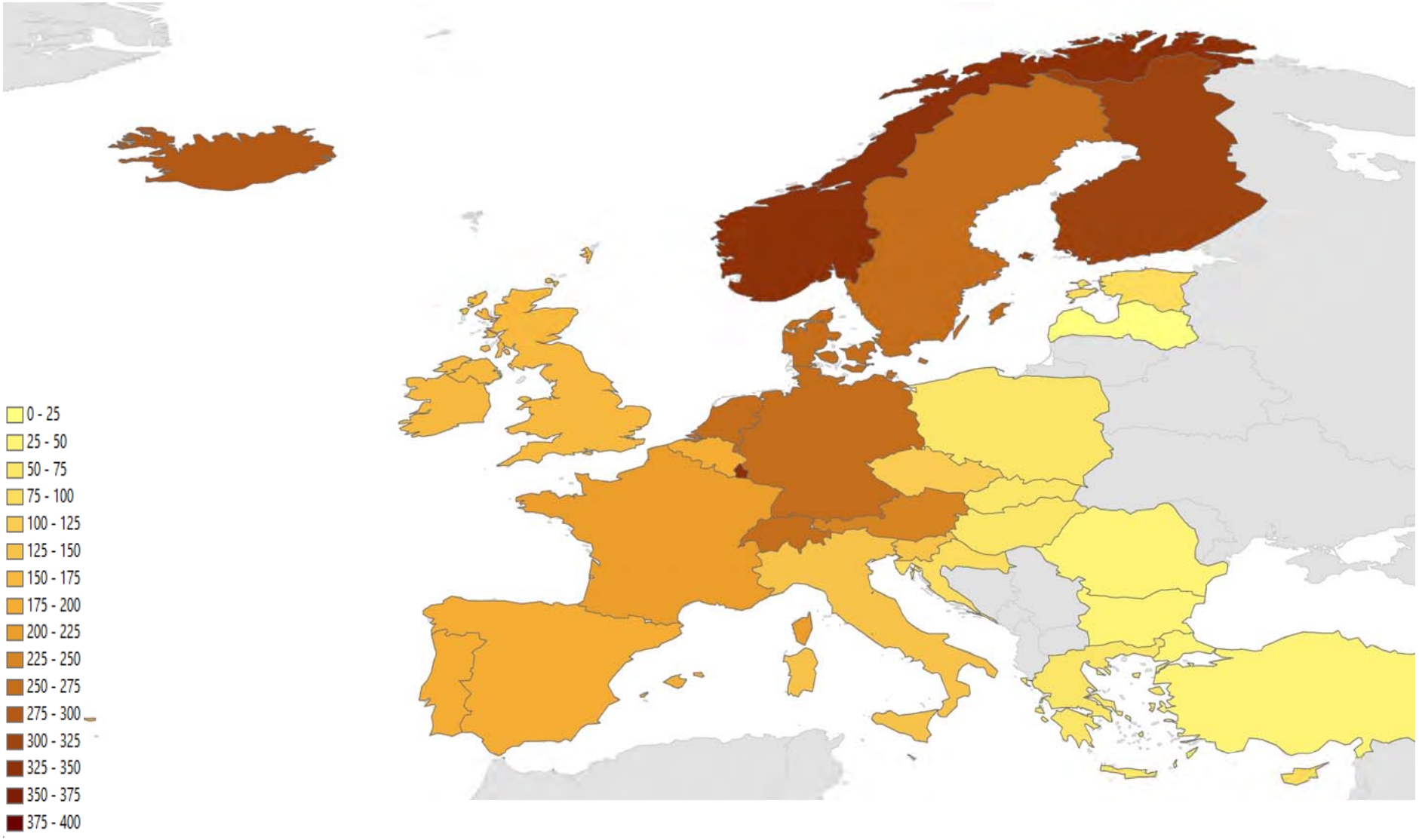
Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 2010

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

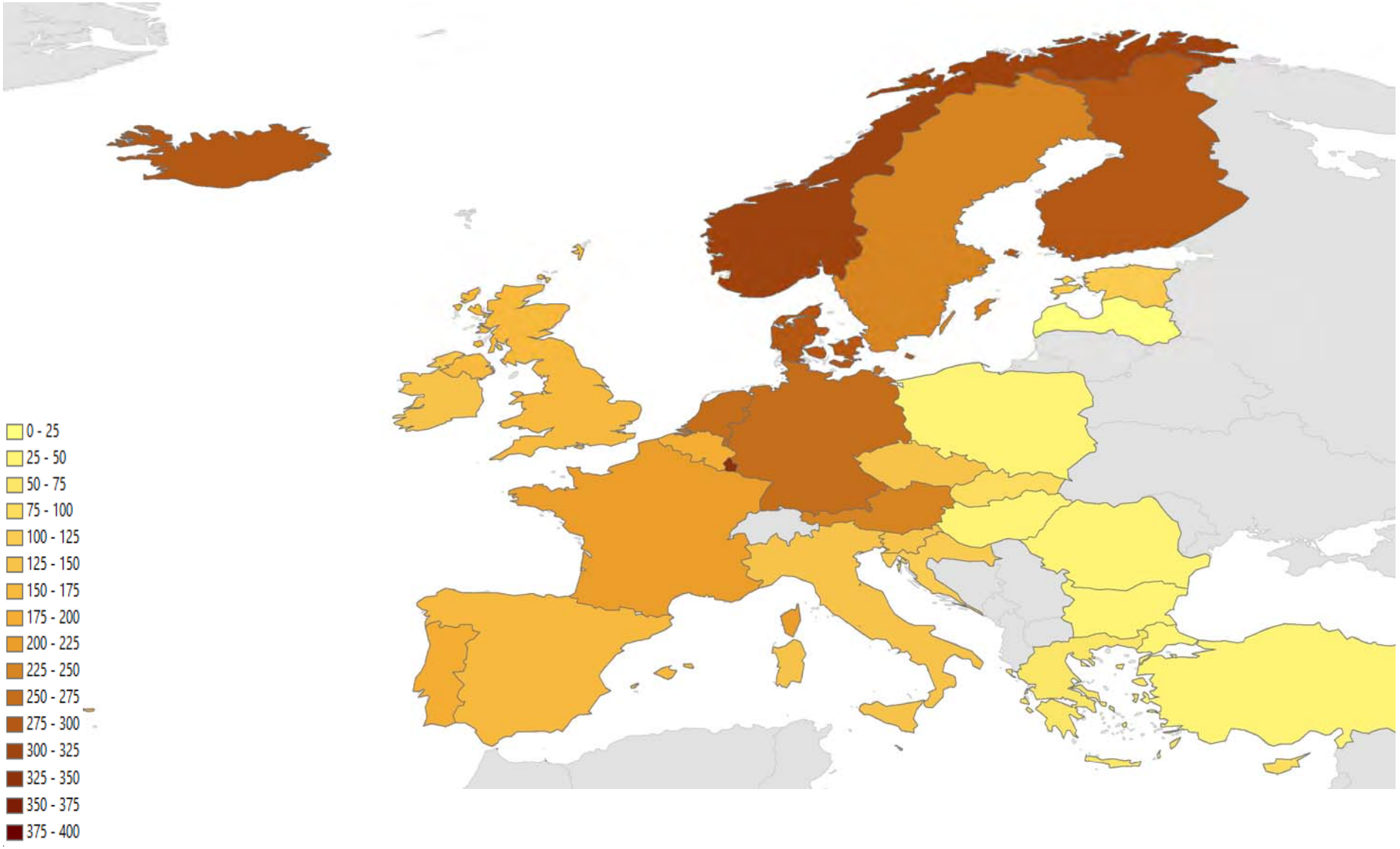
Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 2011

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

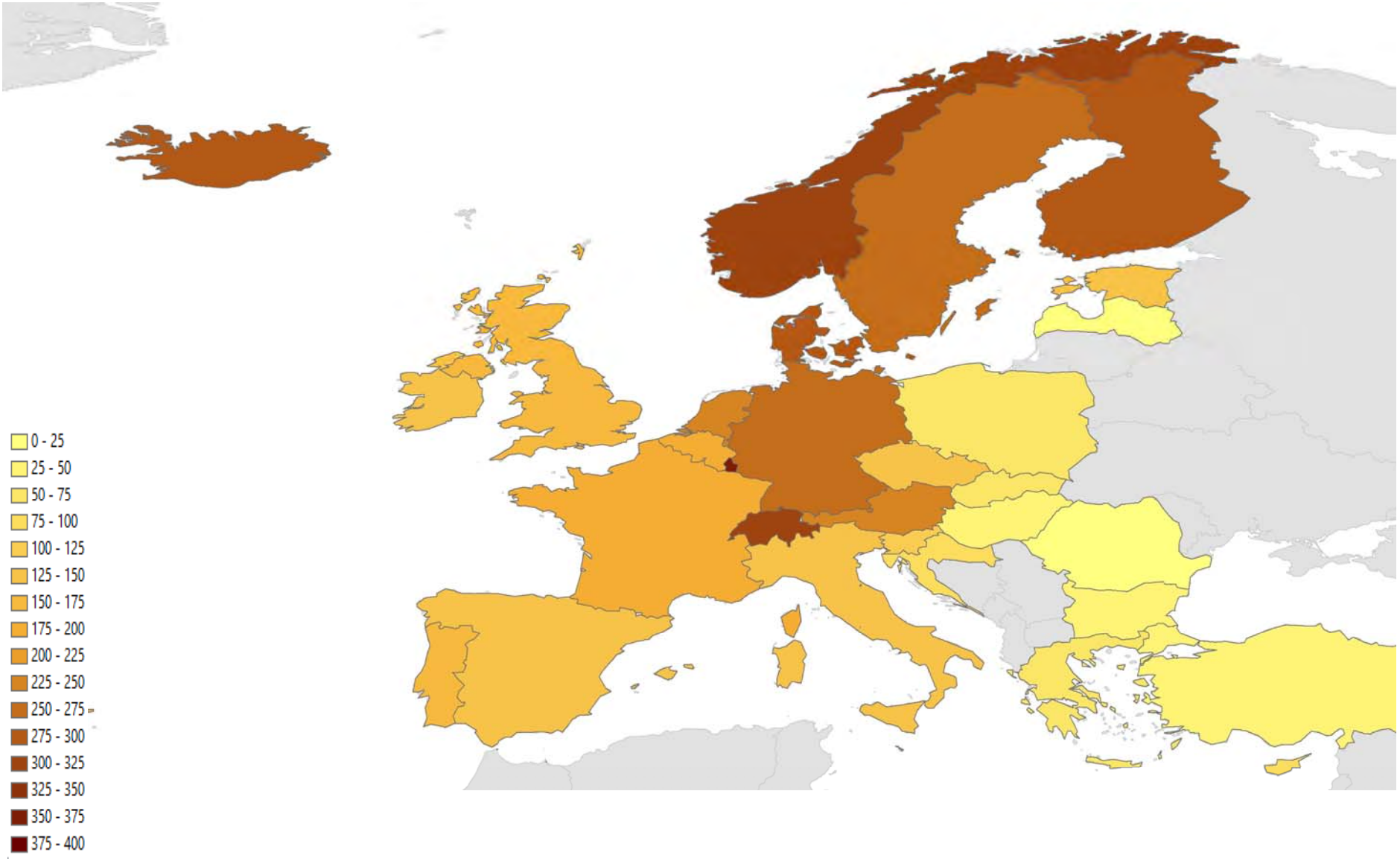
Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 2012

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

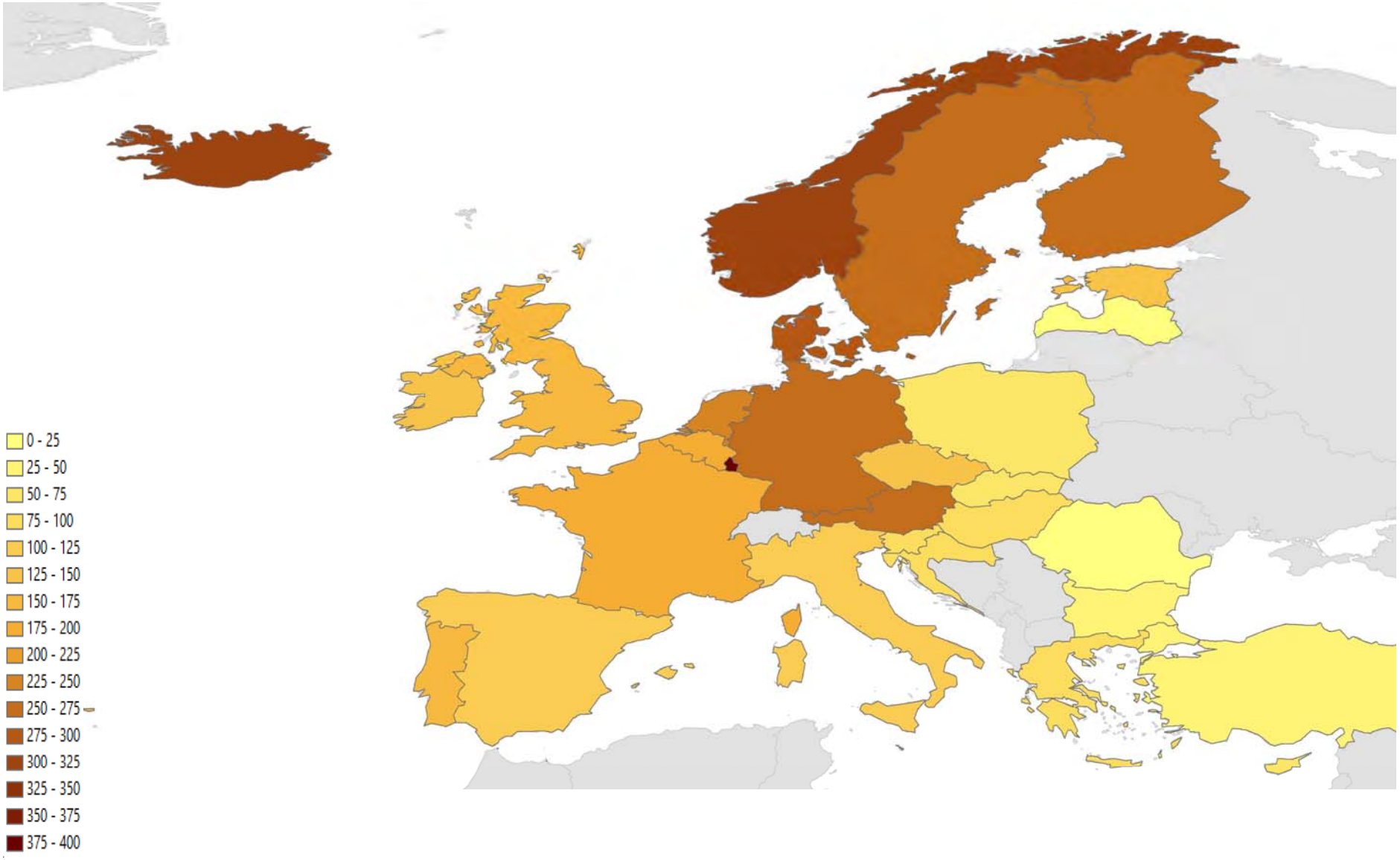
Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 2013

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

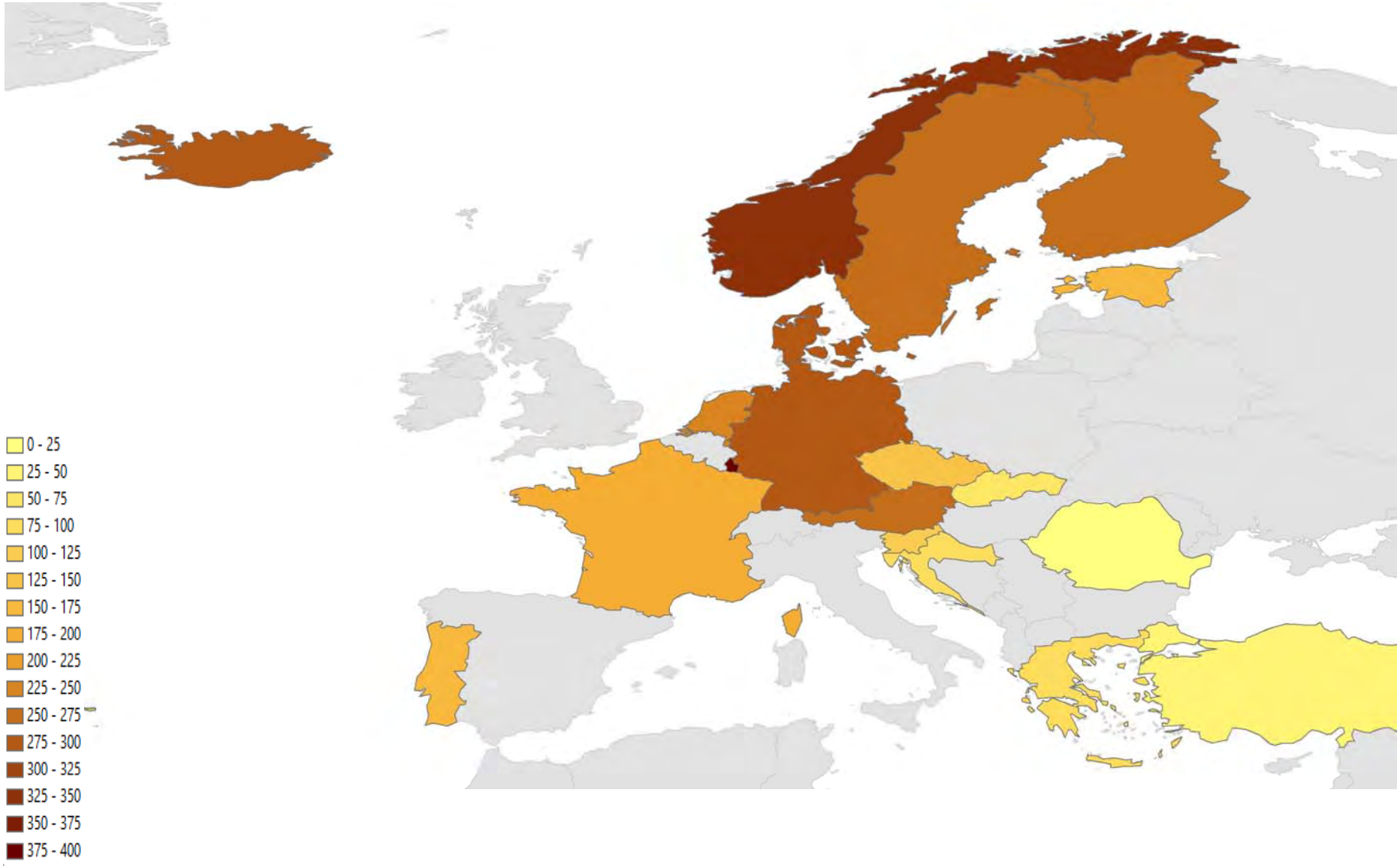
Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)/capita - 2014

(Purchasing Power Standard (PPS) per inhabitant at constant 2005 prices)

Source: Eurostat



Government Budget Appropriations or Outlays for R&D (GBOARD)

Sample of large EU countries

(million current PPP $)

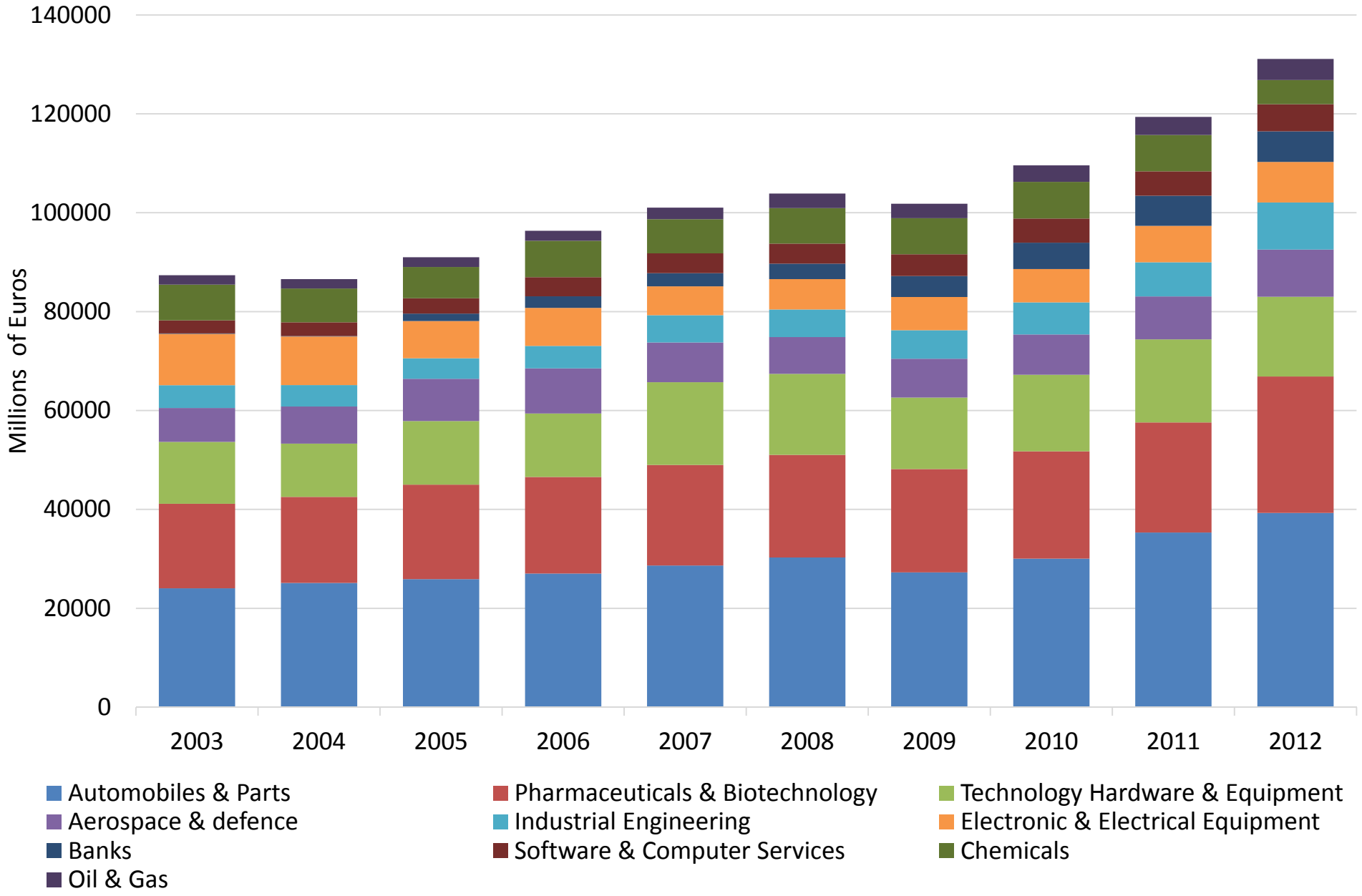
Source: OECD; Netherlands is included in the large sized countries because of the size of the budget

…the quasi stagnation of R&D public investment in Europe during the last decade hides **a major trend of internal divergence inside Europe itself**.

In the year 2000, Germany and France presented similar national R&D budgets; one decade later, Germany outpaces France by 50%. Italy budgets have declined since 2007, and in real terms are 15% lower than in 2000.

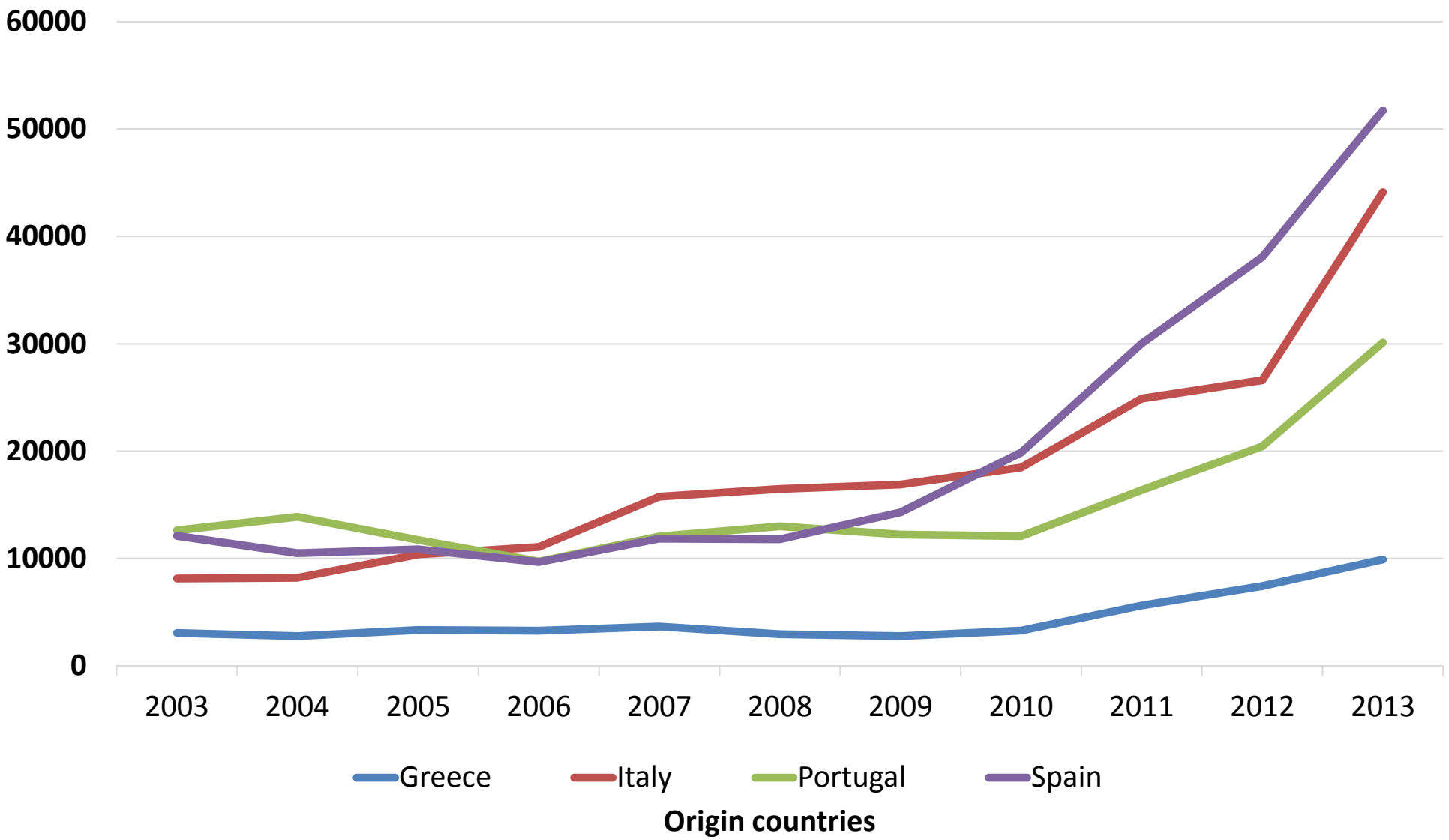
The 500 largest EU firms investing in R&D

(Following ICB - Industry Classification Benchmark; Source: EU Industrial R&D Investment Scoreboard



Fluxo de gregos, italianos, portugueses e espanhóis para o Reino Unido

Evolução do número de atribuições de número de registo (*National Insurance Number*) pelo Sistema de Segurança Social no Fonte: Department for Work and Pensions UK



Emerging major EU vulnerabilities:

- **New migratory flows of skilled people**:

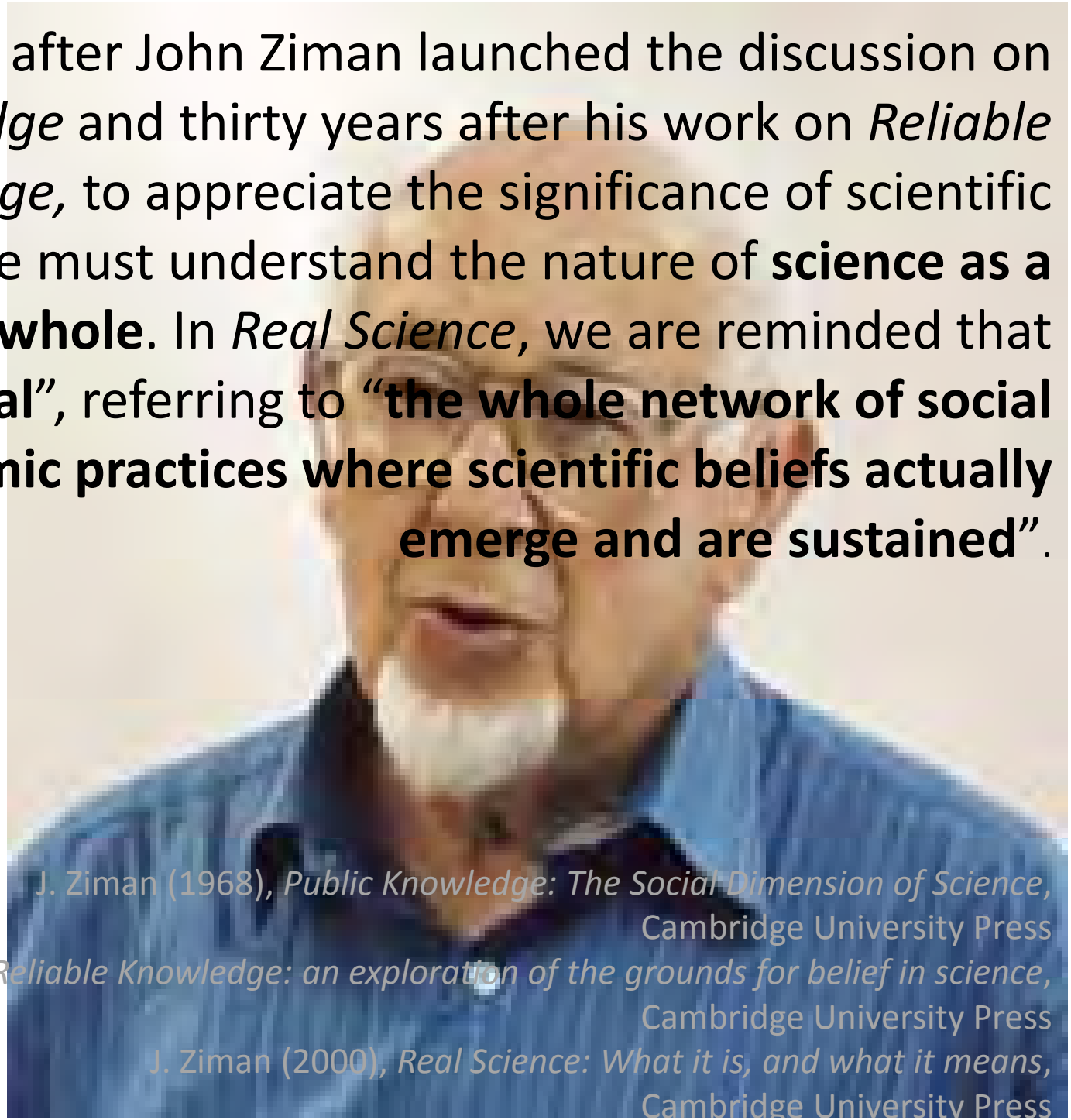
  …the growing scientific and technological capacity of ***less industrialized regions*** is now associated with, also, a growing vulnerability associated with a increasing international competition for skilled human resources.

- **High rates of young unemployment:**

  …weak new job creation in ***less industrialized regions***.

- Accelerated rate of **aging** of population…

Some forty years after John Ziman launched the discussion on *Public Knowledge* and thirty years after his work on *Reliable Knowledge,* to appreciate the significance of scientific knowledge one must understand the nature of **science as a complex whole**. In *Real Science*, we are reminded that "**science is social**", referring to "**the whole network of social and epistemic practices where scientific beliefs actually emerge and are sustained**".

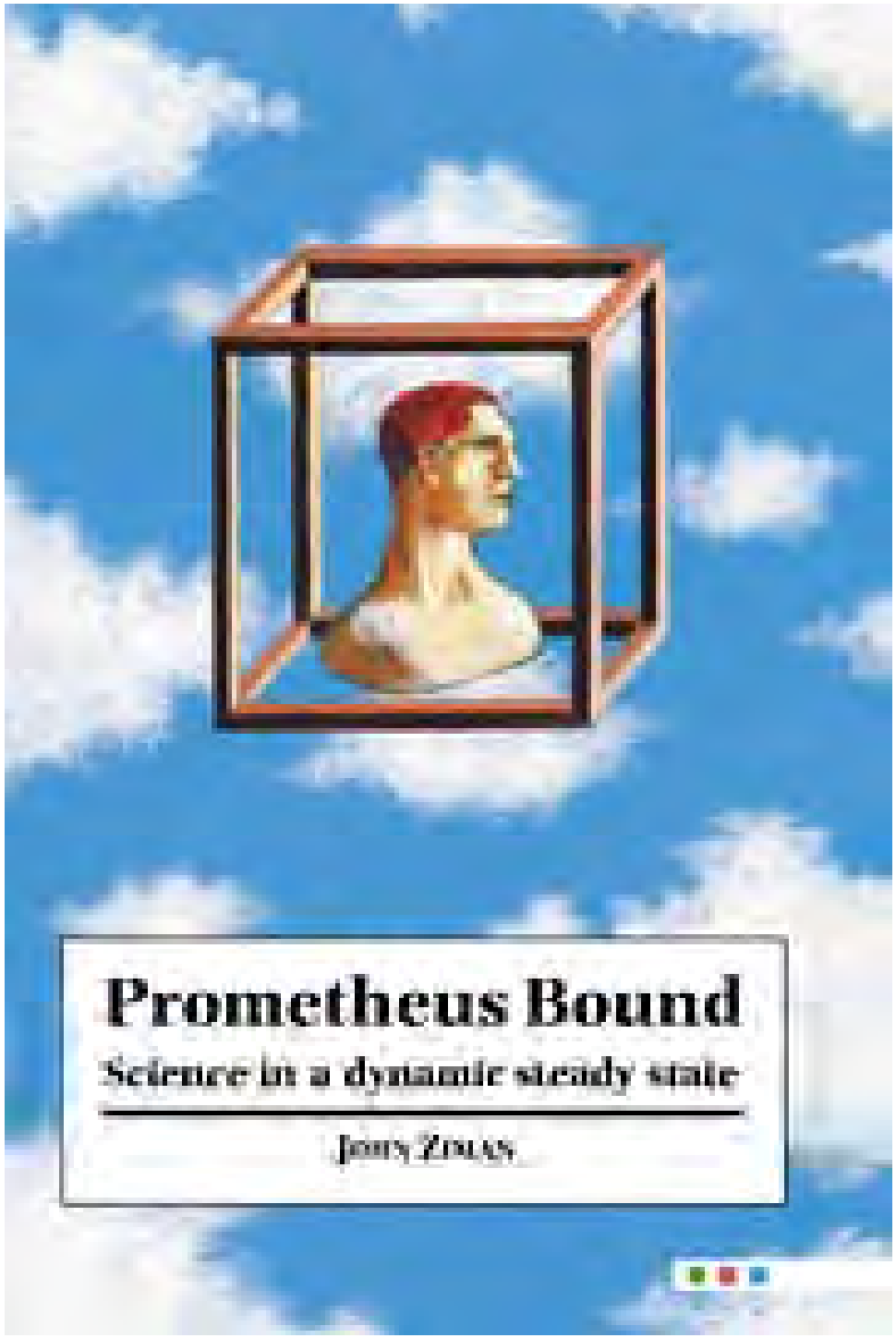


J. Ziman (1968), *Public Knowledge: The Social Dimension of Science*, Cambridge University Press

J. Ziman (1978), *Reliable Knowledge: an exploration of the grounds for belief in science*, Cambridge University Press

J. Ziman (2000), *Real Science: What it is, and what it means*, Cambridge University Press

Ziman takes government funding of science as a given, because the market cannot be trusted to allocate resources wisely and, anyway, research now costs so much that only government can pay the bill.

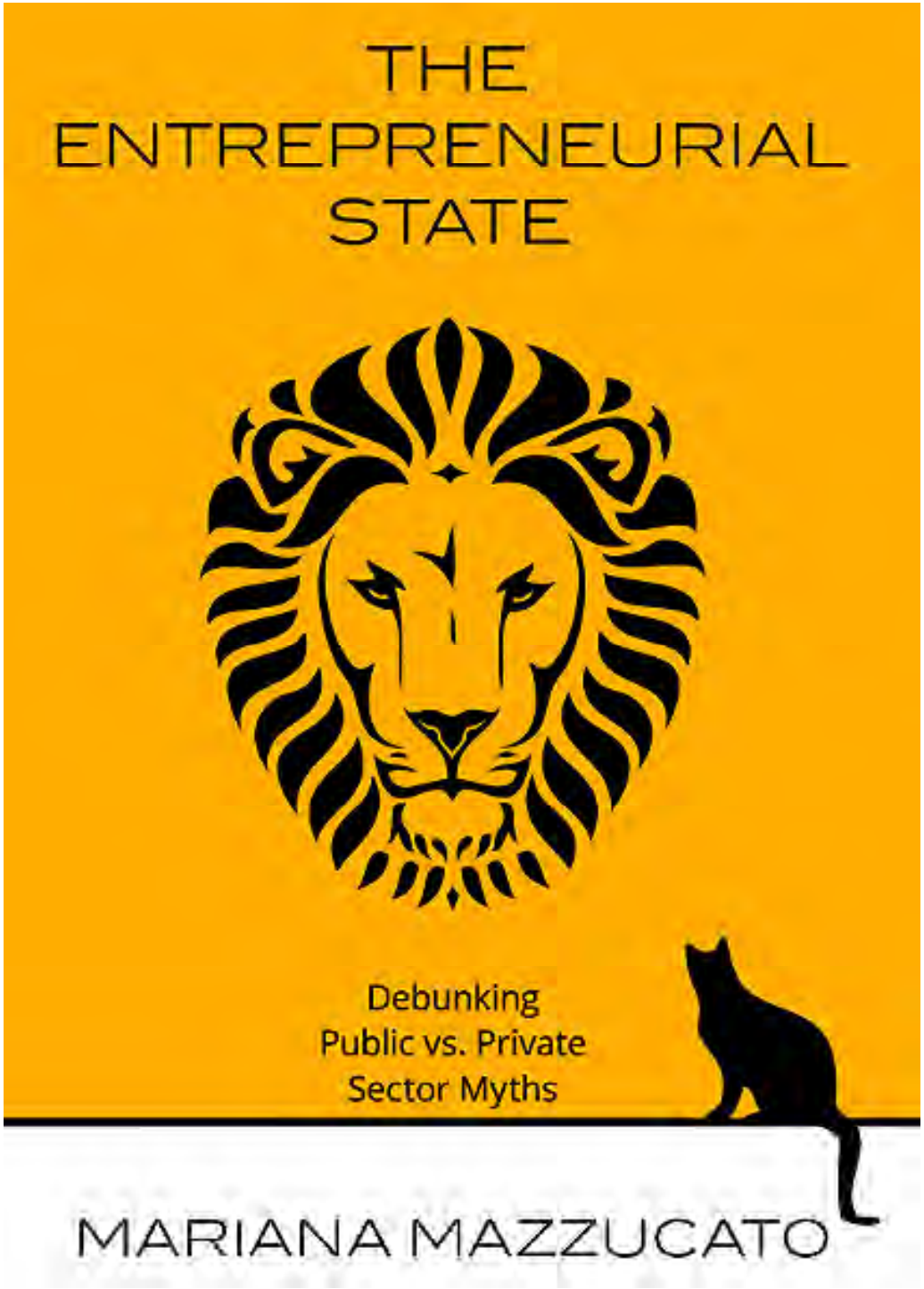


Which myths?

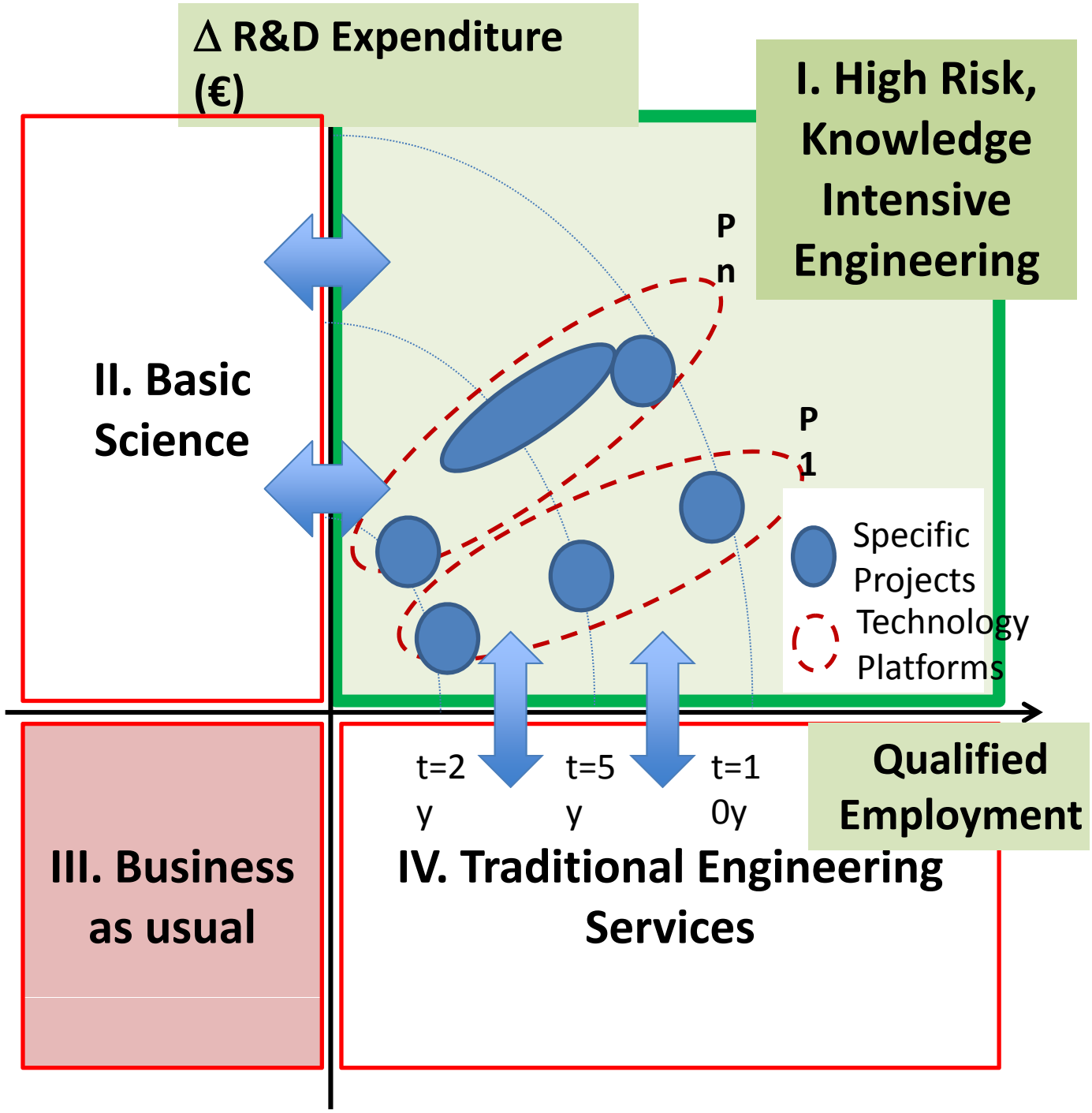
Public vs Private
R&D vs Innovation
Higher Educ vs Vocational Training

…we live on times of increasing socialization of risks and the privatization of rewards

How can we effectively help debunking these myths and guarantee better policies?

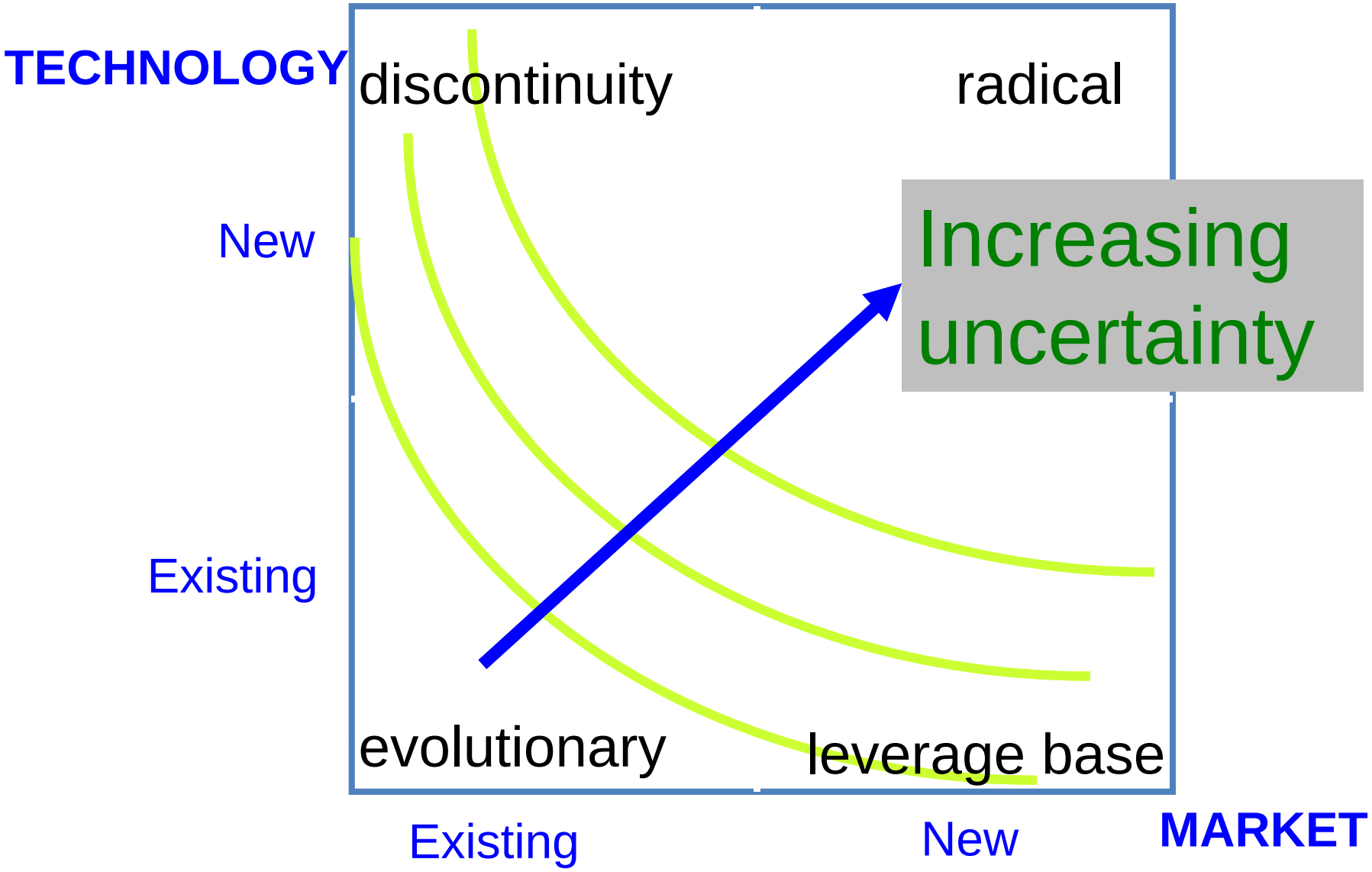


Focus


Δ R&D Expenditure (€)
I. High Risk, Knowledge Intensive Engineering
II. Basic Science
P n
P 1
Specific Projects
Technology Platforms
t=2 y
t=5 y
t=10y
Qualified Employment
III. Business as usual
IV. Traditional Engineering Services

Patterns of technical change

Source: Branscomb,Morse & Roberts (2001): www.atp.nist.gov/eao/gcr_787.pdf



Nathan Rosenberg (2001):

"uncertainty in the realms of both science and technology ... have enormously important consequences and a main concern is how **organisations and incentives migth be modified to accommodate these uncertainties**."

Source: OECD(2001), "Social Sciences and Innovation"

Chris Freeman (2001):

"There is an irreducible uncertainty about future political, economic and market developments ....,technological innovations may actually increase it, since they add to the dimensions of general **business uncertainty**, the dimension of **technological uncertainty**."

Source: SPRU (2001)

...*uncertainty*: which impact?

In a context of increased uncertainty and accelerated rate of technological change, for which knowledge and innovation are critical factors for social and economical development, the role of the science and advanced education may be enhanced, but requires to be adapted!

The scope:... the globalized "learning society"!

Knowledge Institutions → Learning Organisations

Intellectual Property → Learning Networks

Source: Conceição, Lundvall and Heitor (2002)

Why Science and Innovation?

The future requires addressing two key emerging issues everywhere:

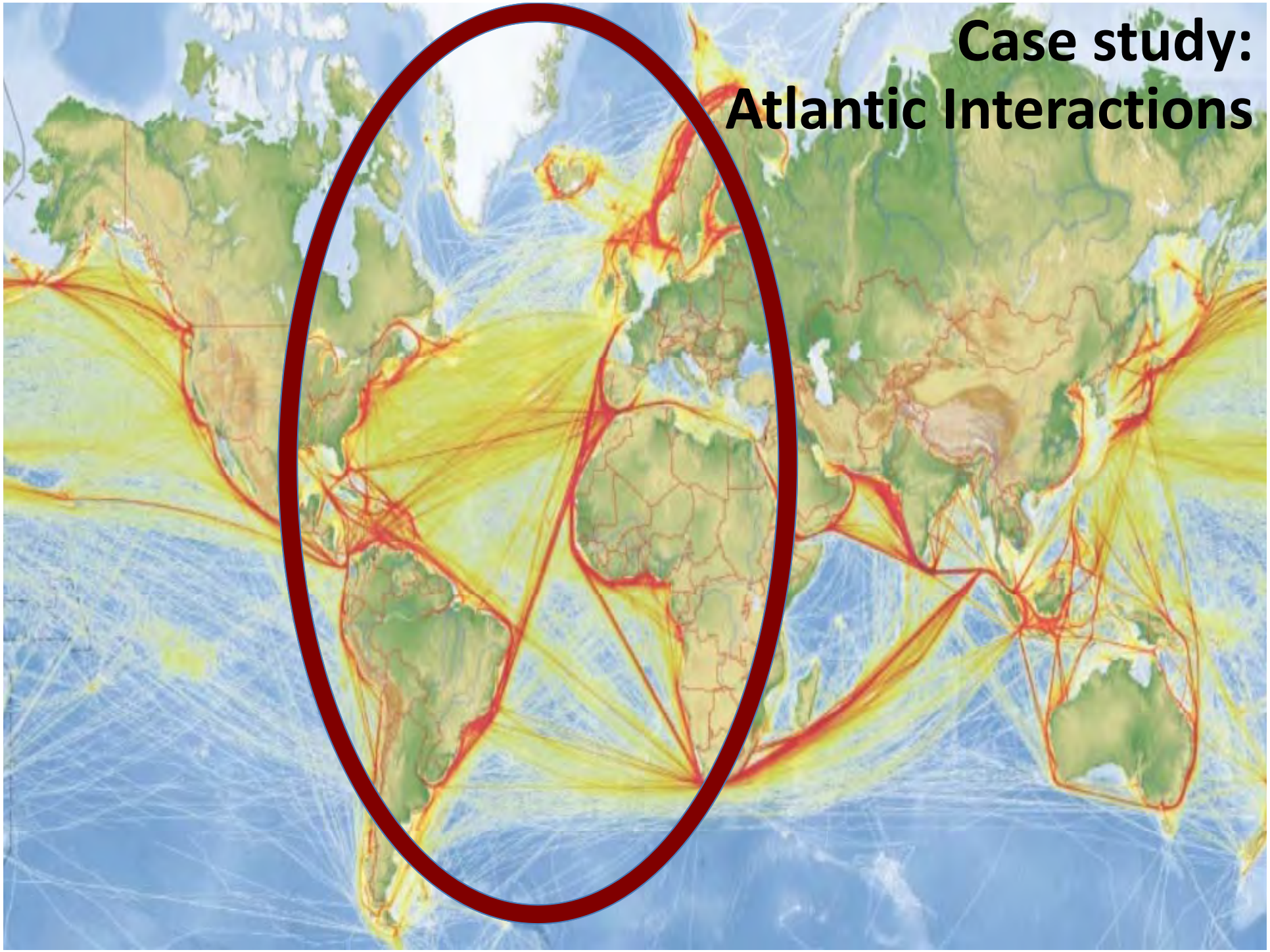
- **EXTERNAL – multilateral:**
  - Multiply **global R&D and HE networks**
  - Develop **international R&D organisations** and programmes
  - Promote the international **debate for new research** agendas

- **INTERNAL:**
  - Better understanding of "**policy mix**":
    - Exploration and exploitation
    - Extended BERD across small, medium and large companies
    - The key role of local productive arrangements for global markets
  - Invent jointly new economic drivers
  - Diversify and combine funding sources

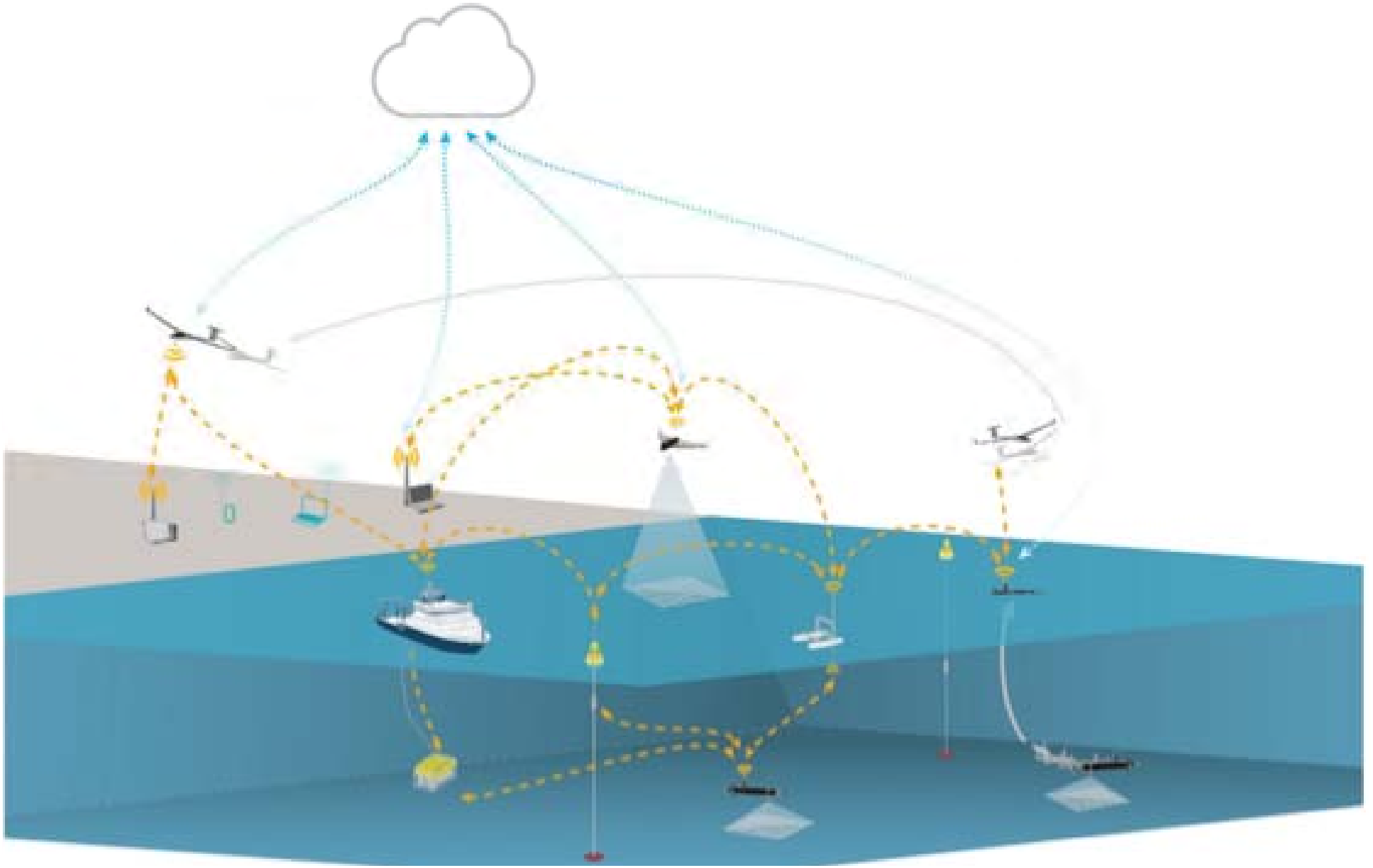
Francisco Díaz Carreño, 1890
"Posición probable del globo antes del diluvio"
Museo del Prado

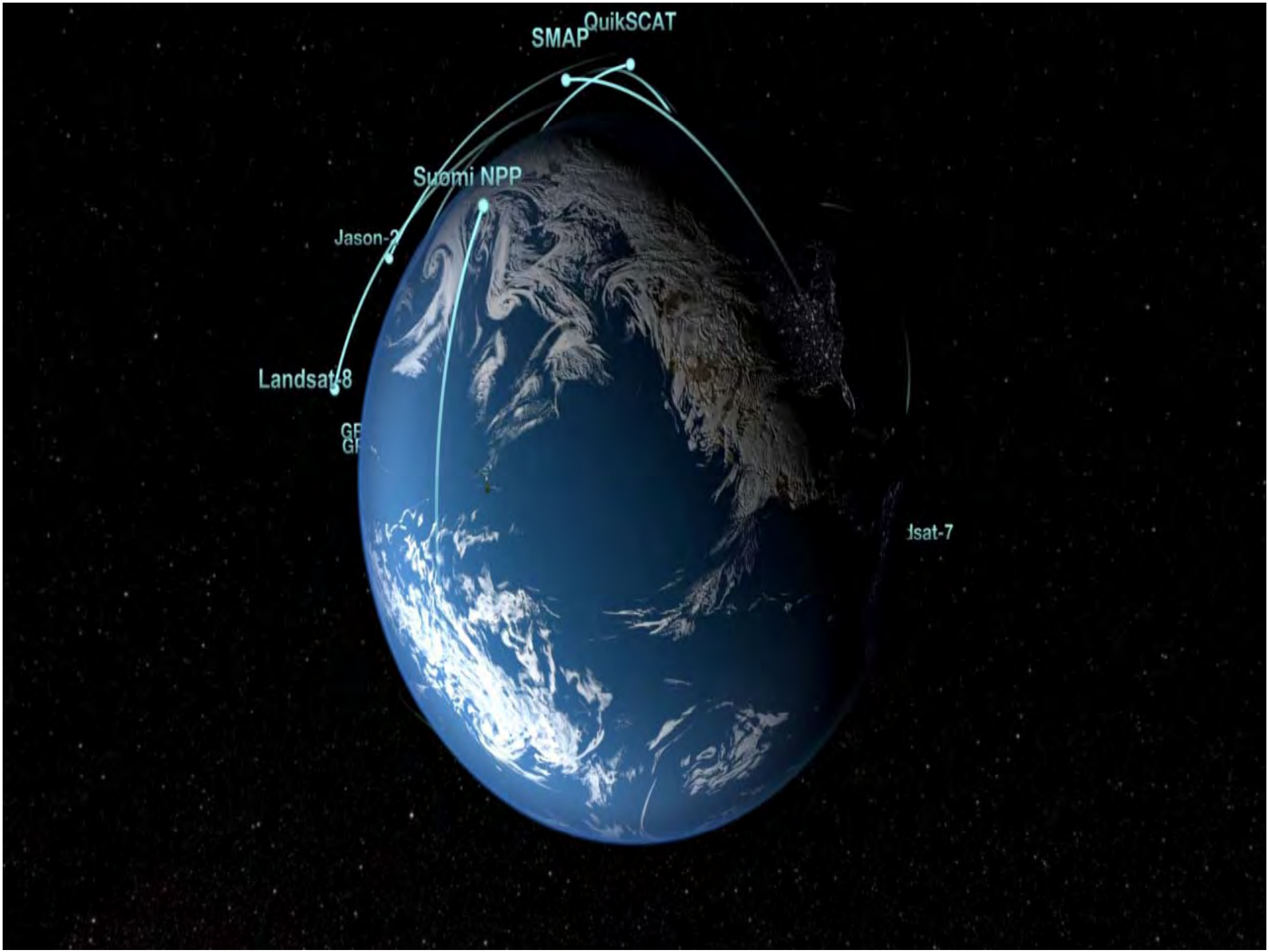
Public Policy is critical:

but, it requires an increasing involvement of scientists and academics…


Case study:
Atlantic Interactions

Case study : **Seamless integration of networked autonomous platforms for ocean monitoring and surveillance**




SMAP
QuikSCAT
Suomi NPP
Jason-2
Landsat-8
Isat-7


CEIIA

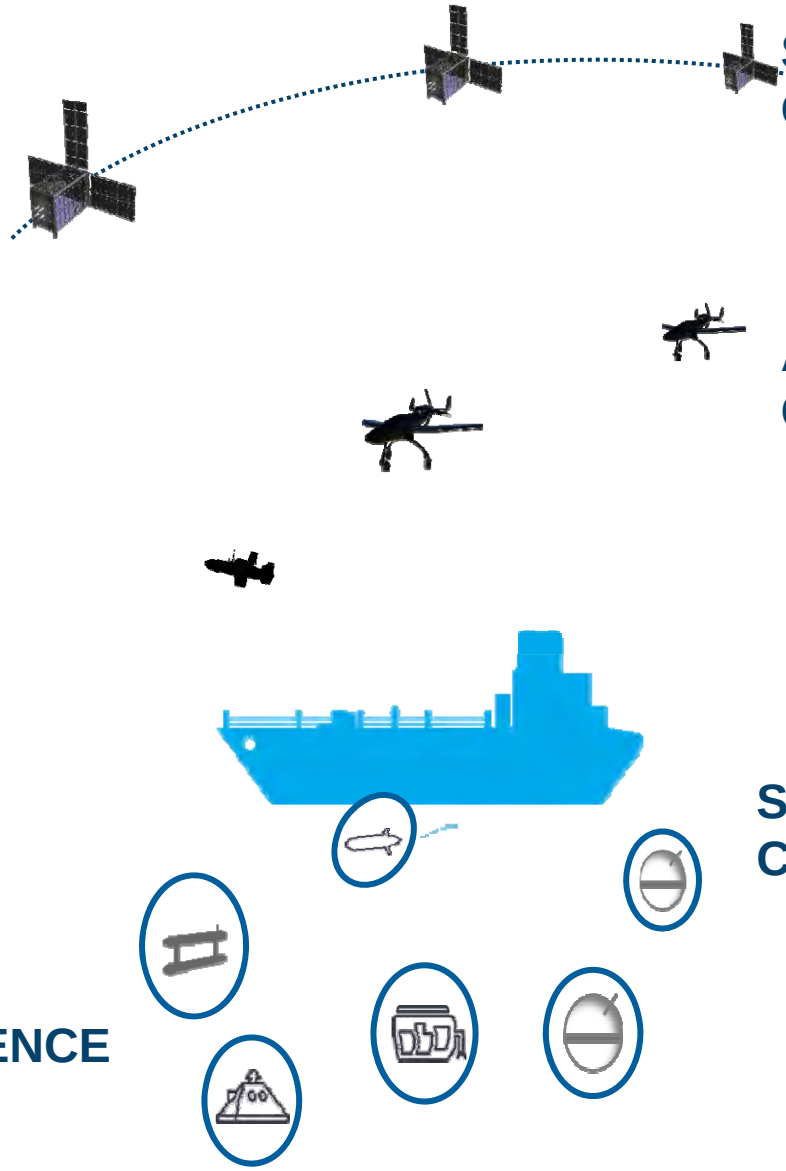
INTEGRATING KNOWLEDGE FROM DEEP SEA TO SPACE

AIR center
Knoweledge for the Atlantic

bringing together:

- *R&D Centres*
- *Intermediaries*
- *Companies*
- *Public institutions*

INTELLIGENCE CENTER



SPACEBORNE CONSTELLATION

AIRBORNE CONSTELLATION

SEABORNE CONSTELLATION

Which questions?

- **WHAT** will these new technologies be like?
- On **WHICH** research we should invest in?
- **WHAT** engineering courses should we teach in our schools and universities?

These are relevant issues,
but the wrong questions …

We can look, instead, at the process...

<u>How</u> people, institutions and incentives can be effectively oriented, transmitted and assimilated **to better connect scientist and policy** in order to allow all our societies, at large, to move towards a socially responsable, sustainable and entrepreneurial world?

Lessons Learned: *the hypothesis*

Science, its impact and the presence of innovation, result from a **cumulative, long-term, collective and uncertainty process**, involving an extensive divison of labour, which requires massifying the training of human resources and qualifying the labour force in many economic sectors, in a way that depends on the structure of the economy

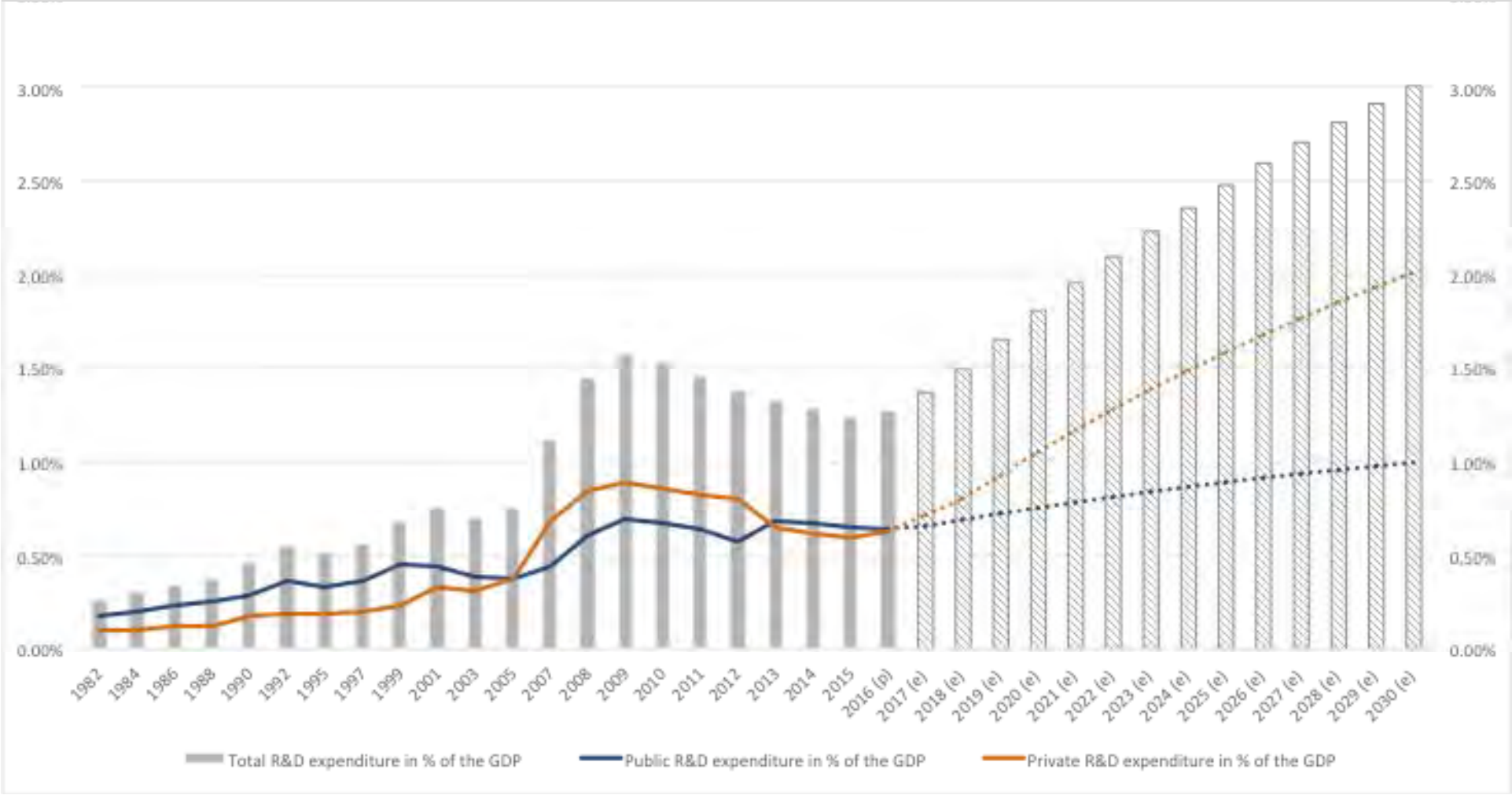
Public Policy is critical:

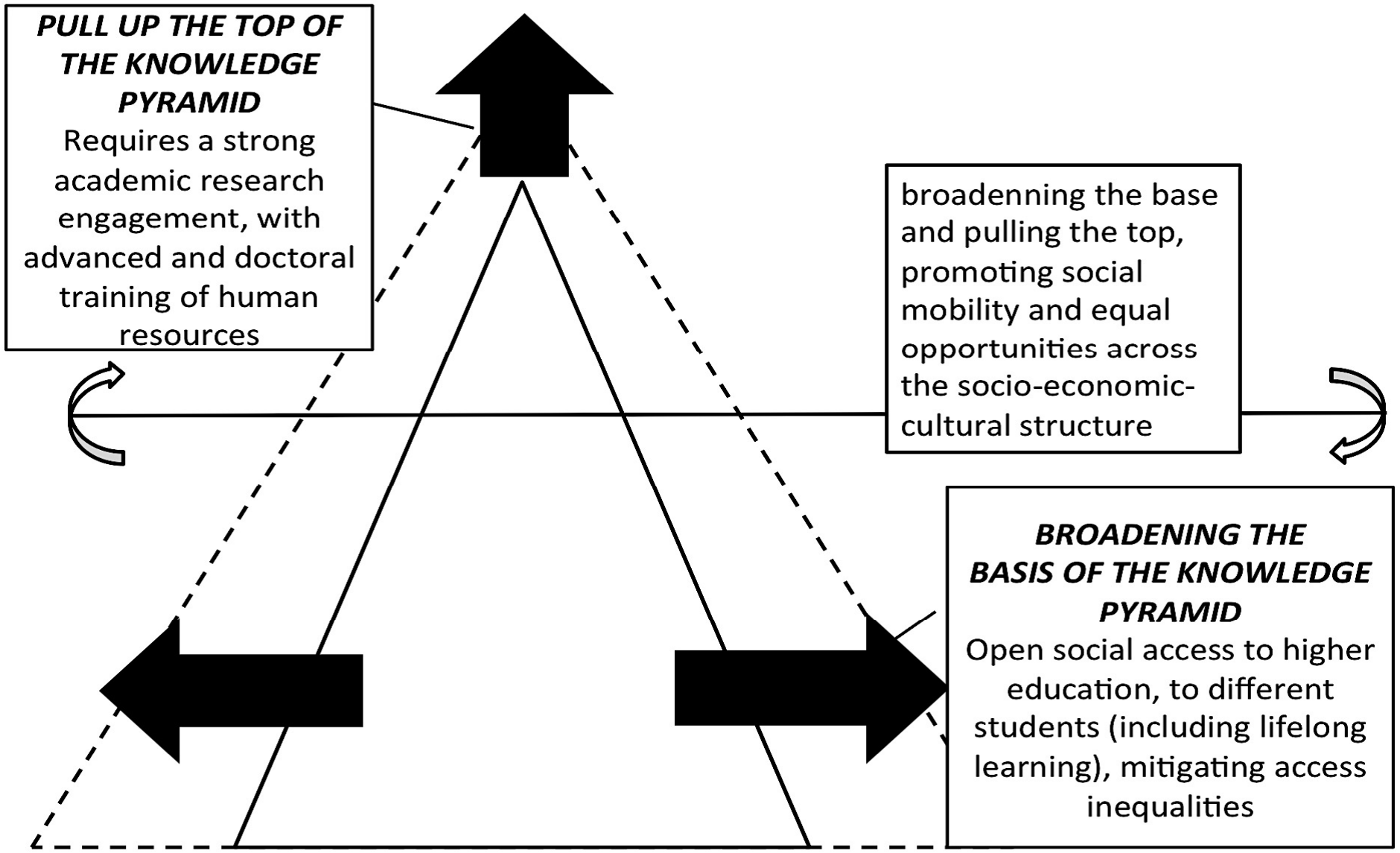
*but, is there room for a **common vision for TIP**?*

The TARGET: GERD/GDP - *towards European convergence*

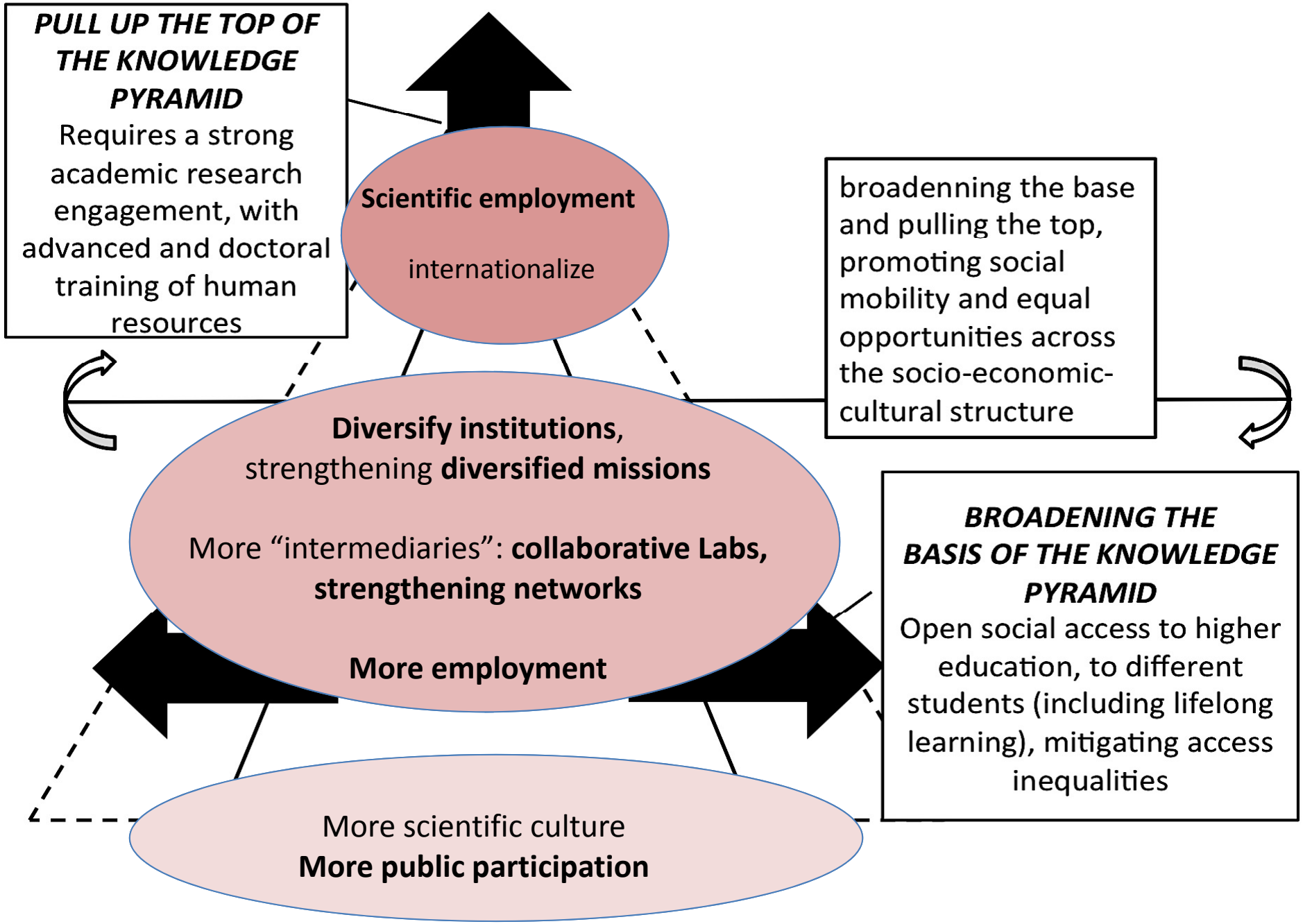
(source: OCDE)

Achieve a level of **overall R&D investment of 3% of GDP by 2030**, with a relative share of 1/3 public and 2/3 business expenditure, corresponding to achieve an overall R&D investment of 1.8% of GDP by 2020 (1.3% in 2016)





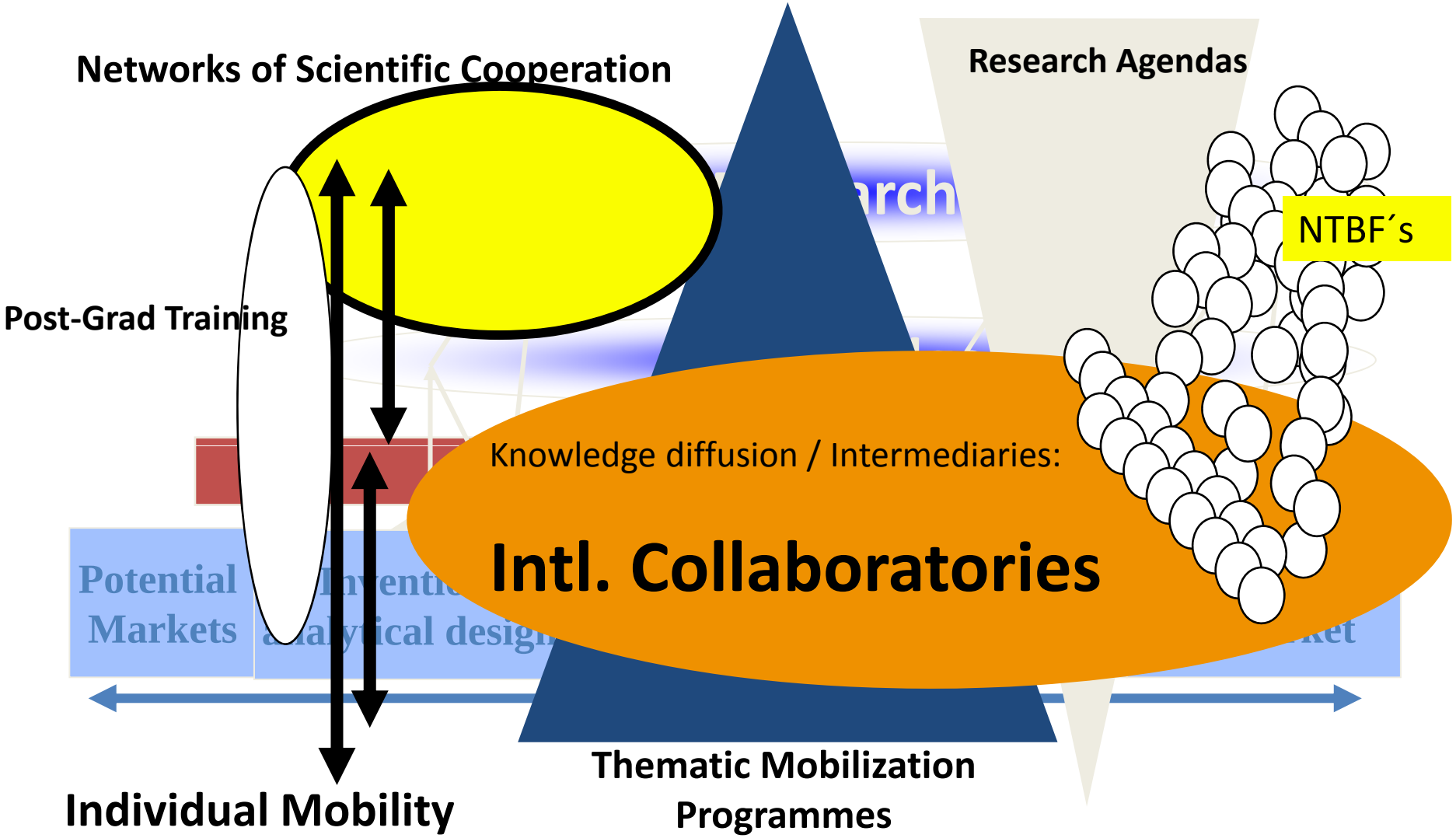
The multidimensions of S&T and the social construction of Technology and Innovation Policy



The social construction of technology and innovation policy

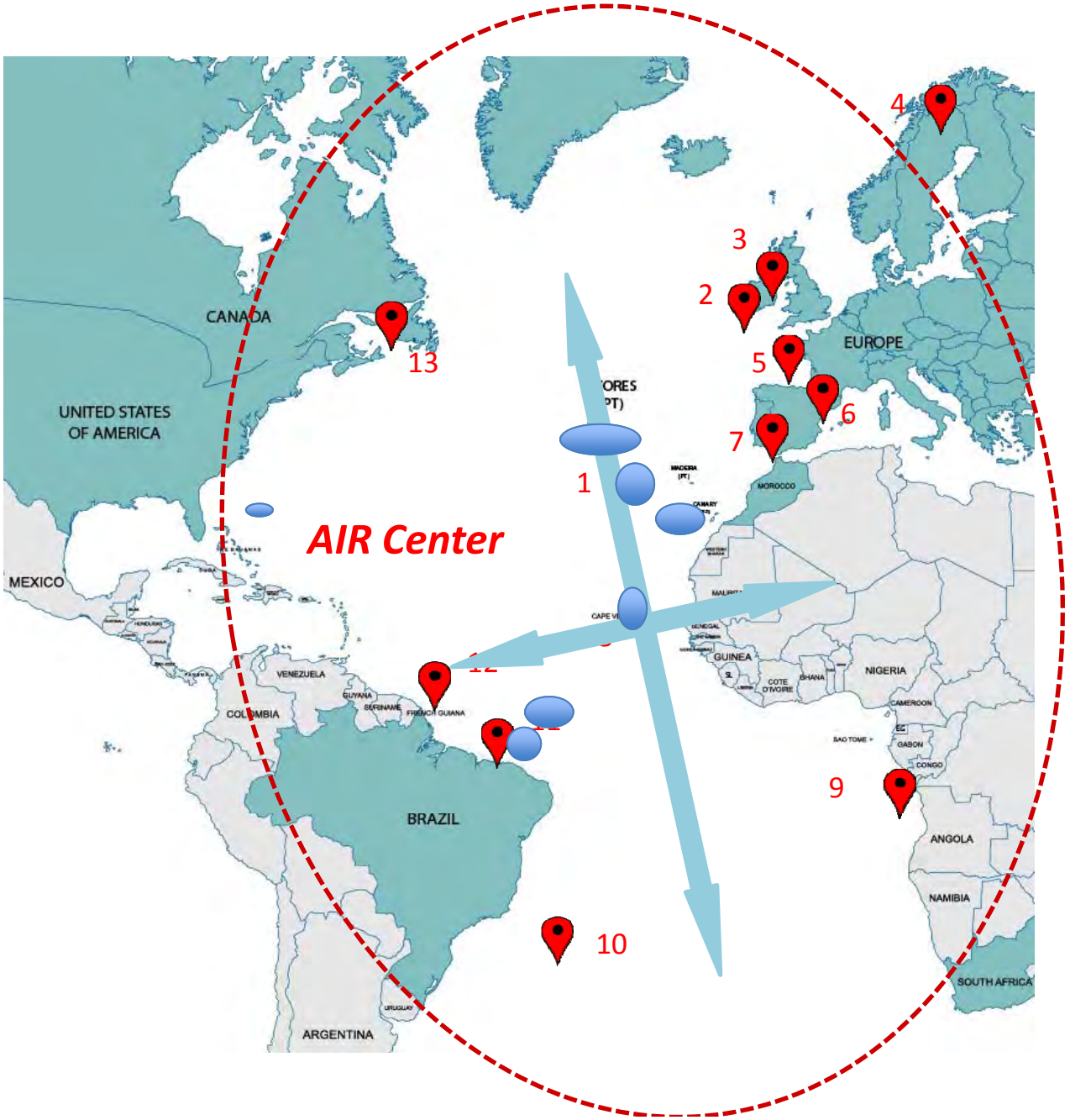
Promoting global ***Systems of Innovation and Competence Building***:

…with **diversified partnerships**




Our goal: space as a new *network of opportunities*
The instruments:
• A global pilot action in Atlantic, ***the AIR Center;***
• linked to a modern space strategy, ***"Portugal Space 2030"***

SOUTH-NORTH / NORTH-SOUTH ATLANTIC RESEARCH INFRASTRUCTURE



AIR Center

2. "Porcupine" EMSO Marine Observatory (UK)
3. Galway Bay EMSO Marine Observatory (IR)
4. Kiruna ESA Station (SW)
5. Molene Isl. EMSO Marine Observatory (FR)
6. Villafranca ESA Station (ES)
7. Cadiz Gulf EMSO Obs. (PT)
8. Cape Verde (CV)
9. Deep-Ocean FixO3 Observatory (UK/US/AN)
10. South Atlantic FixO3 Observatory (UK)
11. Alcântara Launch Center, (BR)
12. Kourou ESA Station, French Guiana (FR)
13. Bay of Fundy Observatory, (CA)

The process (from June 2016): Connecting scientists to policy

to build new horizons for entrepreneurs around the world!

Atlantic Interactions – AIR Center, Terceira, Azores, 20-21 April 2017

Science diplomacy revisited

Connecting scientists to policy around the world

Atlantic Interactions – AIR Center, Terceira, Azores, 20-21 April 2017

The “making off” of the AIR Center:

from Azores, 20-21 April 2017,… to Florianopolis, 20-21 November 2017

ATLANTIC
INTERACTIONS

INTEGRATING SPACE, CLIMATE, OCEAN AND DATA SCIENCES
THROUGH NORTH-SOUTH/SOUTH-NORTH COOPERATION

Towards an Atlantic International Research Center

Air Center

Manuel Heitor

Knowledge asymmetries and implications for strategic planning of *Innovation and Technology Policy*

Human-centered policy design and implementation