
# The *ExtremeEarth* project concept (and how to move forward)

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# European Commission Flagships

In 2016, the European Commission (EC) issued a call for ideas for future Flagships, to be funded by the Future and Emerging Technology (FET) programme.

FET Flagships are:
*"… science- and technology-driven, large-scale, multidisciplinary research initiatives built around a visionary unifying goal ... tackle grand science and technology challenges … strong and broad basis for future innovation and economic exploitation … novel benefits for society of a potential high impact … long-term and sustained effort."*

FETFLAG-01-2018: 'Energy, Environment and Climate change':
*"Earth, Climate Change and Natural Resources: New technologies and ambitious approaches for high-precision modelling and simulation, including the necessary data integration, that enable an in-depth understanding of the earth and climate change, helping in the long run to manage natural resources in a sustainable way, ensure food security and sustainable farming, and protect natural ecosystems"*

**Co-funding: 1 billion € for 10 years**

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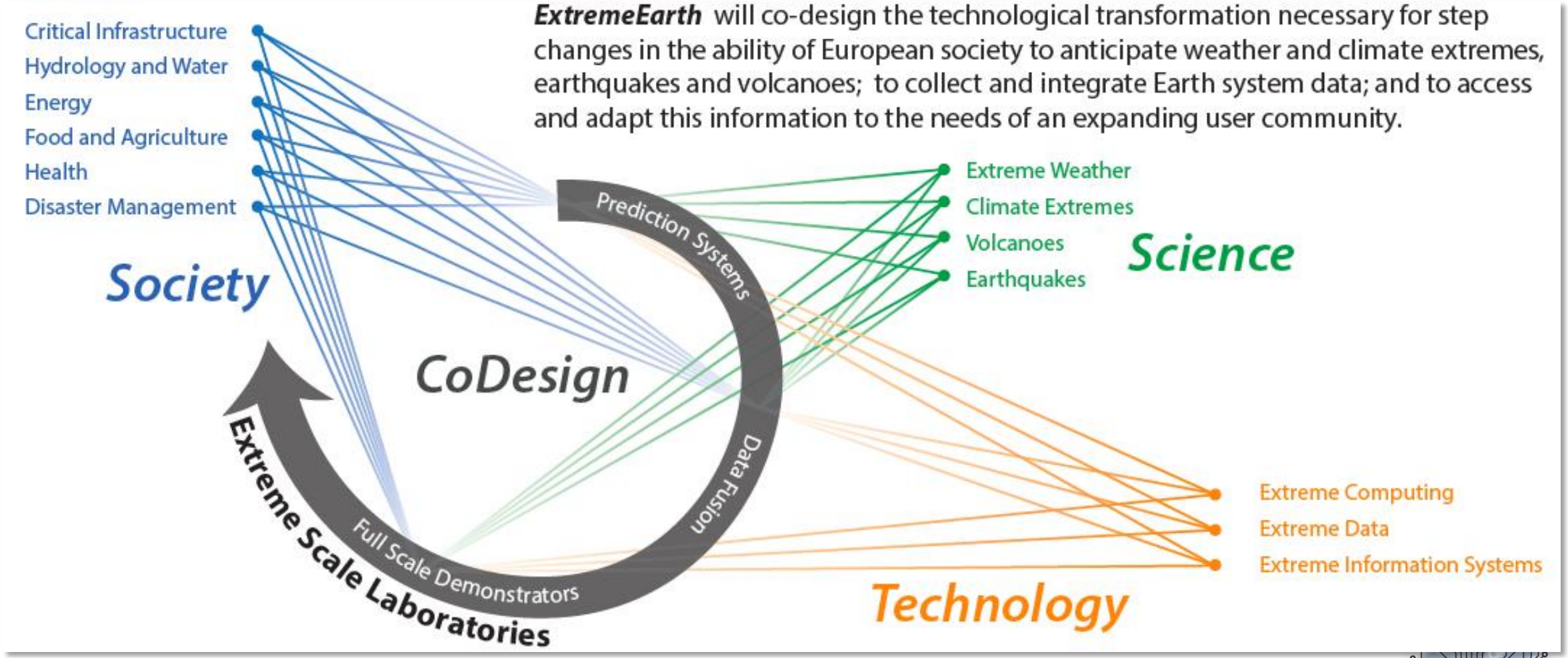
# *ExtremeEarth*: New Science enabled by New Technology

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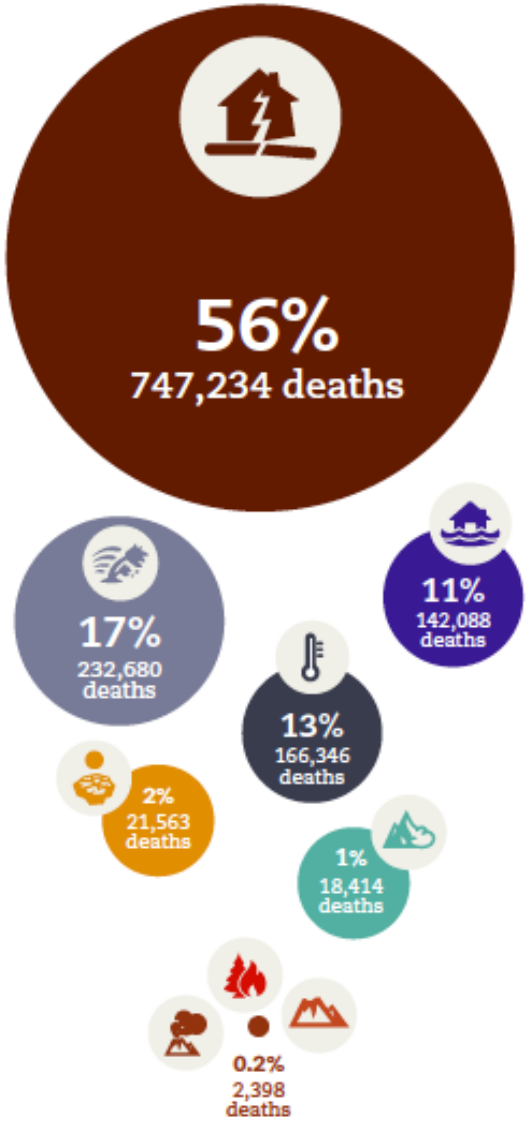
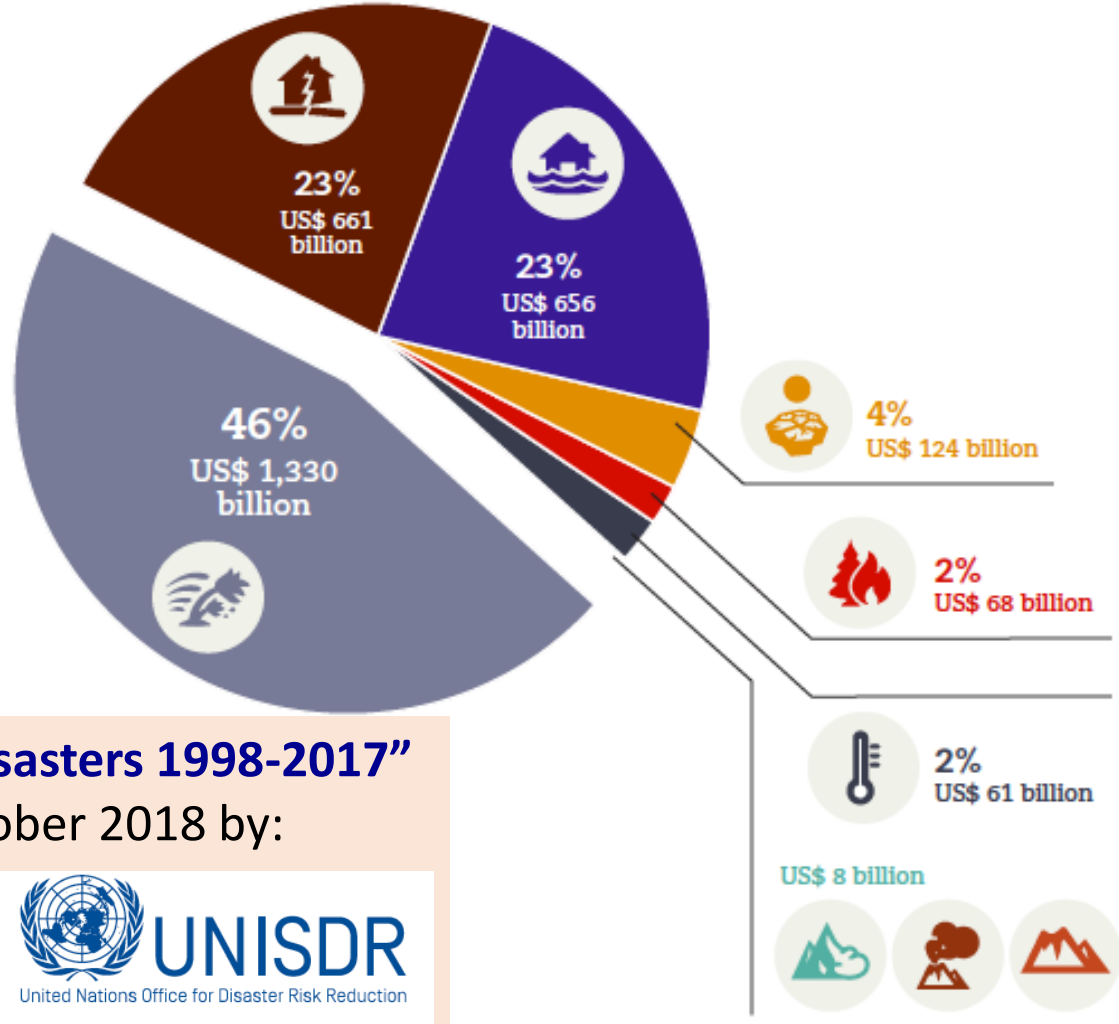
# *ExtremeEarth* is about Extremes Prediction

Number of deaths
per disaster type 1998-2017




- Earthquake
- Storm
- Extreme temperature
- Flood
- Drought
- Landslide
- Wildfire, Volcanic activity, Mass movement (dry)

Breakdown of recorded economic losses (US$)
per disaster type 1998-2017



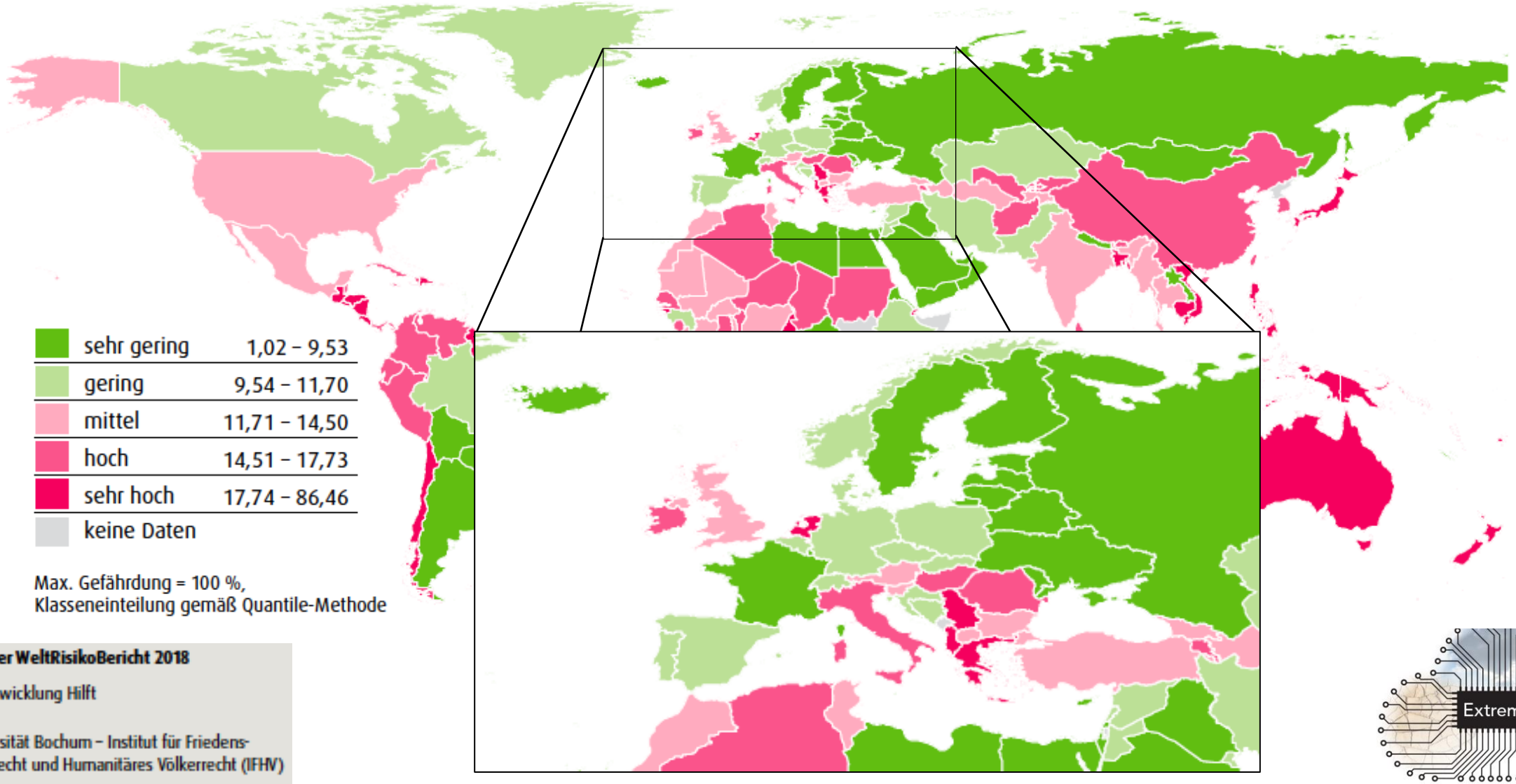

**"Economic losses, poverty and disasters 1998-2017"**

Report published on 10 October 2018 by:

**Centre for Research on the Epidemiology of Disasters CRED**

UNISDR
United Nations Office for Disaster Risk Reduction

# *ExtremeEarth* is about Extremes Prediction

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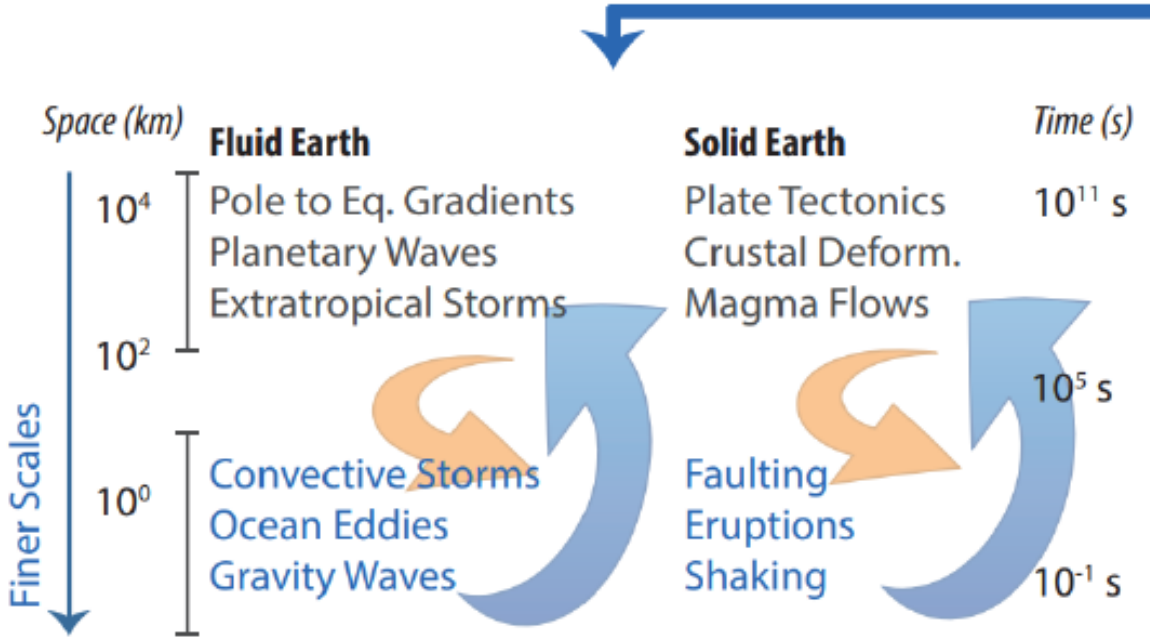
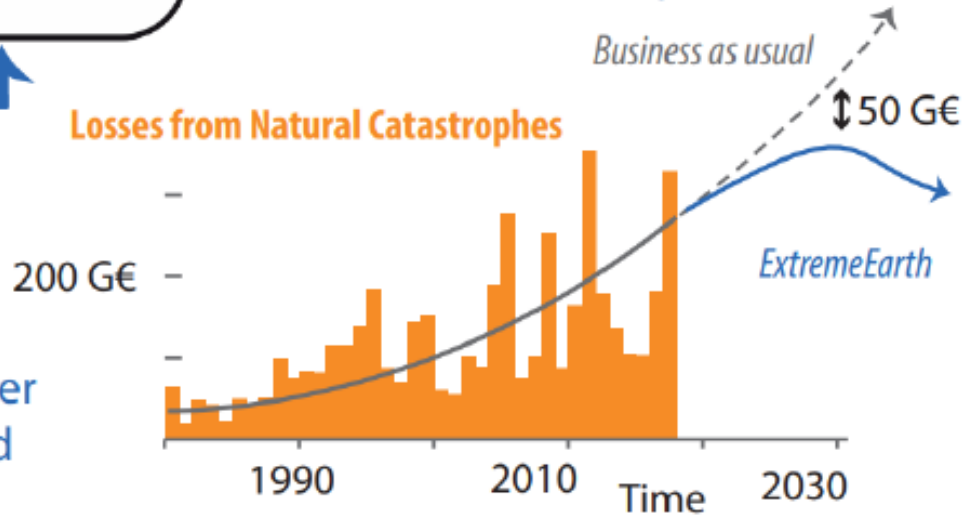
# *ExtremeEarth* makes a qualitative difference




**ExtremeEarth ScienceCloud, EEsC (pronounced "Easy")**

**EEsC** will create collaborative spaces linking predictions, data, and impacts to turn the tide on the growing costs of natural catastrophes




**ExtremeEarth** will develop the technology to enable a new class of models. Models that globally couple the physics and impacts at fine-scales and better assimilate Earth observations, to produce reliable predictions of climate and weather. extremes, earthquakes and volcanoes.

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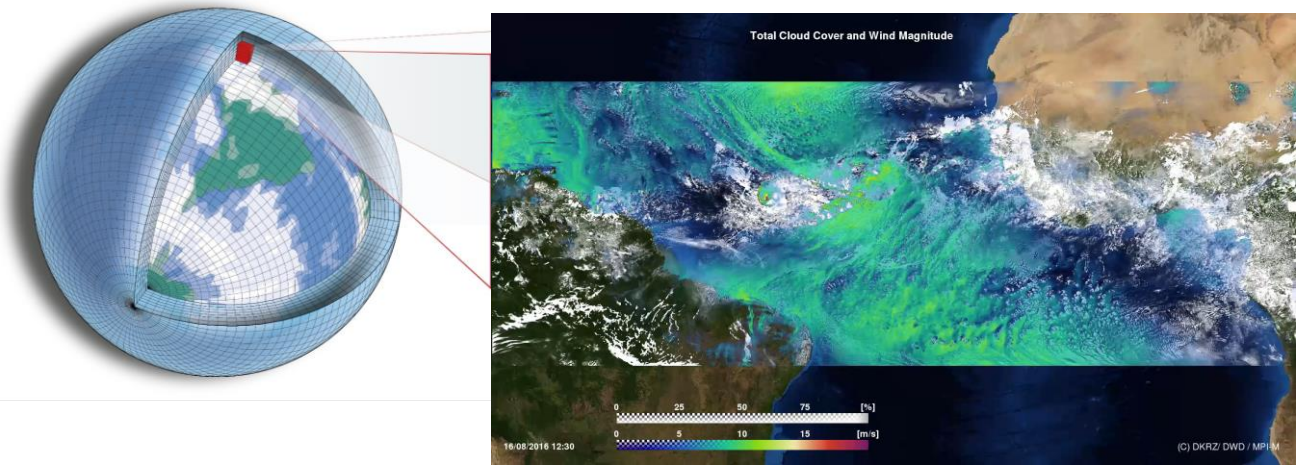
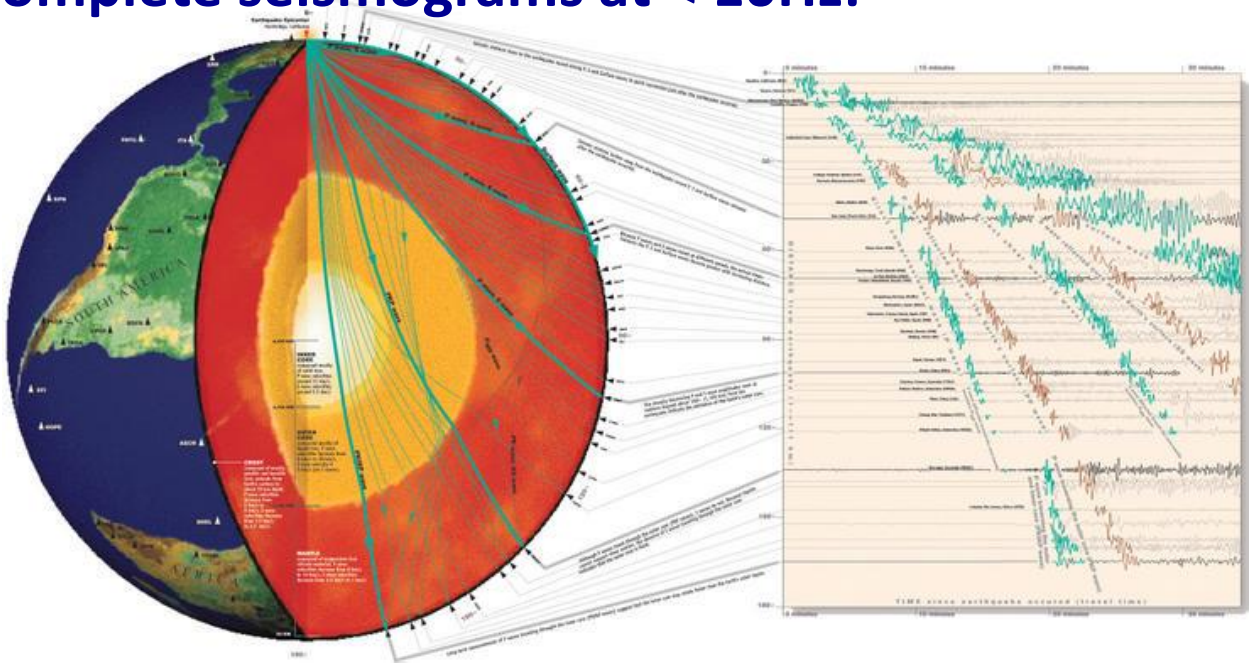
# *ExtremeEarth* is about Extreme Computing

## Global Earth-system simulations at < 1km:




## Complete seismograms at < 10Hz:



**= x1000 bigger computing and simulation data handling problem than feasible in 2020!**

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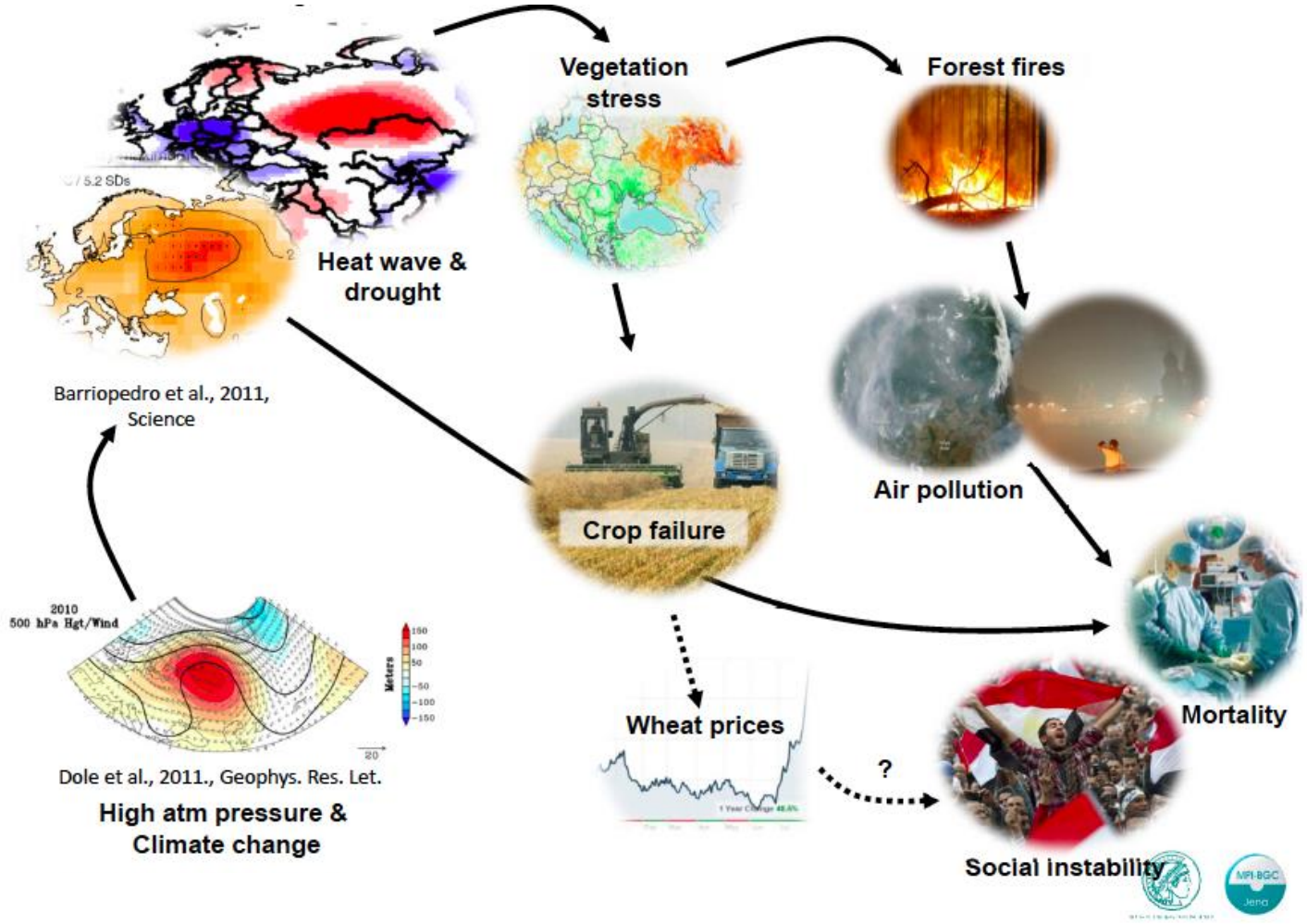
# *ExtremeEarth* is about Impacts of Extremes Prediction

## Impact prediction becomes integral part of Earth-system prediction:

**Example Russian heat wave 2010**




= x1000 bigger data handling and workflow problem than feasible in 2020!

[Courtesy M. Reichstein]

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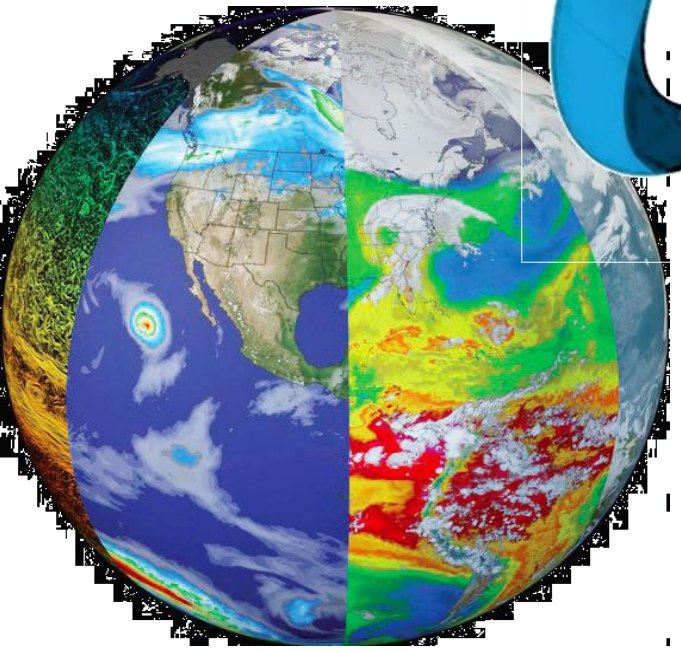
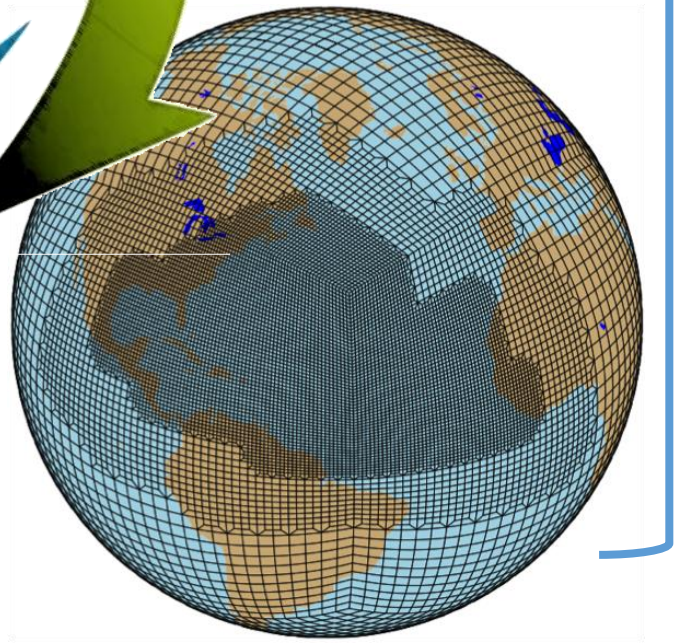
# *ExtremeEarth* is about Extreme Data Handling

## Models that simulate the Earth system indistinguishable from observations:







= x1000 bigger computing and observational data handling problem than feasible in 2020!

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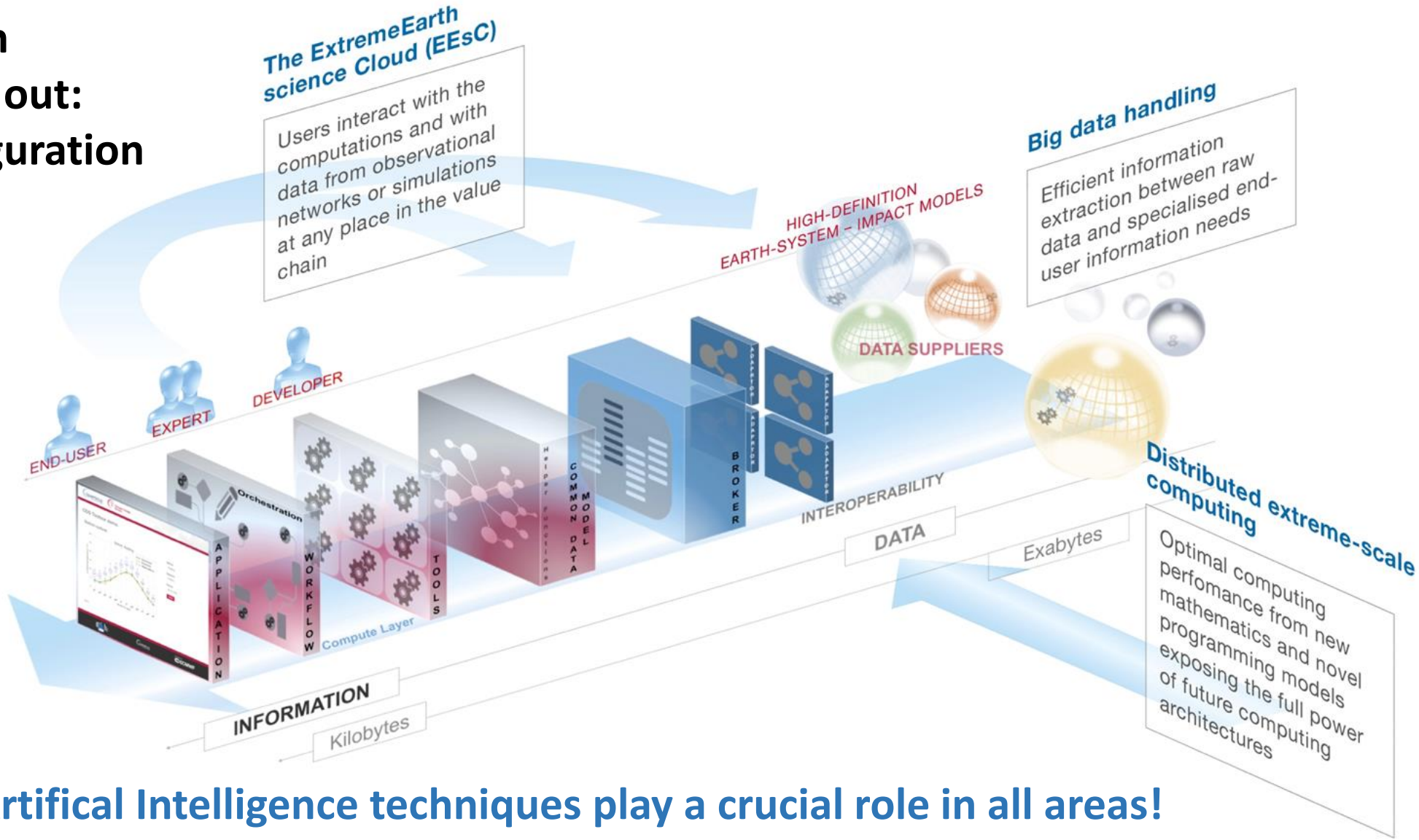
# 3 Key Technologies of *ExtremeEarth*

**The EEsC will turn workflows inside out: users drive configuration of models and observations**

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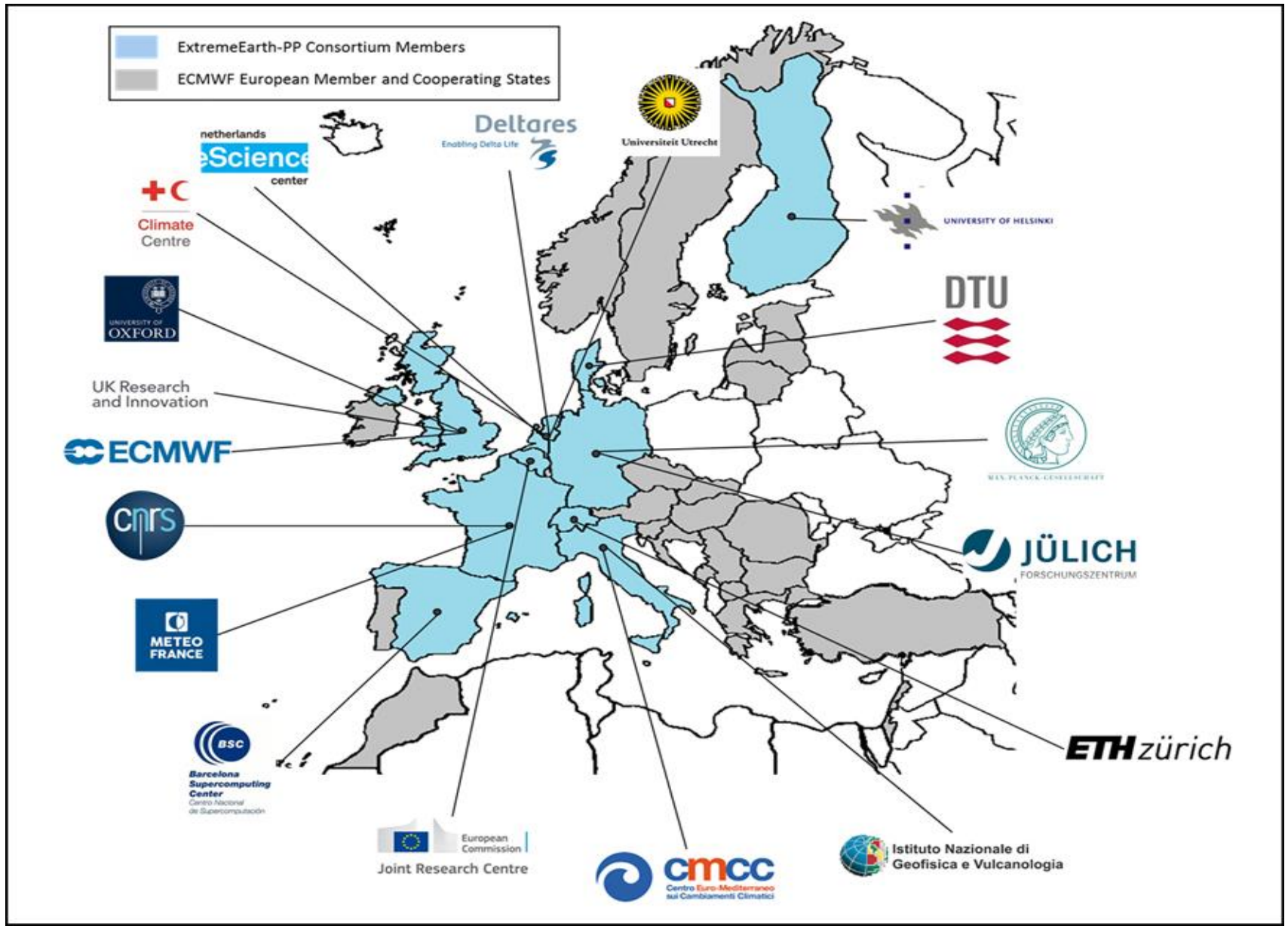
**Artifical Intelligence techniques play a crucial role in all areas!**

# The *ExtremeEarth-PP* Partnership




- ECMWF: international organisation supported by 34 Member and Cooperating States; host of 2 Copernicus services
- 17 partners from academia, industry, service centres, national research and technology organisations, computing centres
  = portals to a much wider community!

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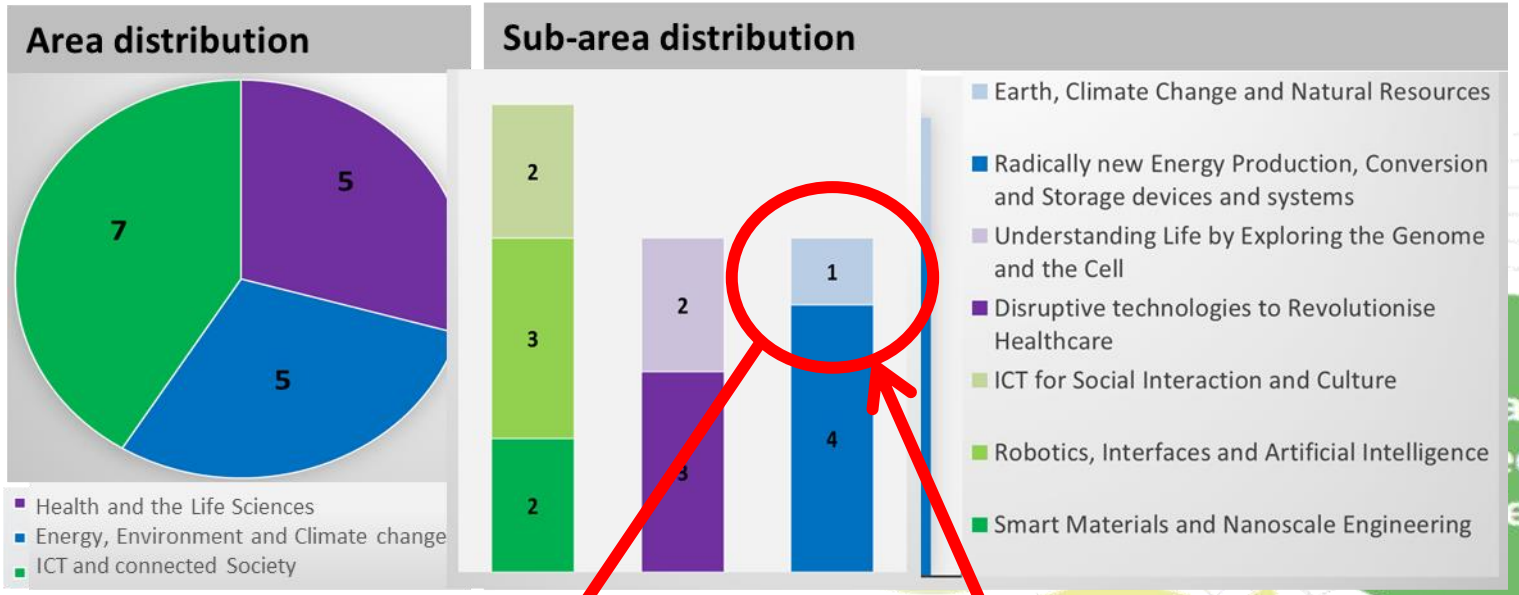
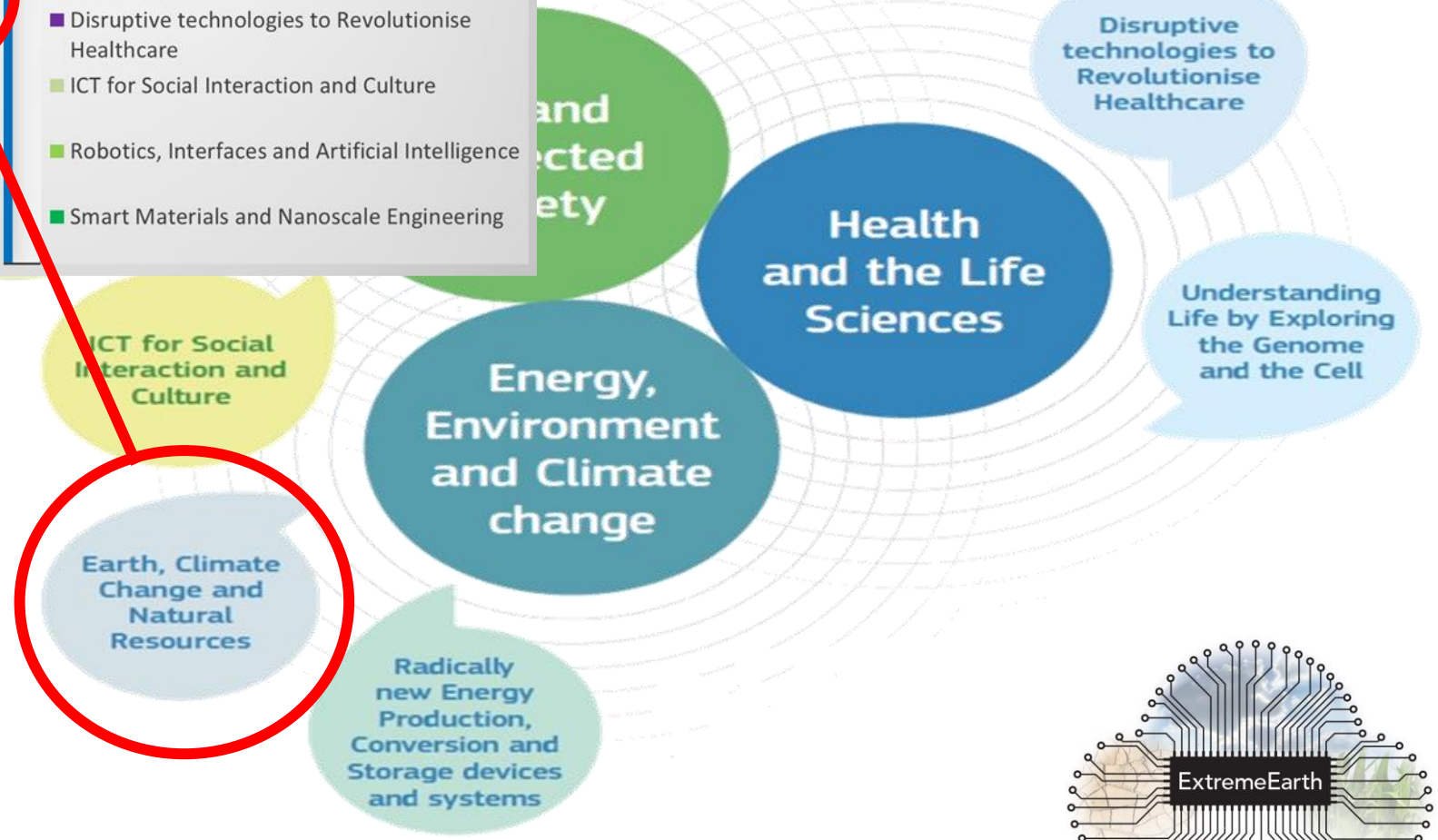
# FETFLAG-01-2018 Stage-1 Evaluation Results




**9.5/10 *ExtremeEarth-PP***

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# FETFLAG-01-2018 Stage-1 Evaluation Results

| ICT and Connected society | | |
|---|---|---|
| TIME MACHINE | 9 | TIME MACHINE : BIG DATA OF THE PAST FOR THE FUTURE OF EUROPE |
| HLP Prep | 9 | Human Language Project Preparation |
| Robotics Flagship | 8.5 | Preparatory Action for a FET Flagship on Robotics |
| TERAFLAG | 8.5 | Terahertz Flagship |
| NanoEngineering | 8 | NanoEngineering: Omni-Connectivity by Nano-engineered Interfaces |
| Humane AI | 8 | Toward AI Systems That Augment and Empower Humans by Understanding Us, our Society and the World Around Us |
| ALOHA | 8 | An Accelerator Platform to Enhance the Longevity, Health and Well-being of our Ageing Communities in Europe. Incubator for European Industry to Lead Future Global Cluster in Ageing |

10/10 Battery 2030+
10/10 LifeTime
**9.5/10 ExtremeEarth-PP**
…

Battery 2030+ has been taken out and gets a separate deal!

| Health and the life sciences | | |
|---|---|---|
| LifeTime | 10 | Revolutionizing Healthcare by Tracking and Understanding Human Cells during Disease |
| DigiTwins | 9 | Digital Twins for Better Health – Better Diagnosis, Better Care, Better Life |
| SynCell | 8.5 | Synthetic Cells: a Paradigm Shift for the Life Sciences |
| RESTORE | 8 | Linking of technology and biology for the development pipeline of Advanced Therapies (Advanced Therapy Medicinal Products and Biologized Medical Devices) aiming to restore challenged tissue homeostasi |
| Health EU | 8 | Health EU – Human avatars to prevent and cure diseases |

| Energy, Environment and Climate change | | |
|---|---|---|
| BATTERY 2030 | 10 | BATTERY 2030+ At the heart of a connected green society |
| ExtremeEarth-PP | 9.5 | ExtremeEarth Preparatory Project |
| CLEAN ENERGY | 9 | Fundamental advancements in materials design, processing and integration for CLEAN ENERGY systems and devices–CSA |
| SUNRISE | 8 | Solar Energy for a Circular Economy |
| Energy-X | 8 | Energy-X: Transformative chemistry for a sustainable energy future |

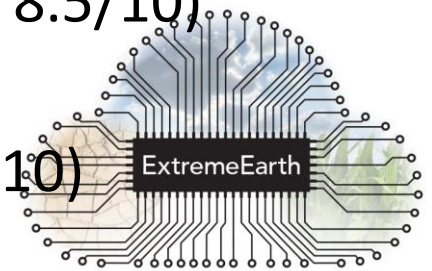
# FETFLAG-01-2018 Stage-2 Evaluation Results

**Preparatory projects:**

- *Time Machine*: Big data of the past for the future of Europe (1st evaluation: 9/10)
- *Humane AI*: Toward AI systems that augment and empower humans by understanding us, our society and the world around us (**1st evaluation: 8/10**)
- *Energy-X*: Transformative chemistry for a sustainable energy future (**1st evaluation: 8/10**)
- *LifeTime*: Revolutionizing healthcare by tracking and understanding human cells during disease (1st evaluation: 10/10)
- *Sunrise*: Solar energy for a circular economy (**1st evaluation: 8/10**)
- *Restore*: Health by advanced therapies (advanced therapy medicinal products and biologized medical devices) (**1st evaluation: 8/10**)

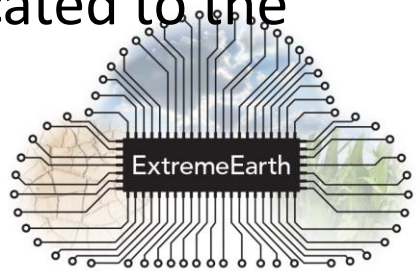
**Reserve list:**

- *Robotics*: Preparatory action for a FET Flagship on robotics (1st evaluation: 8.5/10)
- *ExtremeEarth-PP* (12.5/15; **1st evaluation: 9.5/10**)
- *Health EU*: Human avatars to prevent and cure diseases (1st evaluation: 8/10)

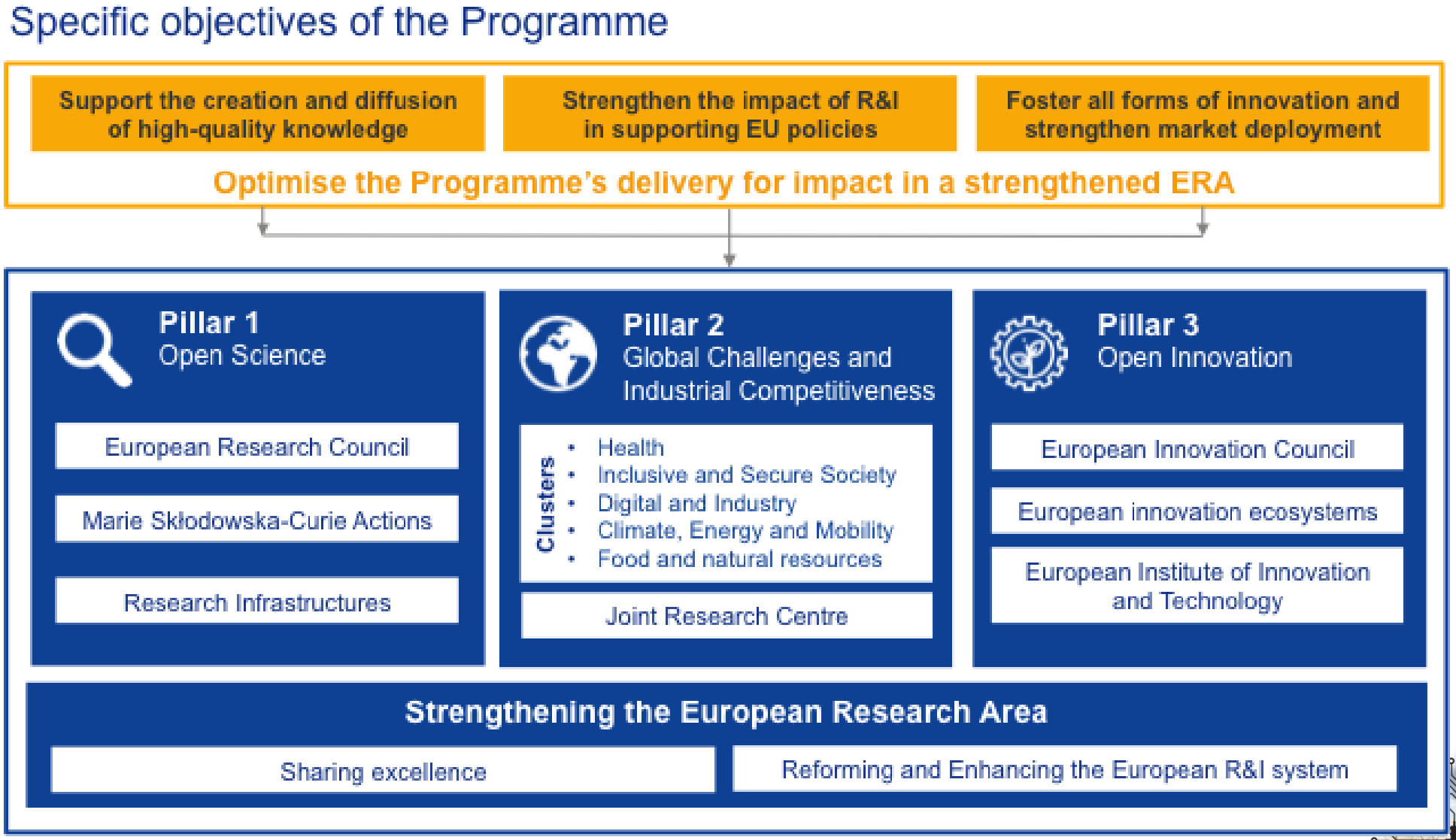


# FETFLAG-01-2018 Stage-2 Evaluation Results

- **Section 1 (Excellence 4.5/5):** "Beyond these fields, critical mass may be an issue, as there are not many people able to bridge the various disciplines and sectors that will be required.""
- **Section 2 (Impact 4.5/5):** "International cooperation is less well articulated. The proposal does not sufficiently detail how *complementarities and synergies* will be exploited with specific sectoral research programmes, such as hydrology & water and food & agriculture."
- **Section 3 (Implementation 3.5/5):** "Apart from the Project Manager who is mentioned by name, the link between tasks, required expertise and key personnel mentioned in the proposal is unclear. Formal decision-making procedures are not adequately described. ...but the total number of person-months is low and the number of person-months for coordination is particularly low. In addition, the resources allocated to the workshops are limited."



# Horizon Europe: 2021 - 2027

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# Horizon Europe: 2021 - 2027

## R&I Missions

R&I Missions

**Relating EU's research and innovation better to society and citizens' needs; with strong visibility and impact**

A mission is a portfolio of actions intended to achieve a bold and inspirational as well as measurable goal within a set timeframe,
with impact for science and technology, society and citizens
that goes beyond individual actions.

Horizon Europe proposal defines mission characteristics and elements of governance

Specific missions will be co-designed with Member States, stakeholders and citizens and programmed within the Global Challenges and Industrial Competitiveness pillar (drawing on inputs from other pillars)

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# Horizon Europe: 2021 - 2027

Survey on possble mission topics following Mazzucato-report :


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# Horizon Europe: 2021 - 2027

## 1st set of Missions:

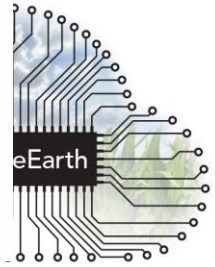
| Mission area | Potential examples of concrete missions |
|---|---|
| Digitisation | Quantum[3]: Build the first universal quantum computer in Europe by xxx to enable breakthroughs in artificial intelligence. |
| Health | Beating cancer: Cure paediatric cancer by 20xx. |
| Clean Europe | Healthy Oceans: Eliminating plastic waste in rivers and seas by 20xx.<br>Clean cities: the first xx carbon-neutral cities with clean air by 20xx |
| Food/ Agriculture | Sustainable land: Restoring soil health by 20xx. |

## Other Mission topics:

1. Paediatric cancer
2. Health in the digital age
3. Reducing inequalities with skills and competences
4. Carbon neutral industry
5. Smart liveable cities
6. Roads without victims
7. Seasonal energy storage
8. Healthy sustainable and resilient agri-food systems for all
9. Land management for bio-diversity and carbon storage
10. Zero-waste society
11. Healthy oceans
12. Quantum computing (FET-Flagship)

## Partnerships:

1. Faster and safer use of health innovations (Successor to IMI);
2. Global health partnerships (Successor to EDCTP).
3. Key digital technologies (Successor to ECSEL);
4. Connectivity beyond 5G (NEW institutional partnership);
5. Innovative space systems (NEW institutional partnership).
6. Metrology (Successor to EMPIR)
7. Air traffic management (successor to SESAR),
8. Aviation (successor to Clean Sky),
9. Rail (successor to Shift2Rail);
10. Connected, autonomous mobility (NEW institutional partnership);
11. Fuel-cell and hydrogen technologies (successor to FCH);
12. Industrial batteries (NEW institutional partnership)
13. Bio-based solutions (Successor to biobased industries*).



# EuroHPC Joint Undertaking

DECLARATION

*Cooperation framework on High Performance Computing*

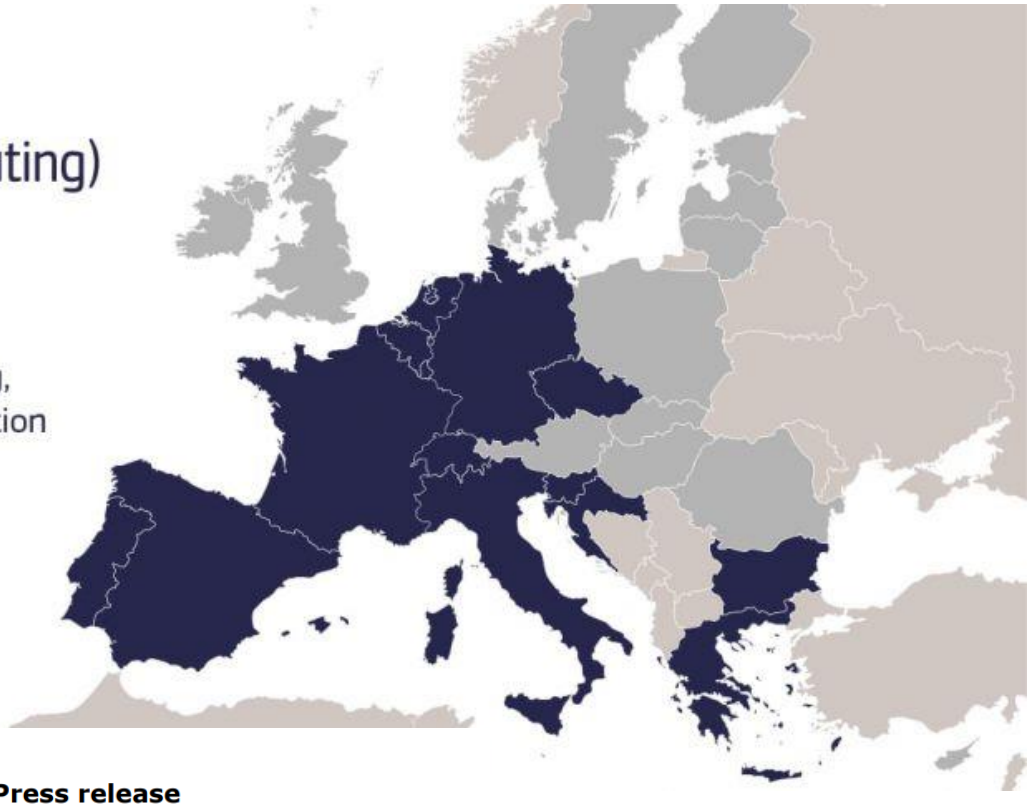
Bundesrepublik Deutschland
and
República Portuguesa
and
République française
and
Reino de España
and
Repubblica Italiana
and
Grand-Duché de Luxembourg
and
Koninkrijk der Nederlanden

The signing Member States agree to work together towards making available across the EU an integrated world-class high performance computing (HPC) infrastructure, which in combination with European data and network infrastructures would upraise Europe's scientific capabilities and industrial competitiveness.

**#EuroHPC** (High Performance Computing)
**Declaration**
*Signatory European countries*

Seven countries – France, Germany, Italy, Luxembourg, Netherlands, Portugal and Spain – signed the declaration in March 2017.

Since then, another seven countries – Belgium, Slovenia, Bulgaria, Switzerland, Greece, Croatia and the Czech Republic – have also signed.



**European Commission - Press release**

**Commission proposes to invest EUR 1 billion in world-class European supercomputers**

Brussels, 11 January 2018

**The European Commission unveiled today its plans to invest jointly with the Member States in building a world-class European supercomputers infrastructure.**

**[Andrea Feltrin, EC]**

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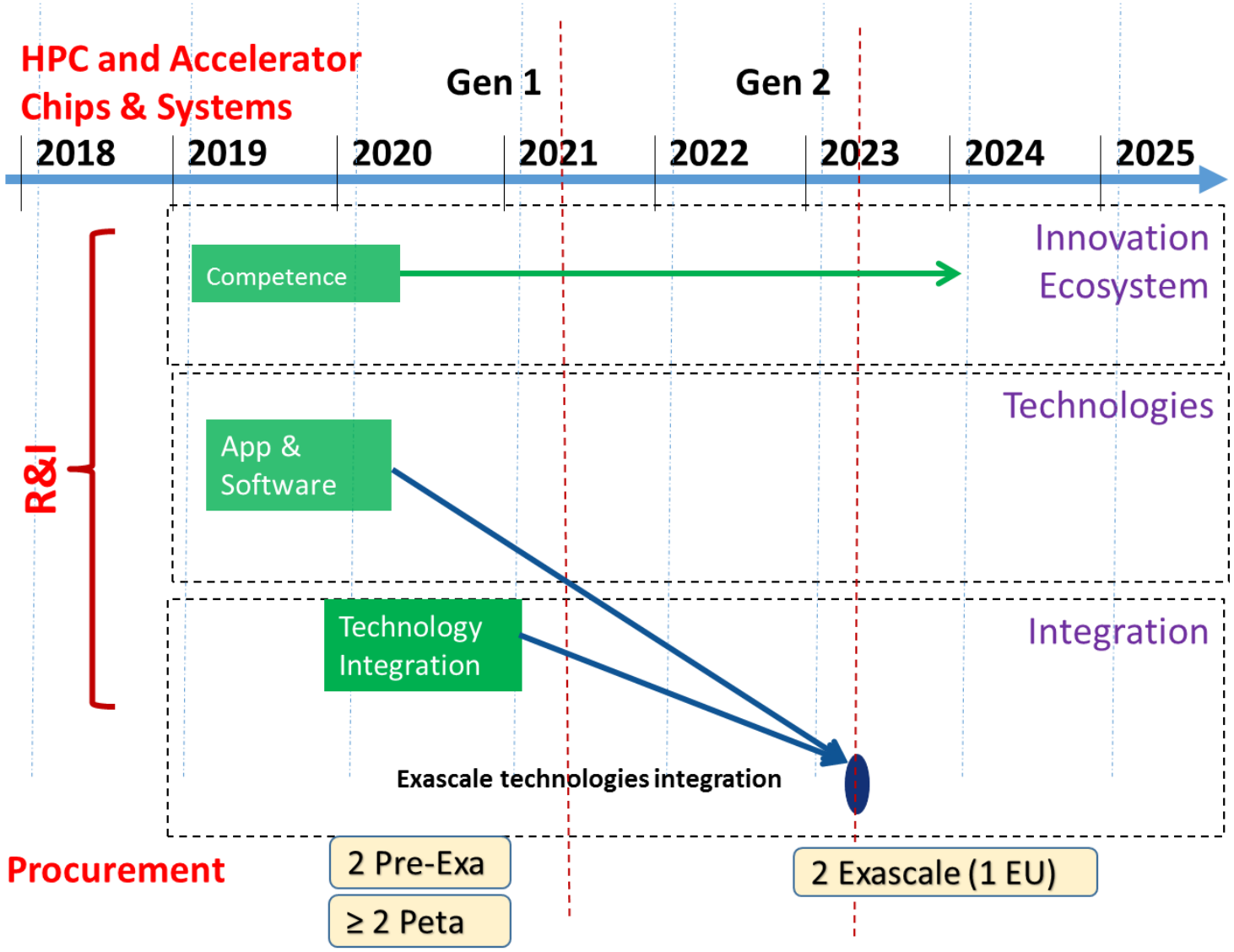
# EuroHPC Joint Undertaking roadmap




[Andrea Feltrin, EC]

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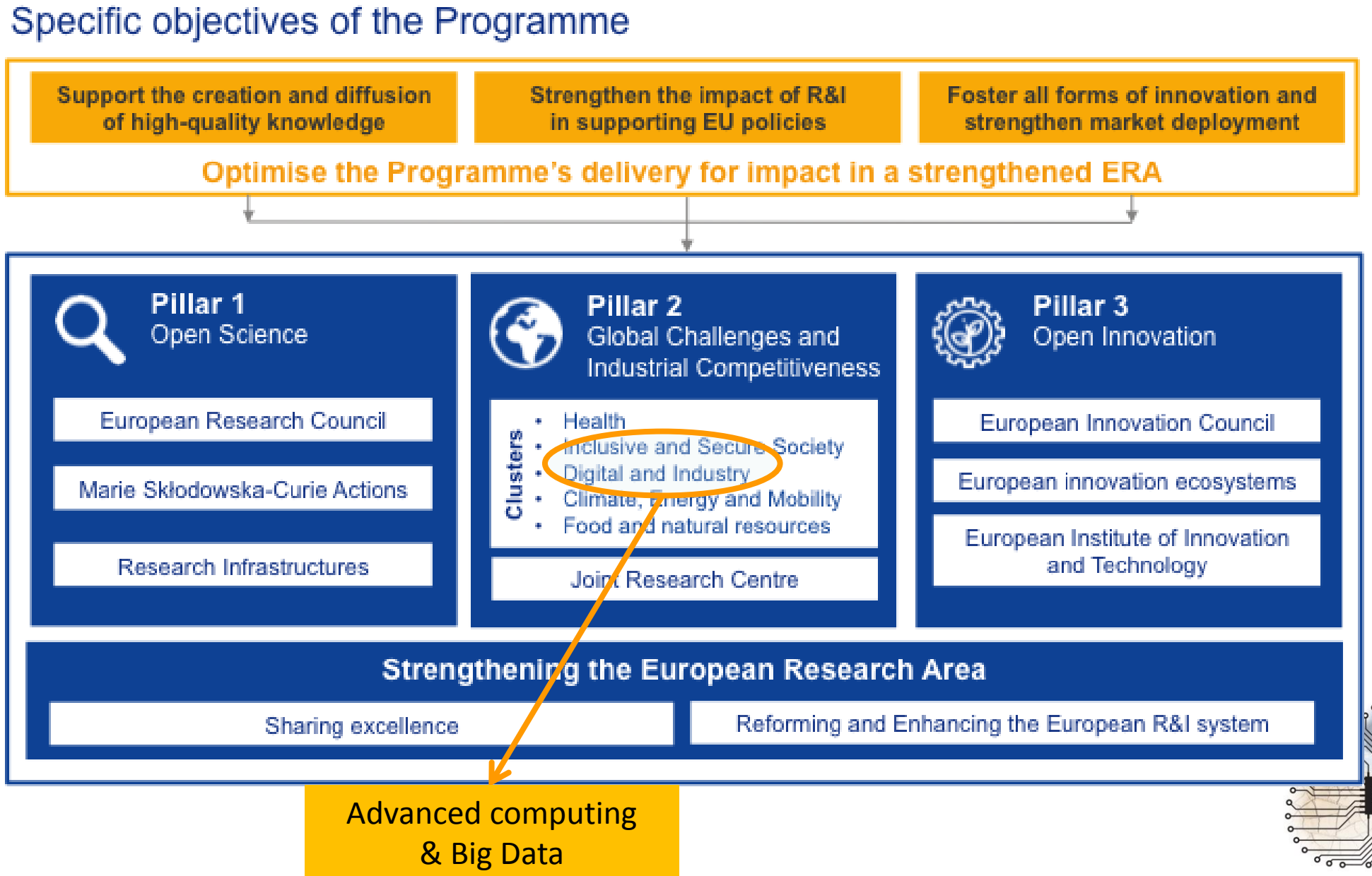
# Horizon Europe: 2021 - 2027

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# Next steps

1. Maintain *ExtremeEarth* as a project concept: the science – technology case remains valid!
2. Clarify business case addressing the "science is solved, let's focus investment on energy technology now" (déjà vu: Australia's CSIRO climate science staff cut in 2016 )
3. May need to add other sales arguments:
   a. *ExtremeEarth* as a demonstrator for European Science Cloud
   b. *ExtremeEarth* as a powerful application for AI
   c. *ExtremeEarth* as a demonstrator for EuroHPC exascale application
4. Seek hybrid funding, e.g.:
   a. National sources (Helmholtz, CNRS, UKRI etc.)
   b. Constellation of smaller EC-funded projects and research infrastructures
   c. Industry (is requirement anyway)
   d. US/Asia (?)
5. Try again next time (just like others that are now Flagship projects)

**Next action: workshop in Brussels on 14-15 March**