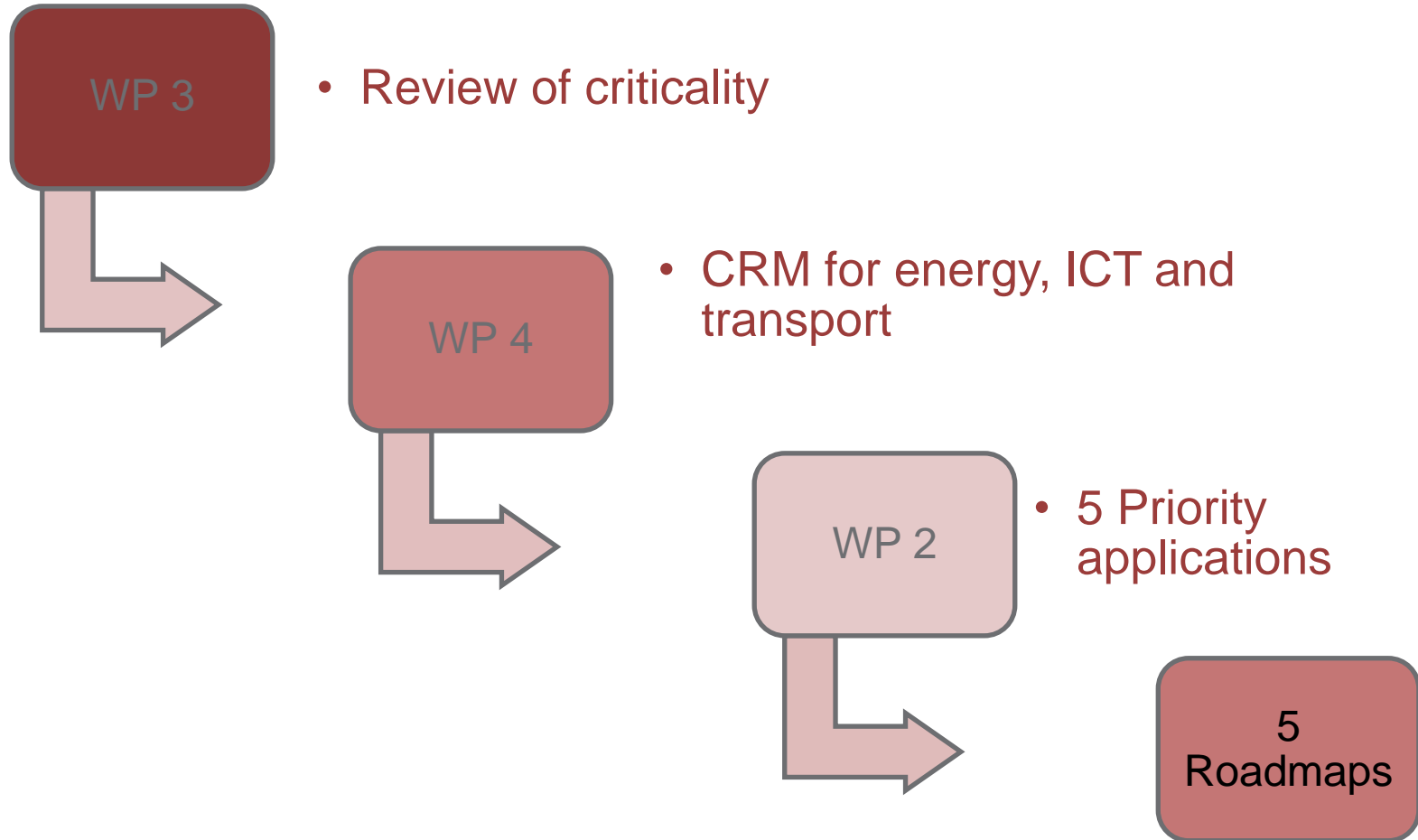


# CRM InnoNet

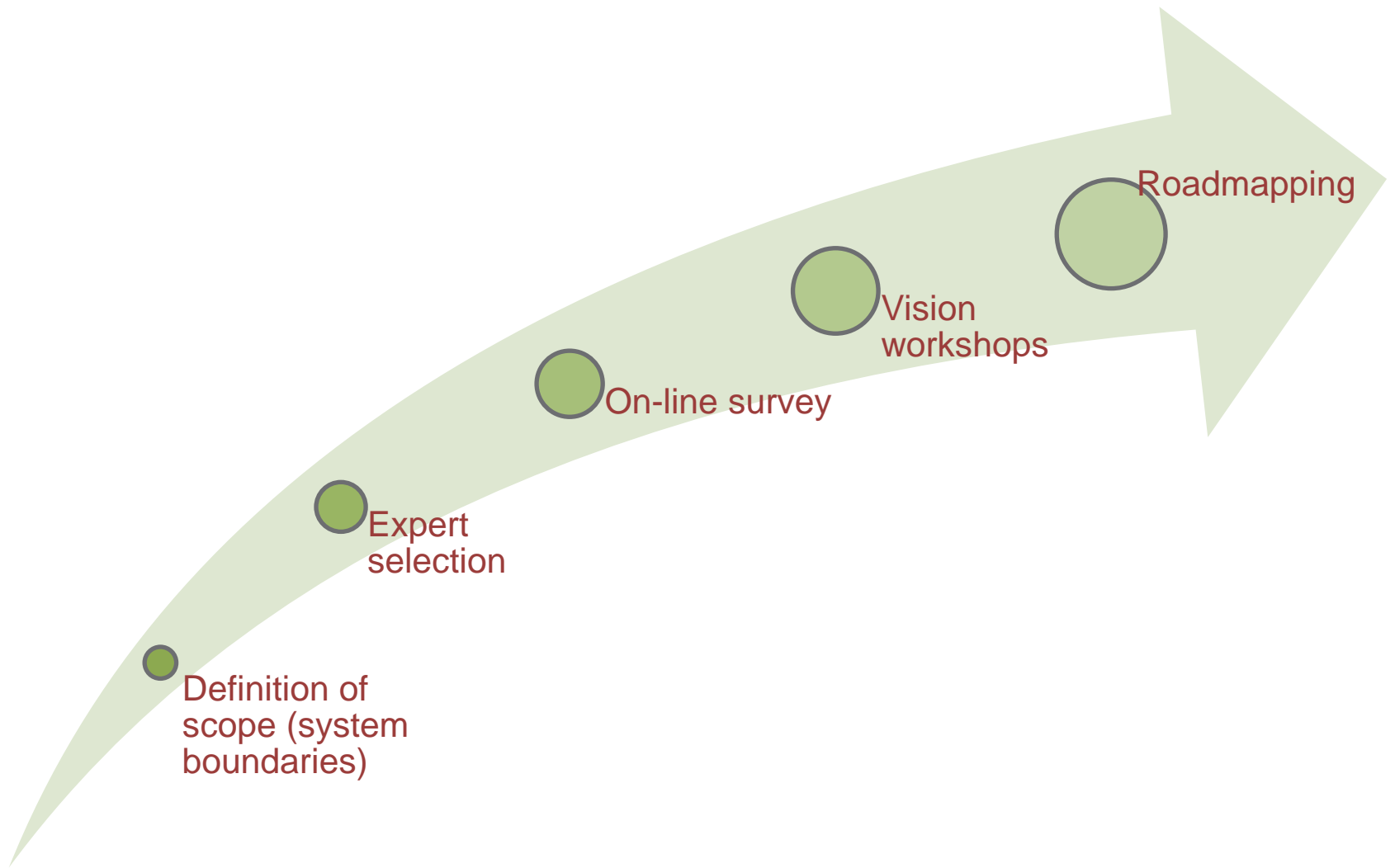


ROADMAPS FOR  
MATERIAL  
SUBSTITUTION

# CRM InnoNet – the way to roadmapping



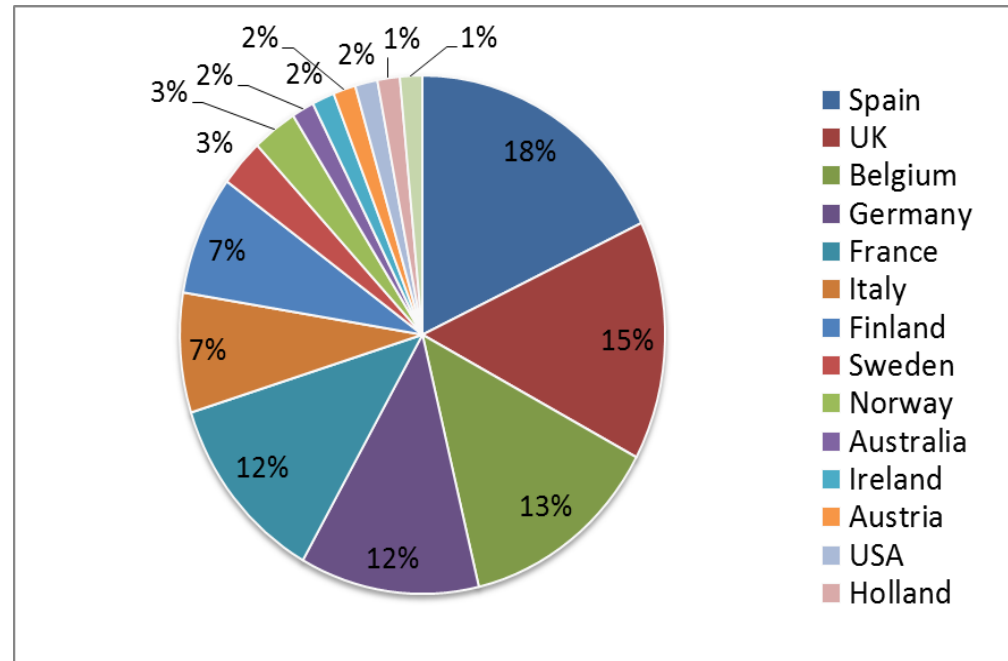
# CRM InnoNet Roadmaps – the process



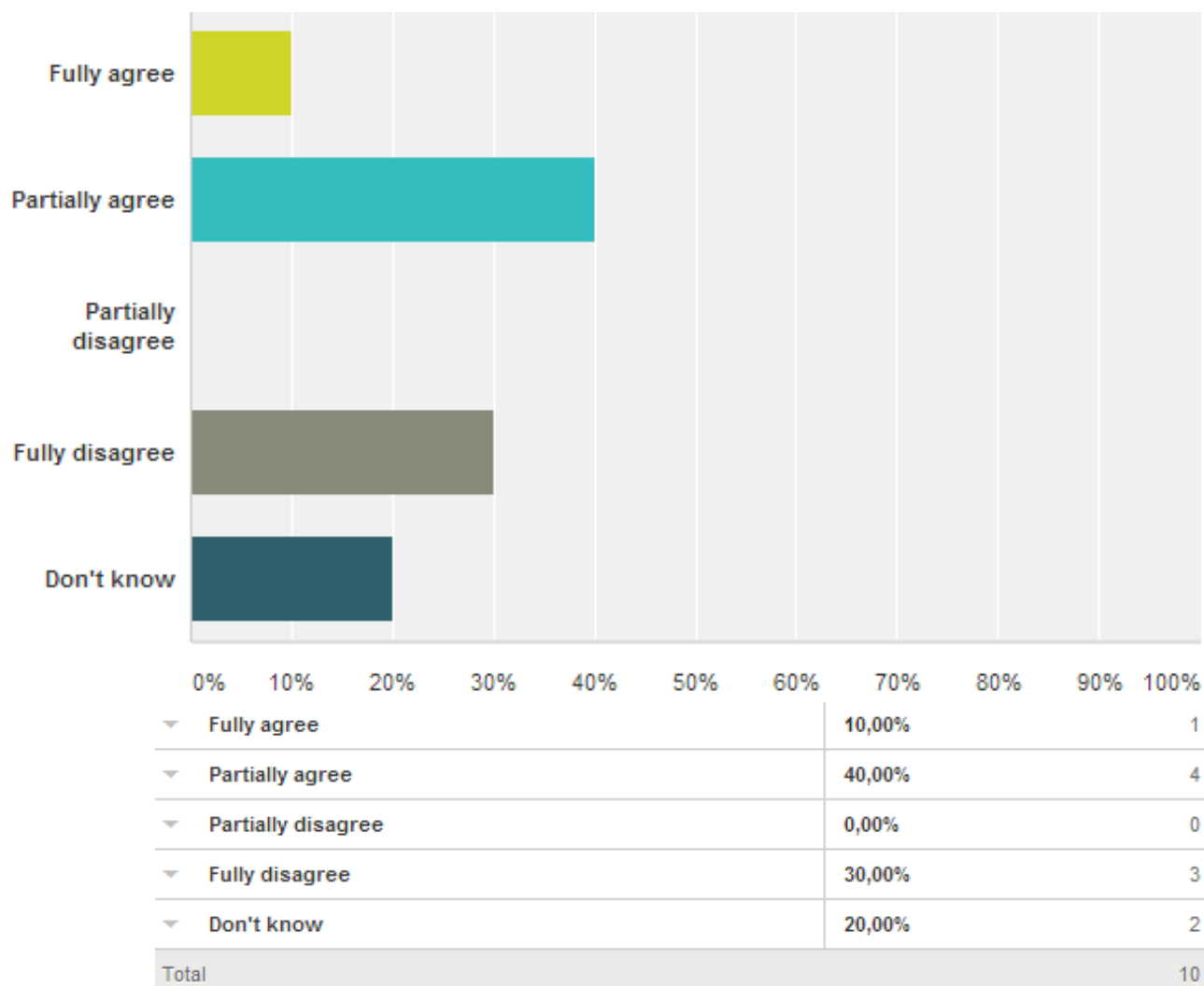
# Our experts

- 49% industry – 51% academia

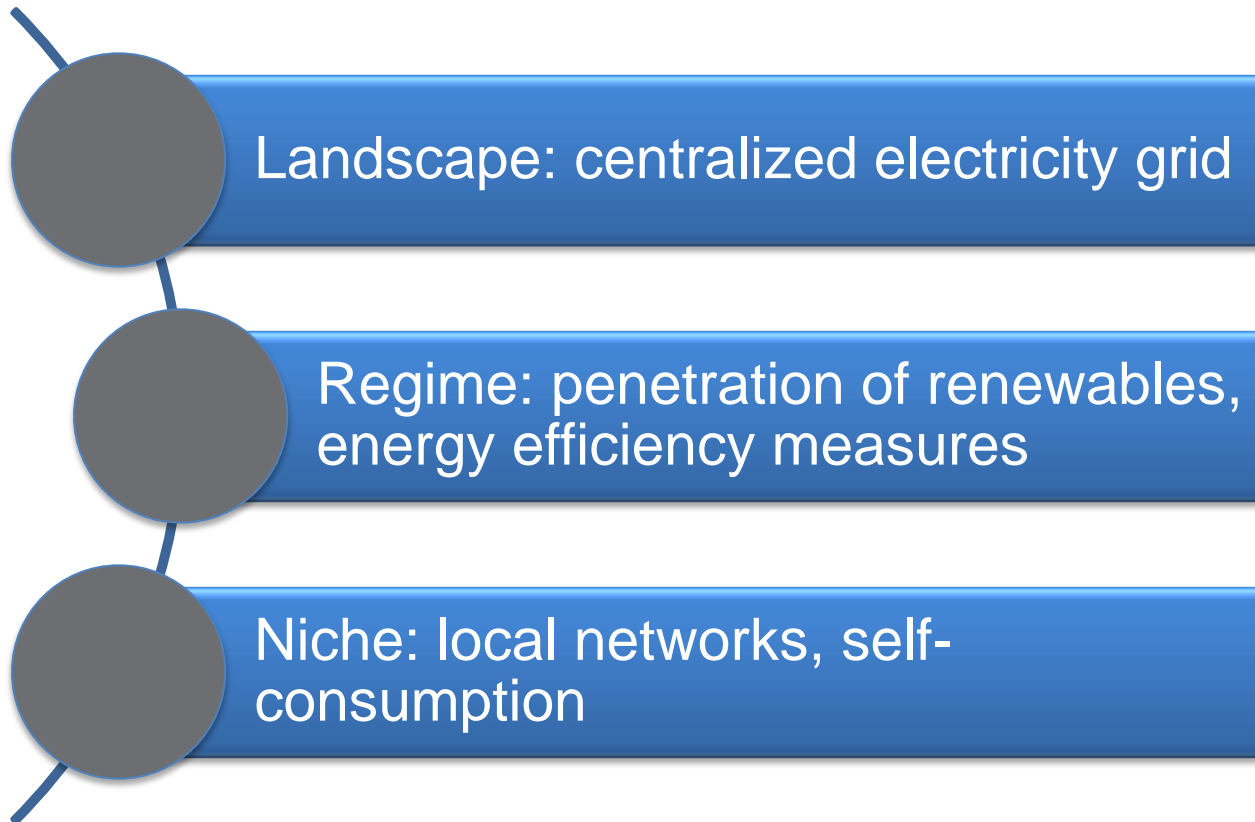
Workshop	Number of experts
Printed Circuit Boards and electronic components	16
Permanent Magnet based applications	17
Advanced accumulators and batteries	9
High-value alloys	16
Photonics – high-end optics	10
<b>TOTAL</b>	<b>68</b>



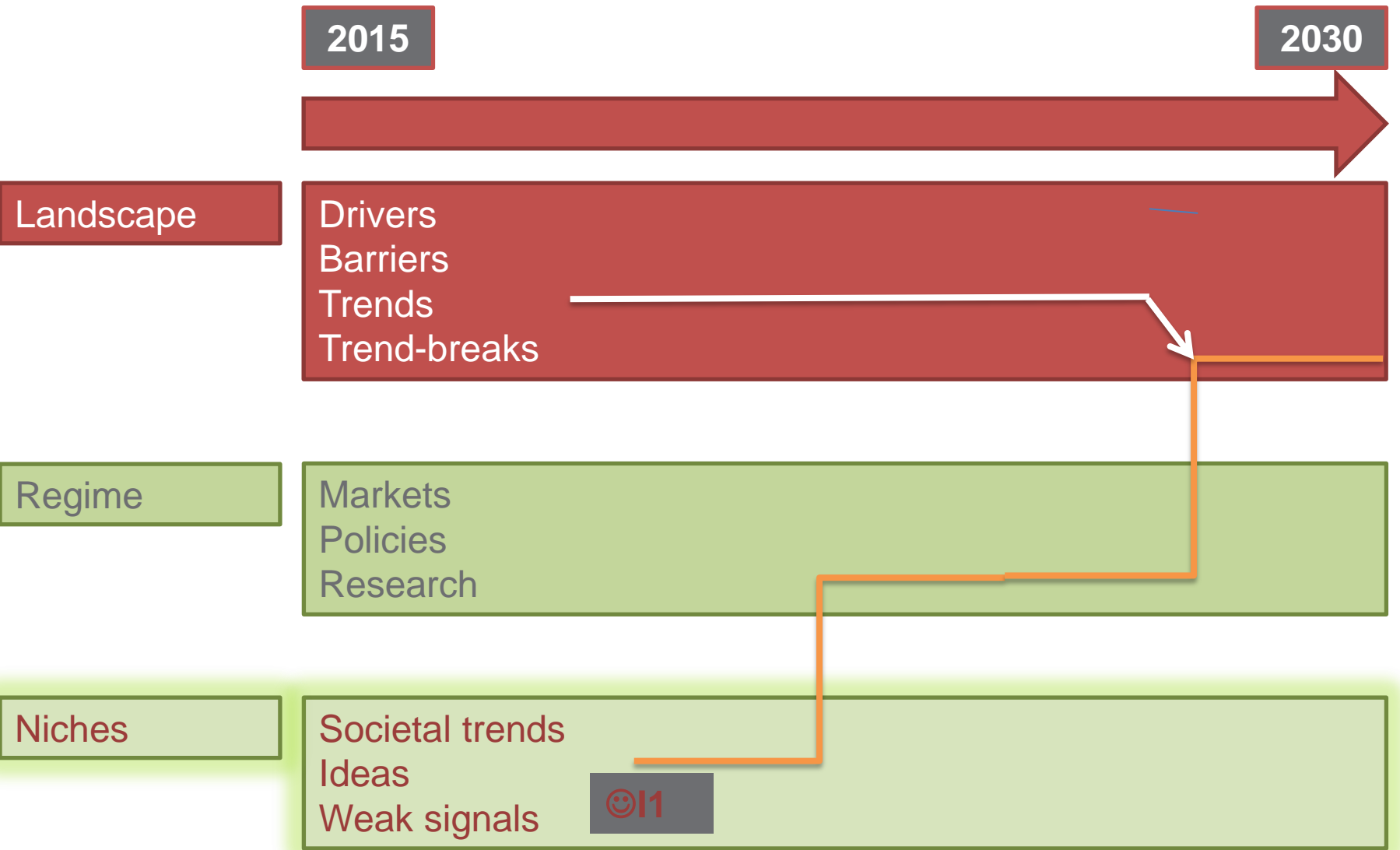
## a. Slowing demand from the aerospace industry until 2030 will ease the pressure on the markets of critical materials



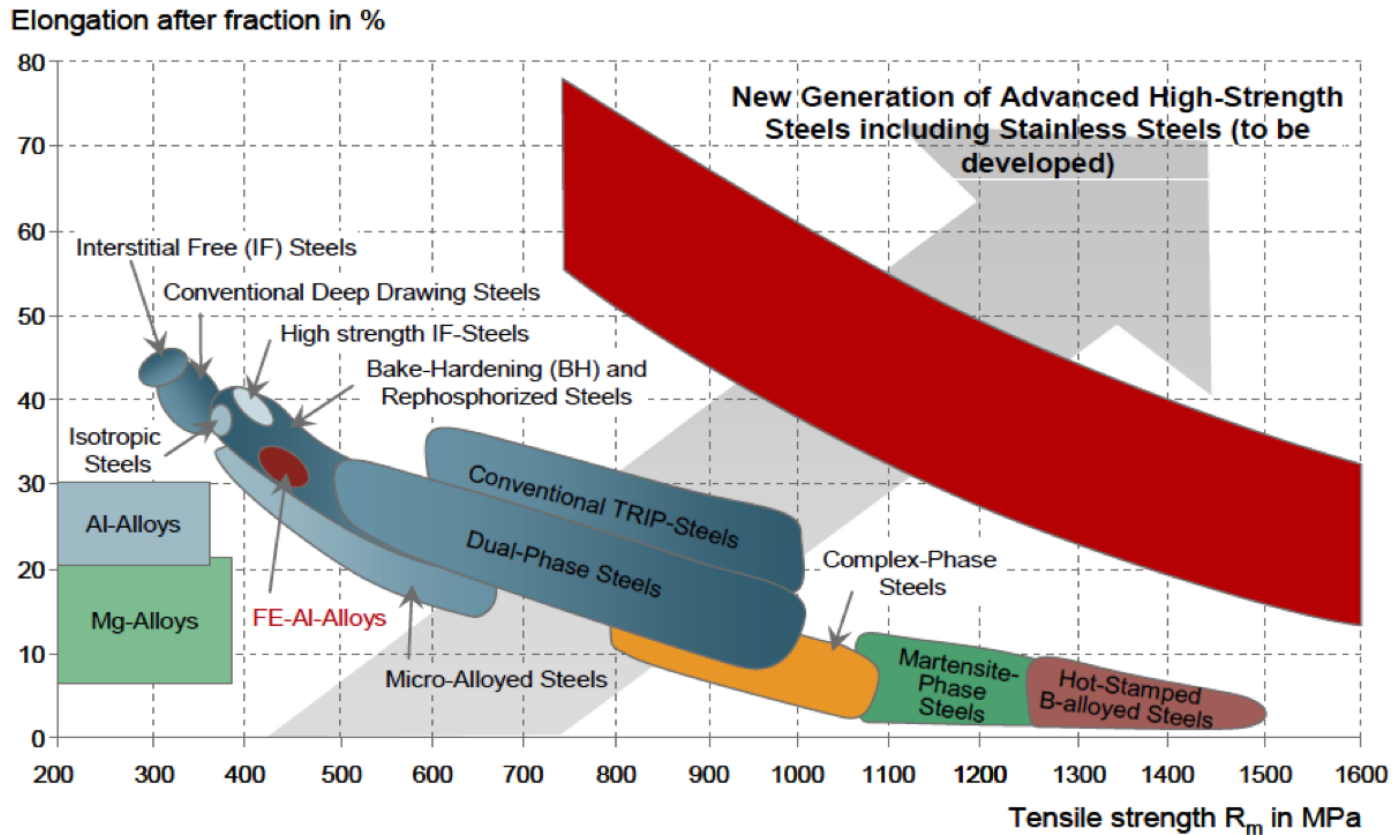
# Roadmapping and transition theory



# CRM InnoNet Roadmaps – the not yet final picture



# CRM InnoNet Vision Workshop - High-value alloys

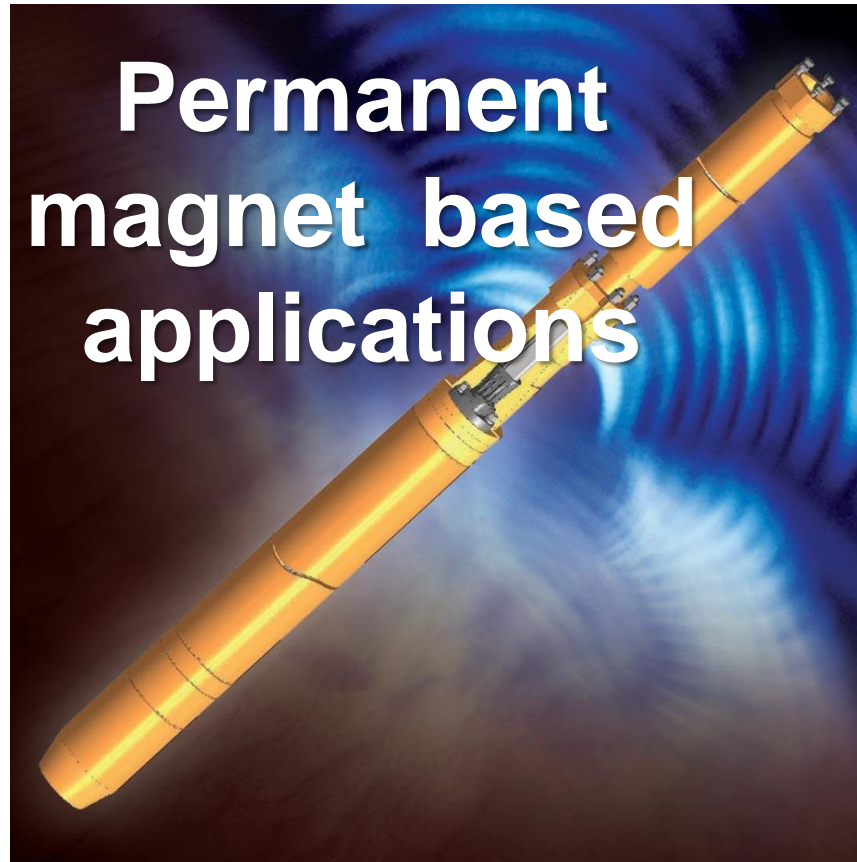


Source: Jean-Pierre Birat, ESTEP

# First conclusions from Vision Workshop

- We have overseen: design for substitution
- Market response is defining what is critical
- Timeline for 2030 is short
- Reindustrialisation: lower costs of wages in Europe
- Impact: Cost-versus performance
- Common European policies, not just national.
- Policy: Environmental standards for imported materials/products needed
- Many examples of substance for substance and process for process research in Europe
- Long term research money
- Need for well educated engineers (process metallurgy, hydrometallurgy, mining)
- EU and national governments should focus on industrial projects in research and education.
- Cooperation between industry to share costs/risk of research to be competitive against China.
- Future alloys: FeAl, intermetallics....
- 3D manufacturing to save material and new applications

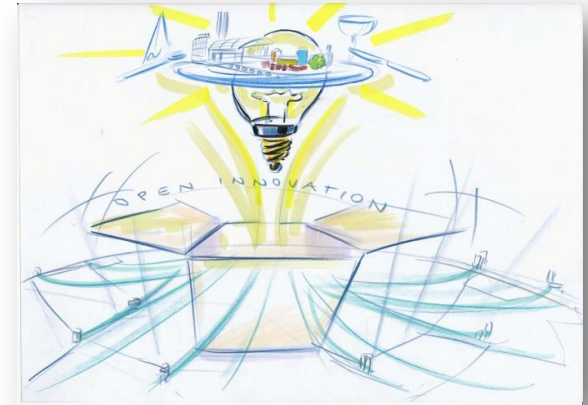
# CRM InnoNet Vision Workshop



# First conclusions from Vision Workshop

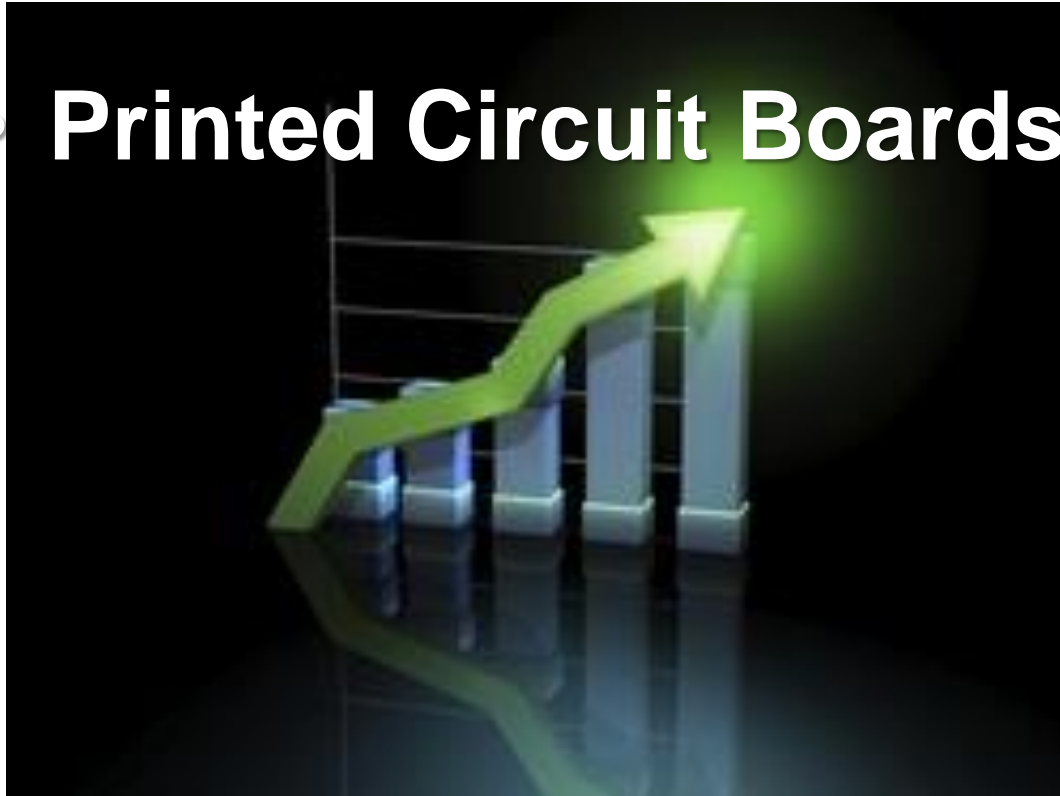
## • Visions for 2030

- More closed loops in material flows (e.g. by recycling or by new business models (leasing instead of selling))
- Better understanding of which materials are used in which products
- New materials for permanent magnets will become commercially available
- Development of mining for REE
- Better design or the suitability of a design for a given application
- Move away from REE
- But CRM will have a place, but in smaller applications (lighter products due to batteries with higher power density)
- Recycling has to become better (permanent magnet based coolings, cars...)
- Permanent magnets will not be replaced!
- People who are “using” materials have to work closer with people who “understand” the materials in order to maximize outcome or to find alternatives for REM



# CRM InnoNet Vision Workshop

## Printed Circuit Boards

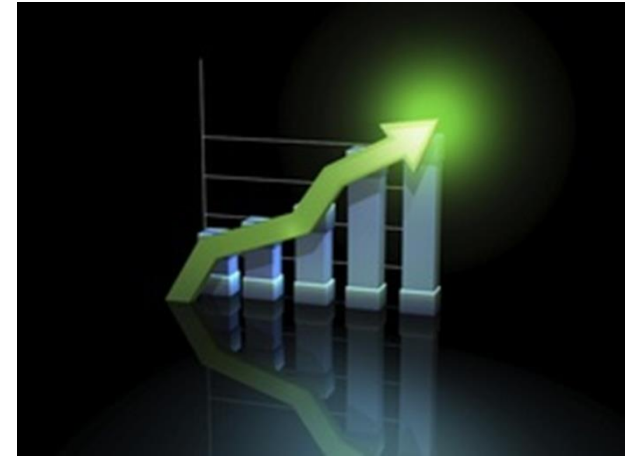


# Printed Circuit Boards

Currently about 90 % of the production in Asia/Pacific

## Market and product expectations:

- Embedded components e.g. in carbon fibre
- Flexible electronics
- In home monitoring
- Safety & Security
- Manufacturing 3.0
- PCB higher temperature resistant
- Privacy related technology



## Key drivers for substitution

- Where recycling & reuse are not the option – e.g., miniaturisation and embedded in different materials
- Performance main driver but varies based on specifics of the application e.g. GaN 'wrong way substitution'
- Availability of CRM

**R&D funding to address gaps – types of ways to fund substitution**

**Collaboration**

# CRM InnoNet Vision Workshop

- Photonics



# First conclusions from Vision Workshop

## Policy

By 2030 CRM's are well understood allowing for informed substitution decision making - government and industry supported.

Recycling / reuse - product and service

European (EU) body on CRMs – substitution focus

Europe is key player on CRMs in the world

## Markets & companies

Production in Europe – across the entire value chain

Venture capital = new ventures

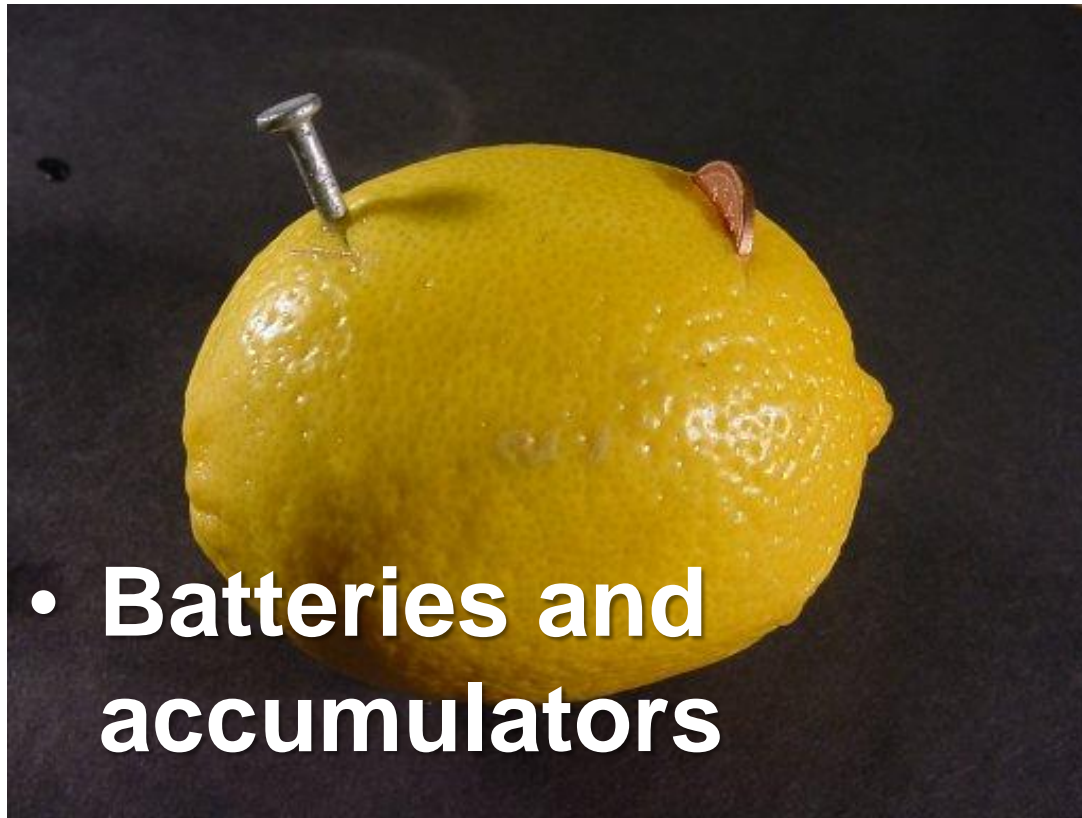
Strong photonics industry voice on CRM

## Research

Aligned with the needs of industry, acting with policy

Disruptive innovation in new materials and processes = substitution

# CRM InnoNet Vision Workshop



- Batteries and accumulators

# First conclusions from Vision Workshop

- Main driving substitution force is maintaining EU security (availability, jobs, costs...) with respect to energy supply and energy technologies.... But restraints are the threats on competitiveness of solutions
- Lots of good will is present, but little actual implementation in policies... although regulatory tools could evolve to be more material focus (e.g. recycling)
- Industry effort is limited by long term horizon and cost issue, but demand (e.g. labelling) could drive the efforts
- Due to numerous energy storage technologies, technology substitution is more likely than material substitution
- Lots of new battery applications (robots, health, sensors...) could drive new needs and development

# Break-out sessions – your input needed!

Landscape

Landscape: Which are the trends influencing the demand for CRMs, which are beyond the control of single actors?

Regime

Regime: what are relevant policy and regulatory initiatives or industrial substitution strategies for these applications?

Niches

Niche: do we perceive ideas, social trends or emerging technologies, which could impact the regime or landscape level in the medium and long term?