

Beyond the Horizon

Foresight in Support of the Preparation of the EU's Future Policy in Research and Innovation (BOHEMIA)

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BOHEMIA – background, purpose and objectives

- A strategic foresight study to contribute to the proposal for FP9
 - Research results of FP have an Impact in society ~5-10 years after its completion
 - Major challenges at the time horizon ~2035 as starting point
 - Taking into account openness and variability of future contexts
- Objectives
 - Draw a picture of possible alternative futures setting the societal, economic and political conditions and boundaries for EU R&I policy
 - Assess possible future evolution of socio-economic as well as of scientific and technological challenges, needs and opportunities
 - Suggest issues which could be addressed by EU R&I policy and funding

The BOHEMIA project

- **Phase 1:** Extensive review of available foresight to produce meta-scenarios relevant for Europe and deeper insights in topical fields (published June 2017)
- **Phase 2:** Delphi survey to gain insights on future technologies, societal issues, and R&I practices (completed in Summer 2017)
- **Phase 3:** Analysis to identify targeted scenarios; policy recommendations (ongoing)



The report describes a range of futures we might be facing in the 2030s, and suggests ways how research might create options for Europe to cope and flourish.

Phase 1 – Meta-Scenarios

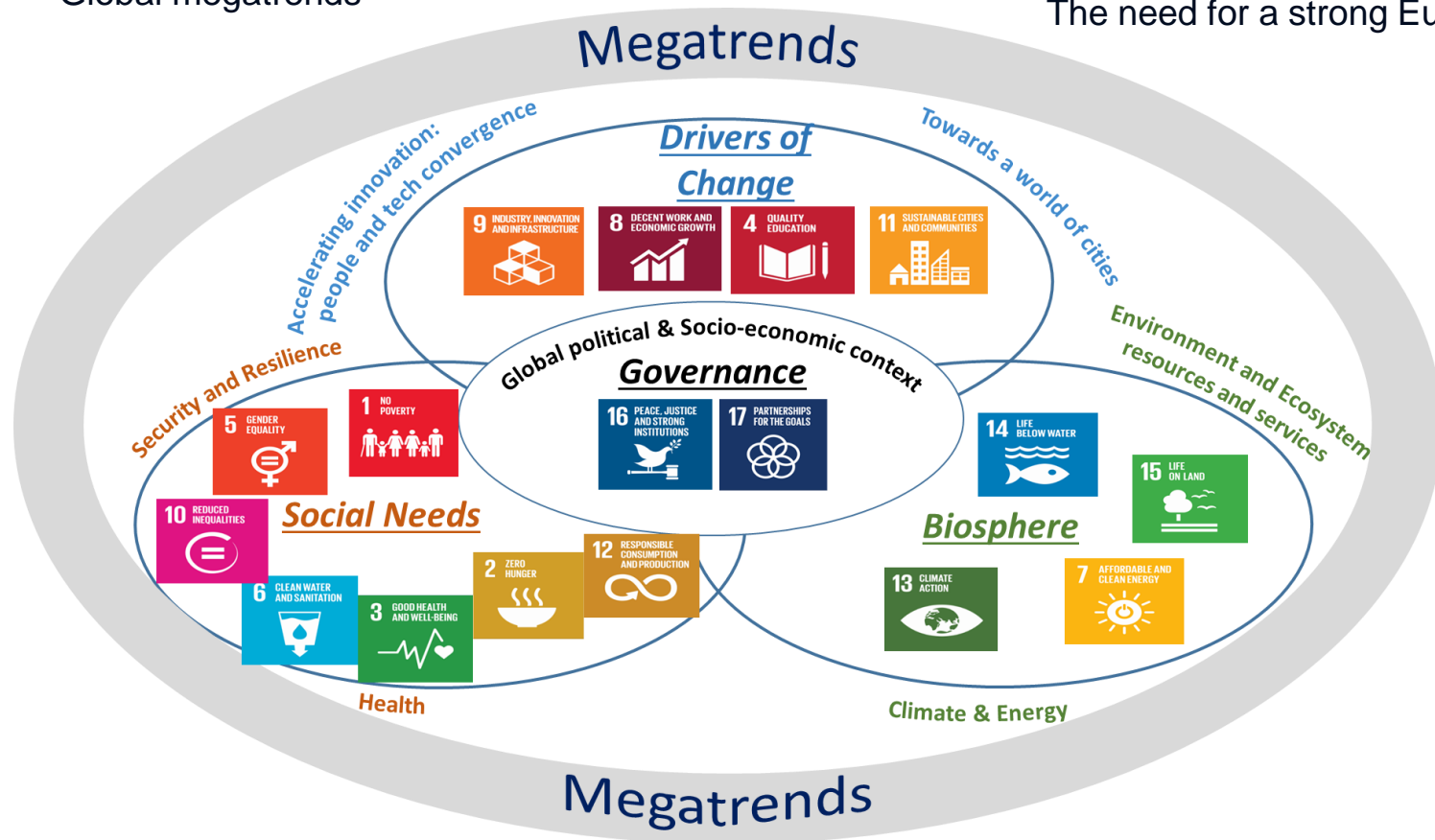
Analytical context

Global megatrends

Normative context

Sustainable Development Goals

The need for a strong Europe



"Europe is at a crossroads: either we keep and strengthen the role as one of the main global actors, or we become an increasingly irrelevant outgrowth on the Asian continent"
 (Gonzales Report "Europe 2030")

Contrasting scenarios of global and European scope

Two types of scenarios to illustrate the possible transitions:

- **‘Perseverance Scenarios’**: Current structures and institutions persevere, leading to a continuation of current cleavages
- **‘Transition scenarios’**: Europe spearheads the structural transition to 'the future we want'

7 Perseverance Scenarios

- Turbulent transitions
- Climate calamity
- The age of over-exploitation
- Health divide
- Security race
- Losing the race against the machine
- Urban jam

7 Transition Scenarios

- Transforming our world for the better
- Low carbon transition
- Towards a new well-being
- Towards health for all
- Building societal security
- The innovation revolution for everyone
- Urban bloom

Example: Environment and ecosystems resources and services

The age of over-exploitation

- Challenge of supplying a growing world population
- Growing demand for resources not counter-acted by systemic strategies, ...
 - Rising consumption of raw materials, energy and other resources
 - Competition between different types of resource use
 - Uncertainty about commodity price development
- ... leading to environmental degradation...
 - Ocean ecosystems & freshwater over-exploited
 - Soil degradation and habitat conversion
 - Loss of biodiversity and increased pollution
- ... and erosion of economic base in affected areas
 - Coastal zones, desertifying regions, and agricultural areas particularly affected
- What if?
 - Social and technological change alleviate, but do not resolve these challenges

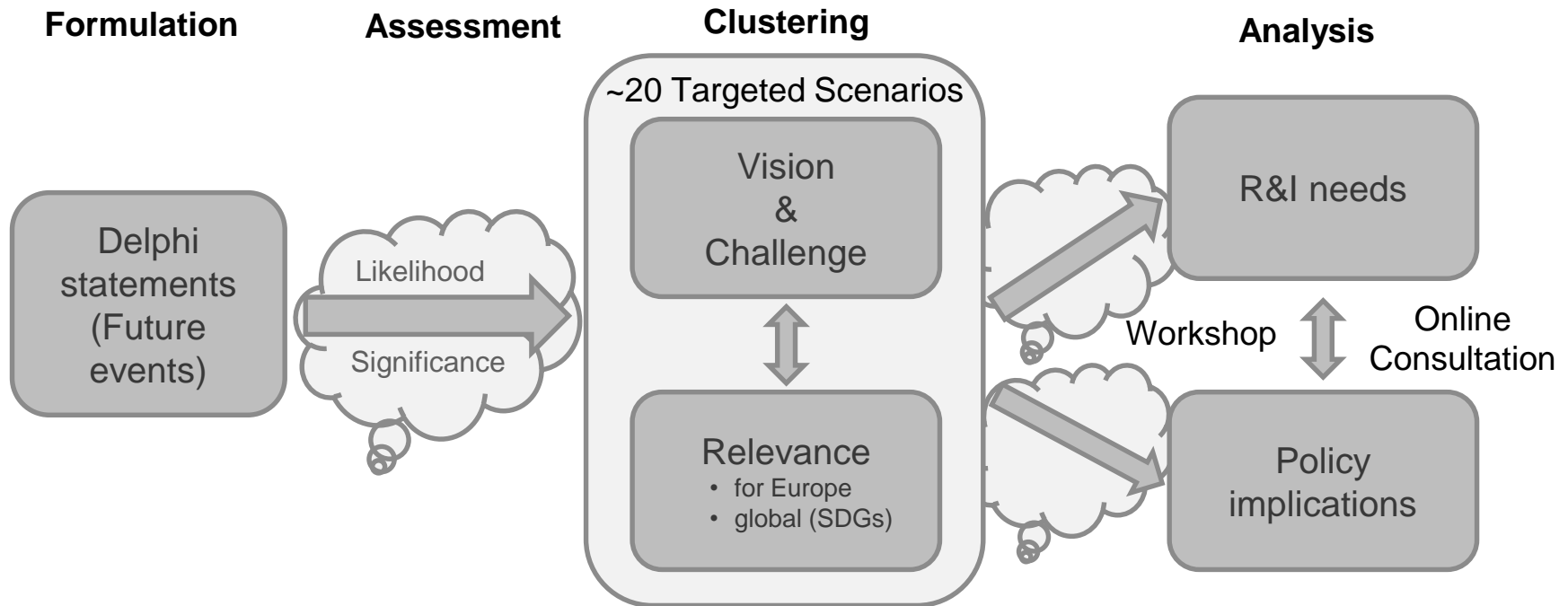
Towards a new well-being

- Respect for planetary health
 - Maintaining high levels of biodiversity
 - Sustainable exploitation of the natural resource base
- Transition to a circular economy limits resource demand
 - Major improvements in resource-efficiency
 - Significant positive externalities
 - Decoupling economic growth from material consumption
- Major environmental benefits from new technology ...
 - Zero marginal cost services enabled by networks & ICT
 - Nano-, bio-, materials & IC tech for „green“ purposes
- ... and new production-consumption models
 - New jobs in distribution & maintenance of long-life products
 - From ownership to sharing
 - Full control of local rather than global supply chains
- What if?
 - The promise of the oceans: Sustainable use as food and energy resource

Phase 2: Questions & Assessments in the Delphi survey

- **Assessment of statements about future S&T developments as well as societal developments and changing R&I practices**
- **Time of Realization in 5 year steps**
 - What is the time of realization? (until 2020, 2021-2025, 2026-2030, 2031-2035, 2036-2040, 2041 and later, never)
 - Ranked arguments for the Time of Realization
- **Significance** ★★★★★
 - **A) Significance of R&I:** Is R&I significant for the topic? Very significant to not significant
 - **B) or: Significance for EU R&I policy:** Is the topic significant for EU R&I policy? Very significant to not significant
 - Ranked arguments on significance
- **Focus: qualitative discussion of significant developments**
 - „Likely“: Significant and likely realisation by 2035/2040
 - „Uncertain“: Significant, but uncertain time frame of realisation
 - „Wildcards“: Unlikely realisation, but high significance if realised

Phase 3: Exploiting the Delphi results



Targeted scenarios outline:

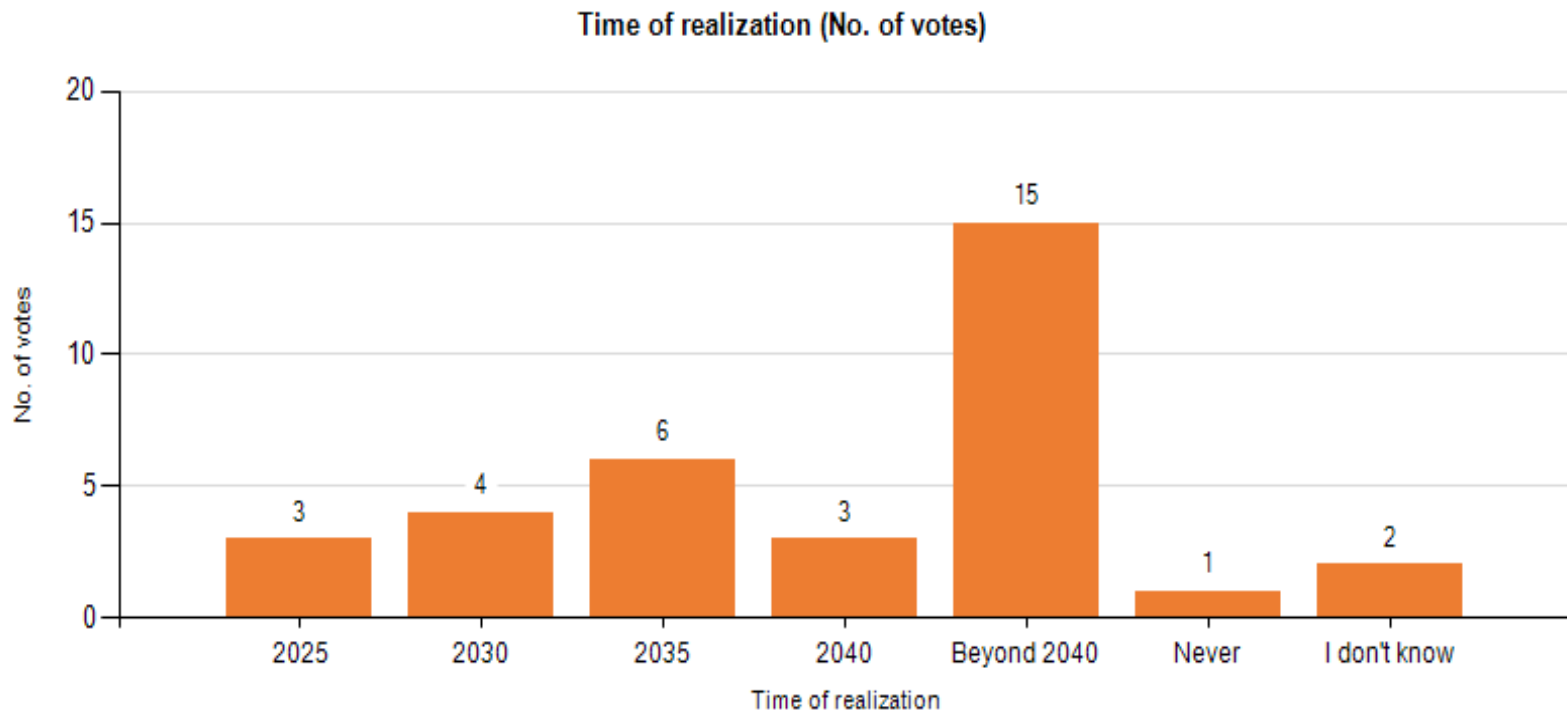
- Vision at 2040
- Relevance for Europe and globally (SDGs)
- Implications for EU policy
- Items for an R&I agenda

Example: Circular economy and rare resources

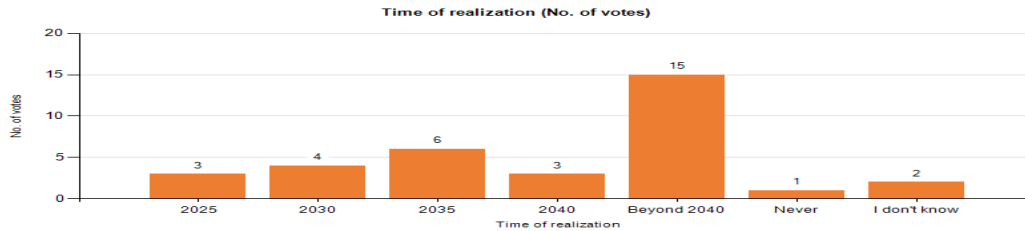
Vision and relevance

- The expected shortage of a range of rare resources, in particular metals, will be counter-acted by a range of technological and systemic responses by 2040
- Ambitious targets yet to be fully achieved
- Europe uses its strong role in R&I in this area to foster its economic position and reduce environmental impact.
- Towards SDG 12 Responsible Consumption and Production

30% and more of the resources needed for electronic devices come from deep sea mining



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Arguments regarding the time of realization	No. of votes
Deep sea mining is a promising future option for primary supply of raw materials. However, the legal framework for exploitation is still being developed and there are only permits for exploration	19
Deep sea mining is a challenge for the environment, and needs a lot of energy. Therefore, it will take a long time before it becomes a reality. "Conventional" mining can also develop a lot, and prevails.	17
Polymetallic nodules can be mined from the deep sea – small lumps of rock that contain up to 28% metal – ranging in size from a golf ball to a potato, which contain, e.g. 26% Manganese, 6% Iron, 5% Silicon, 3% Aluminum, 1.4% Nickel, 1.3% Copper etc.	10
Continuing improvements in recycling and reuse and improvements in recovery from existing mines is likely to reduce the attractiveness of deep ocean mining.	9
Deep sea mining is environmentally critical and should be avoided.	4
Asteroid mining potentially can yield a greater variety of materials than deep sea mining. Psyche is a metallic asteroid that could potentially supply such needs.	3

Average relevance = 3,61/5 with high dispersion

Circular economy and rare resources: Policy implications

- Agriculture
 - Extent of exploitation of renewable resources vs. food production
- Environment
 - Regulatory requirements for extraction, processing & usage of materials/resources
- Trade
 - Ease of global access to resources
- Industry
 - Working conditions in industry and mining
 - Business models and design for long-life products
- Research and Innovation
 - Substitution of materials
 - Extraction and processing methods
 - Recycling and re-use
- External policies
 - Global political stability
 - Cooperation with other countries and world regions

Circular economy and rare resources: Items for an R&I policy agenda

- Understanding oriented research
 - Geology, impact of extraction impacts of waste management practices
 - Fundamental properties of materials
- Regulatory science and science for policy
 - Toxicity
 - Environmental impact assessment
- Solutions oriented research and innovation
 - Materials technology and substitution
 - Depolymerisation and materials separation
- Scaling up experiments, demonstrations and social innovation
 - Circular industrial systems
 - Refitting
 - Demonstration of waste management techniques
 - Scale up in nanotechnology

Phase 3 – Targeted scenarios at draft stage

(currently seeking a tradeoff between *coverage* and *overlaps*)

Drivers of change

- Future of Knowledge Production
- Nano-to-Macro Integral Manufacturing
- The electro-sphere of sensors
- Ambient Emotional intelligence
- Continuous Cyberwar
- Advanced ICT-based security

Biosphere

- Low-Carbon economy
- Next-generation bio-economy
- Cheap Renewable Energy Sources
- A self-reliant circular economy
- Making an economic case for nature

Social needs

- Re-construction of the Meaning of Work
- Towards diversified Food Supply: Natural and Novel Food
- Assisted living / Autonomous living
- Human organ replacement
- Precision medicine
- Defeating communicable diseases
- Mobility as a Smart, Sustainable and Intermodal Service

Governance

- Decision-making supported by open expert systems

Conclusions: Policy alignment

- Targeted scenarios provide narratives of change
 - Embedded in shared ambitions reflected in the seven transition meta-scenarios
 - Firmly rooted in Delphi results, but sensitive to future uncertainty
 - Derive items for future R&I agendas, as well as ...
 - ... future issues and opportunities in other than R&I policy areas
- Targeted scenarios point to need for policy alignment in terms of
 - Joining forces in R&I between several, but not necessarily all European countries
 - Improving coherence between R&I policy and sectoral policies early on
 - Strengthening integration and mobilisation of stakeholders and citizens in programme design and implementation
- Targeted Scenarios as an instrument for strategic dialogue across policy areas to address future change from different policy angles

Next steps

- On-line consultation to validate the targeted scenarios and their policy implications – November
- Final report with recommendations – End of the year

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Download scenarios report

<https://publications.europa.eu/en/publication-detail/-/publication/b2d78a84-3aae-11e7-a08e-01aa75ed71a1/language-en>