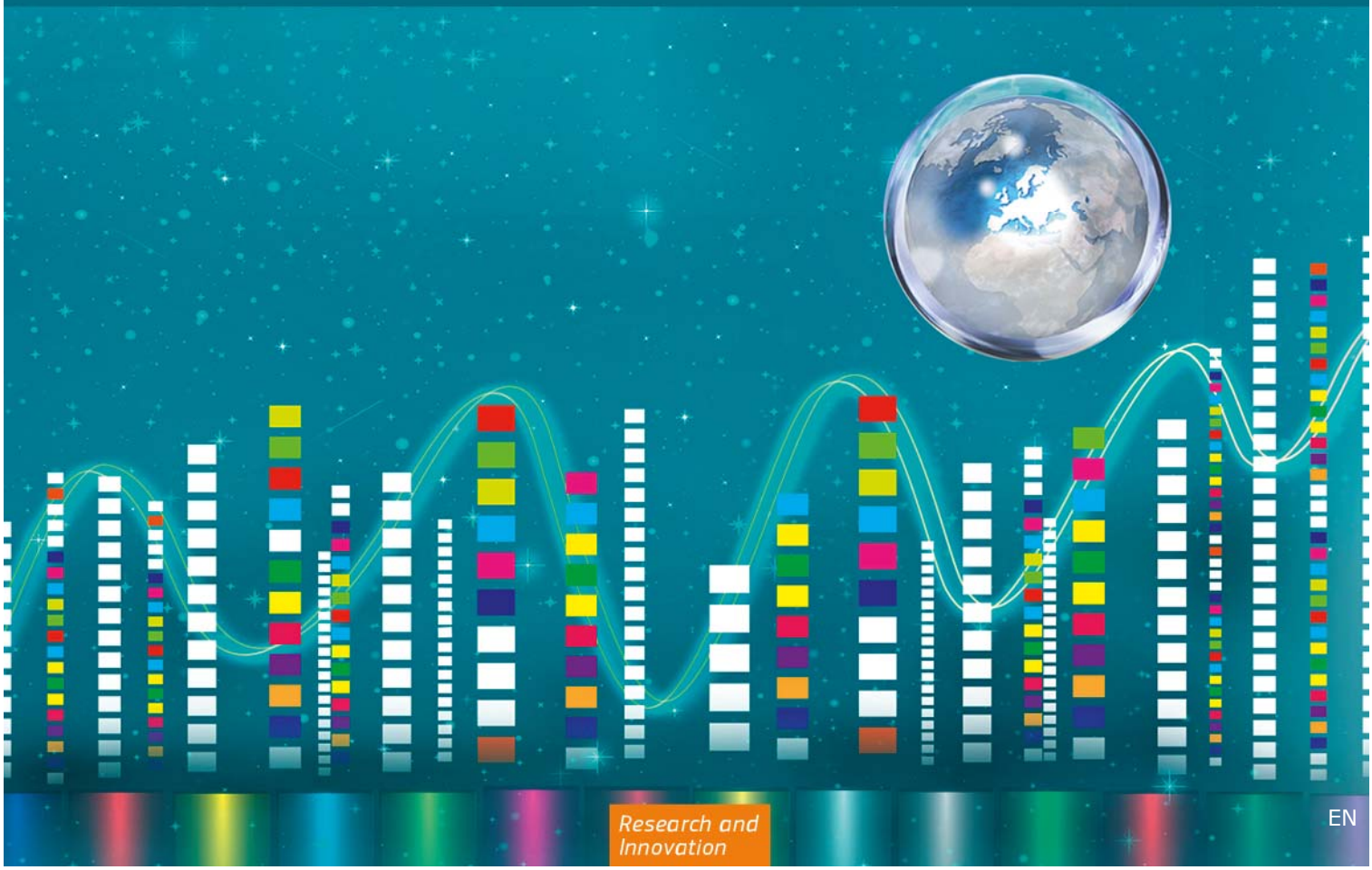
European Commission

Foresight

Long term challenges and EU R&I policy

Report from a workshop

Brussels, 20 February 2019



Research and Innovation

EN

Long term challenges and EU R&I policy – Report from a workshop

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EUROPEAN COMMISSION

Long term challenges and EU R&I policy

Report from a workshop

Brussels, 20 February 2019
co-organized by DG RTD and the JRC

Synthesis produced by

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All view expressed are view of the authors and do not necessarily reflect the views of the European Commission nor engage it in any manner,

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Directorate-General for Research and Innovation

2019

Foreword

Since the industrial revolution cheap energy and innovation have allowed an increasing number of humans to live longer, safer and more productive lives. On the road to prosperity, we have started crossing planetary boundaries, which heralds large-scale turmoil, both in nature and in society.

Funding science and innovation keeps bringing technological opportunities. But our success will come from our ability to drive creativity to sustain growth and to grow sustainably. We are looking at a 10-year window responsibility and opportunity where research and innovation combined with audacious policies will need to make the difference

In 2017 Europe was the number one destination for the world's top 340 investors. They cited as Europe's main advantages its stability and its better prospects for sustainability.

Our policies aim to build further on these advantages. We need to join up our different policies and our visions of a stable, sustainable Europe, and bring innovation, supply and demand, with the public and policy-makers pulling together in this direction.

We need to envision the future, anticipate challenges and seize opportunities, and build common approaches and common agendas. This is where foresight comes in.

This workshop was part of an effort to look at the long-term challenges for Europe as opportunities for shared visions and common R&I agendas across the European Commission. It was a brainstorming occasion to which many people contributed their time and effort, for the benefit of policy-informing foresight but without commitment of the Commission to translate the views expressed into concrete policy proposals.

Knowledge and good ideas are important food for EU policy. I remain grateful for this creativity, and I look forward at discussing the forward-looking ideas created in this workshop with colleagues, stakeholders and citizens to collectively shape a kind of future that is kind to humankind.

Kurt Vandenberghe,

Director - Policy & Programming Centre,
European Commission,
Directorate General for Research and Innovation

Introduction

The workshop was part of an effort of the foresight correspondents' network of the European Commission to develop a shared view of EU R&I policy based on a common vision of Europe after 2030. It sought to explore sustainability transitions that Europe has to undergo to achieve sustainability, identify important long-term challenges in that context, and reflect on possible implications for EU R&I policy.

The workshop began with a welcome address emphasizing the importance of long-term visions in a shift of EU R&I policy, from a focus on industrial competitiveness, towards a broader role in making Europe sustainable.

The Commission's reflection paper *'Towards a Sustainable Europe'* established that the EU is making important progress towards the Sustainable Development Goals (SDGs). Yet, it is important that the EU does not rest on its laurels, but works tirelessly to build further momentum towards sustainability. It is from this perspective that the workshop discussed long-term challenges and EU R&I policy[1].

Workshop methodology

The workshop as structured followed the framework of the BOHEMIA study[2], dividing participants in four groups, each with a different perspective towards the needs and aspirations of the EU for the future:

1. The needs of the biosphere
2. The needs of people
3. Innovation
4. Governance

Collectively the four perspectives form a meta-narrative towards the SDGs. There are considerable overlaps and interconnections between the four perspectives, which nonetheless place the focus on different issues. The overlaps could be helpful to compare and contrast the different discussions.

[1] Without disregarding the considerable challenge to ensure the sustainability of what Europe has already achieved in terms of the SDGs.

[2] https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/support-eu-research-and-innovation-policy-making/foresight/activities/current/bohemia_en

Participants in the discussions were instructed to think about long-term challenges (and opportunities) in two different ways:

1. In relation to the duration of a trend
2. In relation to the 'three horizons model'[3]

Challenges and opportunities relating to 'the third horizon' can only be speculatively identified. Nonetheless, these are the kind of issues that typically form blind-spots of policy intelligence and analysis. When thinking of R&I policy responses to the challenges, participants were asked to reflect on: a) Understanding oriented / translational R&I b) Enabling / solution oriented R&I; c) Regulatory science / policy studies, and d) Scaling-up innovation and social innovation.

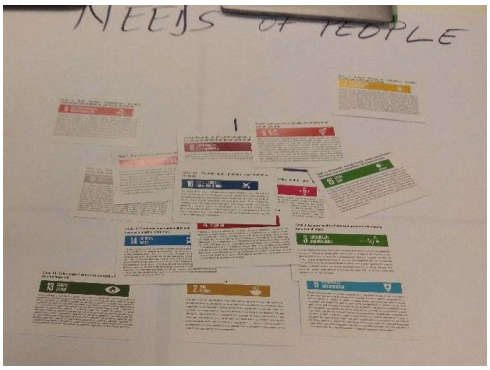
The structure of the report

The first section provides a brief overview of the session in which each group explored the normative (SDGs) and analytical (megatrends) elements of its perspective. The second section attempts to capture the discussions in each group on the important long-term challenges and opportunities, while the third section attempts a synthesis of the R&I agendas developed in the course of the fourth session of the workshop. A brief concluding section – going beyond what was discussed at the workshop - presents an appreciation of the contribution of the long-term perspective on the EU R&I policy discussion.

1. Exploring the transitions

In the first session, each group explored the perspective it was given, as a transition space. The task involved discussing the placement of each SDGs as central or peripheral to the perspective and then repeating the same exercise with megatrends (powerful, some would say inescapable, trends that frame, drive and challenge the transitions). The workshop used the collection of megatrends developed by the JRC (https://ec.europa.eu/knowledge4policy/foresight/about_en).

One of the most challenging parts of the exercise was to agree on how the SDGs relate to Europe. For many participants, several of the SDGs primarily relate to the needs of poorer and developing nations, and do not reflect in the same way the needs of European societies. In fact, Europe, in many ways needs to work for the sustainability of what it has already achieved in relation to the SDGs.

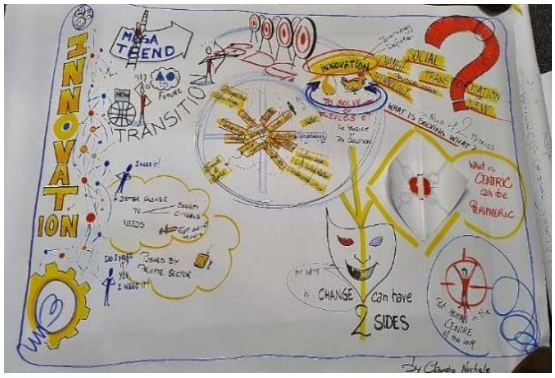


The discussion on the perspective of the biosphere was consensual in its understanding that the biosphere is a planetary issue that concerns the needs of all people worldwide.

[3] See Hodgson, A. and Sharpe, B. (2007). 'Deepening Futures with System Structure'. In Sharpe, B. and Van der Heijden, K. (eds.) *Scenarios for Success: Turning Insight into Action*, Chichester: John Wiley. Sharpe, B. (2013). *Three Horizons: the patterning of hope*. Axminster: Triarchy Press.

The discussion on the relevance of the SDGs for Europe from the perspective of <u>providing for the needs of people</u> was divided in three different views of who provides for whose needs:

a) Europeans providing for the needs of Europeans (euro-centric);
b) Europeans providing for the needs of humanity (through commerce and aid) ; and
c) Humanity as a whole providing for human needs (universalistic).



The discussion on <u>innovation</u> also faced important challenges associated with normative and analytical semantics (innovation as a political pursuit vs innovation as a cultural value vs innovation as a phenomenon we observe). Are the SDGs to be considered as inputs to innovation or are R&I to be seen as critical contributions in achieving the SDGs?

Similarly, the discussion on <u>governance</u> found the positioning of SDGs challenging. They come from a very specific governance framework. Their level of achievement could affect this governance framework, and progress on almost all SDGs depends on governance.

2. Long-term challenges and opportunities

What are the most important challenges and opportunities? Each table had the task to identify the 6 most important long-term challenges and opportunities. One of the most salient feature of these discussions was the extent of commonality in the key concerns across the groups.

The concern with climate change was prevalent across all groups, as an existential threat for humanity and as a huge driver for global governance. Everybody's eyes are on innovations that promise effects on the causes and consequences of climate change.

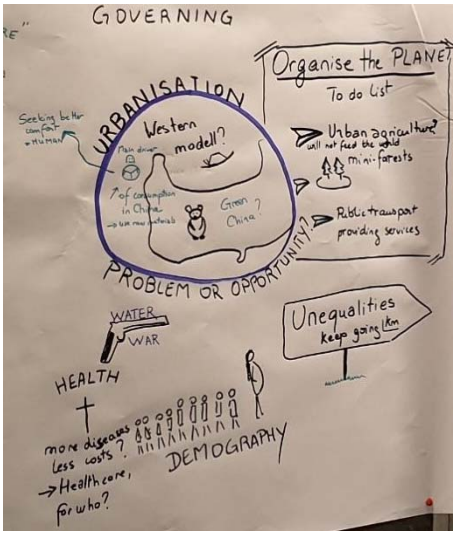
Biosphere

Climate change is hugely important from the perspective of the biosphere, where it is seen as the number one threat.

The concern with the biosphere is indivisible from the governance of common resources; the need to develop an economy that values and employs regenerative systems, (in agriculture, industry, and life-styles), in order to restore and safeguard biodiversity; and the need to develop appropriate governance systems and structures that resolve the

long term challenges.

While it is understood that such systems should be developed, there is little understanding of how they could emerge – what would be a feasible transition management practice. This is a good research question in itself. Nonetheless it is important to note that there are at least two sets of issues here.



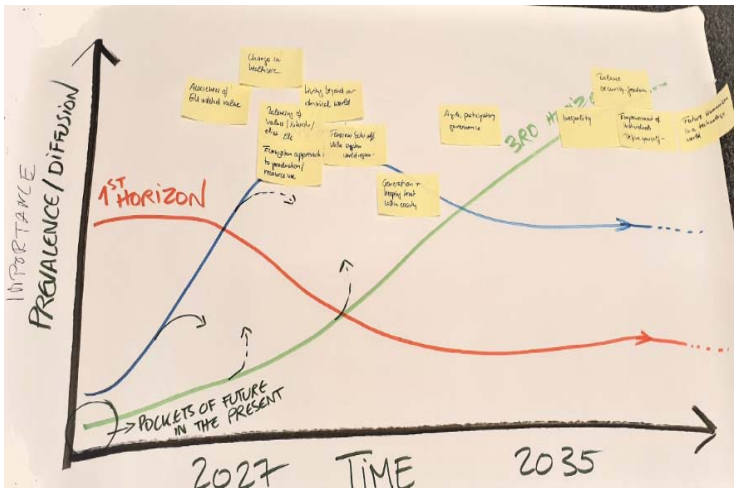
One is the role of education as a system that supports societal change. Our education systems can ensure that everyone is taught the basics of how earth systems work, from trophic cascades to nutrient and pollutant fluxes. Another is the role of nature protection and other ecological management agencies that can provide a great deal of knowledge on the governance of the biosphere.

The governance of a global biosphere cannot be separated from the governance of a number of key concerns – which were seen as important parts of shorter-term agendas, such as:

- Global migration flows, often related to environmental and climate related changes,
- 'Urbanization', a trend that involves the massive movements of people and the development of a great deal of durable infrastructure, which increases the separation of space into urban, rural, and countryside; and
- Development of incentive schemes for incentivising low carbon transitions in the context of the current world economic systems.

The needs of people

As an existential threat, climate change is a determinant factor in the perception of the needs of people, but the need to address it is a short- and medium -term necessity rather than a long-term trend. A similarly short-term important challenge that relates directly to the existence of the EU is the important lack of awareness of its added-value amongst many citizens. The contribution of the Union to the avoidance of war in Europe is not as engrained in the public conscience as once was. Dissonance between the values of the EU, the competencies of EU institutions, and the ability of Europe's governance structures to respond to citizen's wishes, to deliver results seen as adhering to those values, poses risks of the alienation of sizeable groups from the European project.

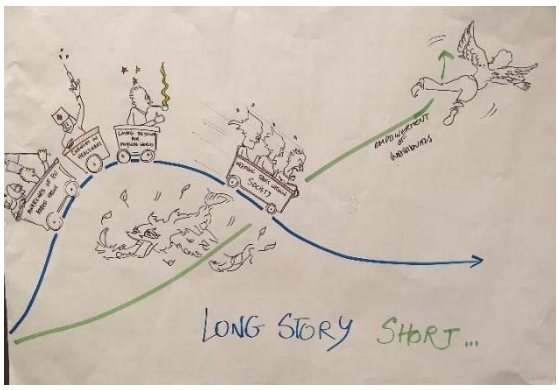


Broader value-tensions and conflicts are likely to arise in the medium term as interactions between increasingly diverse people

intensify, and social cohesion is threatened. Convergence of values between different peoples is not only a major challenge, but also a prerequisite for transitions. Keeping trust in society and maintaining social cohesion will be an important medium-term challenge especially in the context of inter-related long-term trends such as aging; the growth of non-communicable diseases; emerging health treats and health inequalities, and environmental degradation. This is relevant to citizens, to health systems, and to the model of social market democracies (that includes universal healthcare) underpinning the EU. The development of an ecosystem approach to resource management will also be an important medium term challenge.

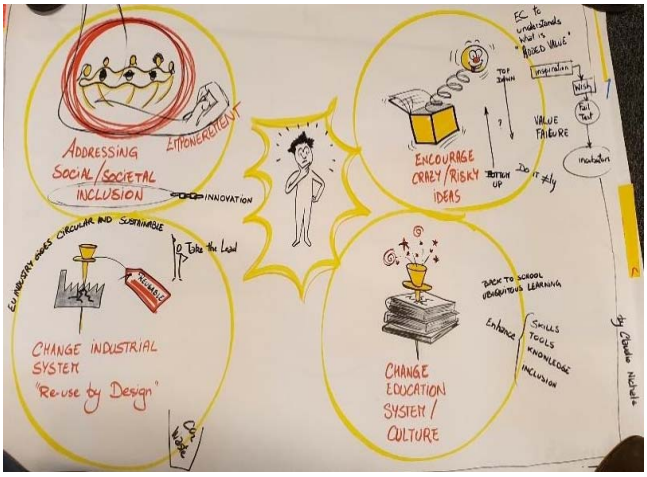
From the perspective of the needs of people, the most important long-term challenges are

- inequality;
- balancing security and liberty,
- empowering individuals
- combining humanism and technology, and
- developing agile, anticipatory governance.



Whilst all these challenges have always been there, in the longer-term they are likely to be completely reshaped by technological possibilities – and the tensions of those transformations underpin many of the short and medium term challenges discussed.

Innovation

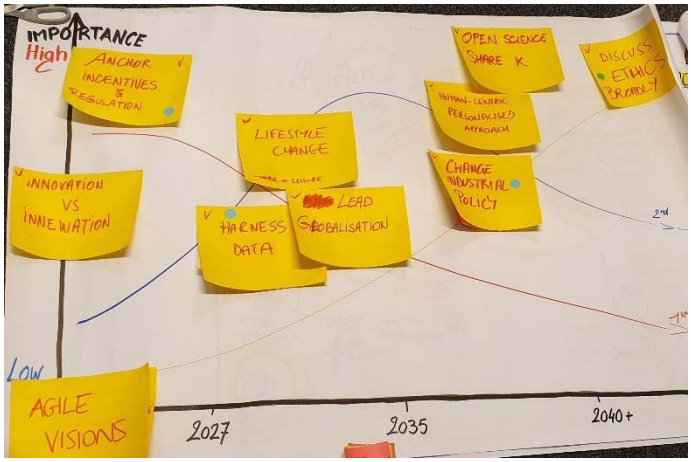


Individual empowerment is a very important long-term challenge and an opportunity that lies at the heart of liberal value systems. Three of the four long-term challenges identified in the innovation transition are in one way or another related to individual empowerment:

- the challenge to strengthen societal inclusion must go hand in hand with individual empowerment to innovate and to keep up and participate in societal innovations ;
- the challenge to reform the education system must empower individuals to be curious, inquisitive and innovative; and
- the challenge to encourage people to pursue seemingly unrealistic ideas in science and industry ("thinking outside the box") is about empowering individuals to disregard conventions.

A fourth long-term challenge for innovation is to incentivise and enable industry (manufacturing and services) as well as society at large to be circular and sustainable, including to minimize carbon emissions and play its due role in combating global warming. Remarkably, many participants underlined the importance to embed "innovation" into ethical and political discussions at the stage of implementation.

While the long-term challenges in innovation have to do with sustainability and individual empowerment, in the shorter term there is an important challenge to provide appropriate regulatory frameworks for innovation that empower innovators and promote sustainability, reduce inequalities and promote fairness. Important medium-term challenges include harnessing data for appropriate innovation environment and actions, promoting a human / person centred approach, and appropriate lifestyle changes. An emerging challenge in innovation relates to agile visions, flexible to adapt to changing needs and conditions without losing their mobilising character – similar to the need for agile anticipatory governance identified in the group discussing the needs of people.



Governance

Governance is an important long-term challenge for Europe and the world and improving it is a perspective in its own right. Broadly 'governance' includes four quite distinct, although inter-related, sets of challenges:

1. the challenge of effective solutions to climate change – a classic tragedy of commons type problem;
2. the challenge of maintaining the EU position in the world, in the face of significantly slower rates of population and economic growth in the EU than outside it;
3. the challenge of an evolving global system with diverse actors, from states through non-governmental organizations, trans-national companies and markets, to powerful individuals – where power is exercised at different domains in very different ways.
4. The challenge of AI and other emerging technologies, which give actors new capabilities and challenge traditional governance systems.

The challenges are not instant events, but evolving trends undermining individual and collective responsibility, and making it very difficult for the EU – and for any country - to take effective action at the world stage.

Climate change needs effective global governance, and therefore the EU must strive to promote effective global governance. However, in the absence of effective global governance, there is a moral responsibility for the EU – based on its values (and arguably on its social and economic interests) – to do whatever is in its power to combat climate change.

New models of governance are likely to remain an important long-term challenge. The drivers include an increase in problems of commons, fuelled by the rise of global human populations and the increase in the ways in which these populations interact. They also include the massive increase in the rate of accumulation of knowledge and data, which opens up new opportunities and challenges for perceiving problems (that require governance) and for solving such problems through markets or through government provisions. Algorithmic governance, by AI systems or by AI-assisted administrations and market players, is an important long-term challenge. Another is safeguarding social integration and avoiding growing and diversifying inequalities in an environment of multiple governance models.

3. R&I policy agendas responding to the long term challenges and opportunities

3.1. The Moon-Shot: Beyond Carbon

Climate change, due to the accumulation of Green House Gases (GHG) in the atmosphere, is a major threat to the biosphere, to society, human life and the economy. To reverse already effectuated dangerous climate change over the next decade there is a need for immediate, abrupt, and drastic cuts in CO2 emissions as well as rapid and drastic increase in carbon sequestration.

Significant changes in lifestyles are needed worldwide, as well as rapid transitions to alternatives. At the level of the European Union, policies for Climate, Energy, Mobility, Environment, the Economy, Regions and Agriculture and rural development need to coordinate with a view to transitioning to a "Clean Planet for all"[4], with substantially strengthened resilience against natural disasters and other stresses caused by climate change.

R&I is needed to develop, implement, scale-up and diffuse technologies that do not emit GHGs, to replace ones that do. R&I is needed to understand resource and technology substitution and management processes, and how to organize such processes in society. R&I is needed to rapidly scale up solutions and lifestyles that have a negative GHG emissions balance – ones that draw carbon from the atmosphere.

International trade and foreign aid need to become engines of transition world-wide. Verifying and accounting for carbon emissions for calculating taxes and tariffs requires regulatory science, while solutions oriented R&I is needed to find ways of averting natural

[4] COM(2018) 773 final; A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy

catastrophes due to further global warming, and how to safeguard life and the integrity of the biosphere in conditions of global warming.

The multi-sectorial, multi-faceted R&I effort needs to be comparable to the John Kennedy's 'Moon-Shot' – the effort of the US to put a man on the moon in the 1960s. At its peak in 1966, this amounted to three quarters of the total federal R&I effort or to 4.4% of US GERD (Gross Domestic Expenditure in R&D). The EU has the scale to undertake such an effort. Indeed the EU Framework Programme represents currently between 3 and 4 % of EU GERD.

However, such a Moon-Shot requires resources and political will unparalleled to any effort in the history (of the EU). Some estimate that the total investment required is 10 times more than the R&I programme, because a great deal of it concerns the diffusion of existing technologies and solutions, but at a very rapid pace.

Who will be the agent or agents entrusted with this mission? Who has the authority and power to achieve coordination of resources at such scale? Can any existing institution or organization be accountable for delivering it? This Moon-Shot needs to succeed. The consequences of failure will be dire for Europeans and for inhabitants of the planet as a whole.

3.2. Research programmes and networks: put the agents first

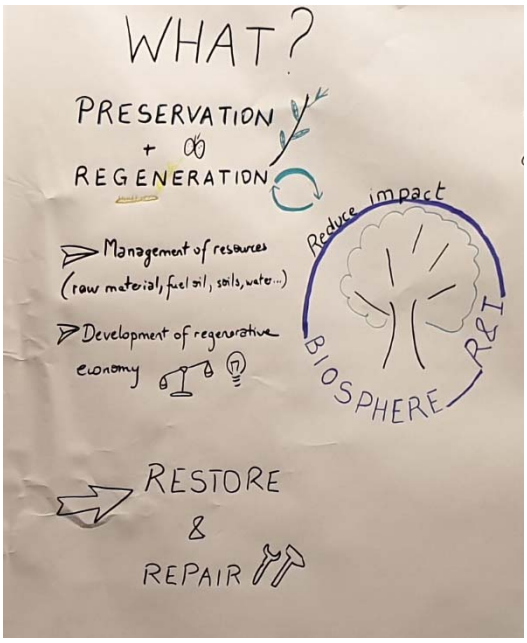
A number of long-term challenges form the concern of existing policy and regulatory agencies – and Commission departments – as well as research communities. To prepare for, address and ultimately defeat such challenges, Europe needs agents with appropriate knowledge and tools, and a governance system – economic, political or mixed - that provides appropriate incentives and rewards. The R&I policy agenda for the long-term challenges identified involves a mixture of understanding oriented research, solution oriented R&I, regulatory science and policy studies, and experimentation in practice, whether for the purposes of scaling up and promoting technological solutions or social practices. How can this mixture of activities be best coordinated in order to be ready to defeat the challenges? A number of suggestions were made, from loosely run programmes to the formation of specific institutes. The common element in all these suggestions is that knowledge accumulation needs to be linked to agencies that have incentives and authority to act and responsibility for the actions to be taken. Considering the European eco-system of research, innovation, policy and regulation, appropriate ways of programming and implementing programmes may vary for different areas. Flexible programming may accommodate different arrangements even within each area.

The presentation that follows presents three clusters of issues that are directly associated with the Moon Shot described above, and will have positive contributions to it (on 'regeneration', 'governance' and 'innovation' for sustainability), and two important complements to the Moon-Shot: the European programme for humanist technology' and the European programme for a peaceful future'. These two programmes were seen as organized around specific poles (which could have the form of a centre or institute) which concentrate diverse knowledge creation efforts, at a large-scale, on issues that are key for Europe's long term future. How these efforts are best embedded in the overall context of R&I in the EU deserves rigorous study and further debate.

3.2.1. Regeneration: energising sustainability[5]

We consume more resources than the planet has to give. Planet-overshoot day – the day when humanity has consumed what the planet takes a full year to generate, has been arriving earlier every year. In 2018 it arrived on 1 August. The sustainable management of natural resources, for food, shelter and other needs of human, natural and planetary health, is an alternative to resource depletion and ecosystem degradation. As planetary capacity to sustain life shrinks, humanity needs to contemplate lifestyles and economic processes that not only recycle, but that actively encourage regenerating resources. A global middleclass emerges and megacities become commonplace across the planet. The effect of individual behaviour on sustainability becomes a central policy concern, that requires new and better understandings – e.g. how incentives affect individual and collective behaviours, as well as better ways of enabling, incentivising, and effectuating behavioural changes.

R&I can help with devising appropriate systems for accounting, monitoring and assessing resources and their state, with developing alternatives, designing appropriate incentive systems, monitoring social innovation and organizing exchanges of experience. It can strengthen the monitoring capacity of EEA and its powers to influence industry and citizens. Most of all, R&I can help understand how resources are generated and re-generated in nature and in technical and industrial processes (including processes of land and water remediation, and carbon sequestration). There is a need to actively research and understand empirically regenerative processes, and to generate technologies that heal (rather than harm) the environment. Metrics for 'healing', 'harming', biospheric gain and loss need to improve and to support regulatory processes. A culture and technology of regeneration needs to be mainstreamed and to be valued across society. Europe needs to build on its diversity, which needs to be strengthened even more by strengthening the local nature of regenerative solutions. The regenerative economy will come as a loose network supporting co-creation at a massive scale. The regenerative economy will function across society, achieving wide validation, and lead to bioremediation at a massive scale.



The reach of the Common Agricultural Policy, combined with the strengths of the EU statistical and geo-physical (including environmental) monitoring systems are strengths for the EU. The EU has little competence in policy areas that directly incentivise behaviours, but it can send powerful messages through its policies and leverage existing structures and processes whereby Member States learn form each-other, as well as the reach of EU institutions in higher education. A loose investigative network can support he transformation from insights to daily life changes, through media and interventions in primary education.

[5] This is a synthesis of a series of suggested R&I responses to long term challenges with the following titles: a) beyond the circular economy: the regenerative economy, b) regenerative pathways for natural resources; c) changing behaviours: towards biocompatible life-styles; d) sustainable resource use; e) industry goes circular and sustainable

Sustainable use of resources requires a life-cycle approach that minimizes the environmental impact of production and consumption processes and brings materials and resources back into the economy after their use. There is a need to change the industrial system to re-use by design, to minimize emissions of all kinds, to use less material, more investment and more operation and maintenance. Reducing CO2 emissions and waste also promotes security of resources' supply. The smart decentralization of labour intensive maintenance functions helps with distribution of economic growth and social cohesion. Combined they can provide Europe with the means to maintain technological leadership, with stronger economic growth and employment. Despite considerable discussion on the circular economy, it still requires a great deal of R&I: the structures of industry, sectors, products groups and their spatial organisation need to be well understood to design effective circular loops in practice.

There is a need to study successful circular loops to extract models of policy, regulatory options and societal value models that can help policy implementation. More effective material composition and decomposition technologies can enable new circular loops. Demonstration projects can boost the rapid diffusion of good practices while targeted incentive systems can support industrial conversion to sustainable resource use models. While Europe has strong environmental legislation and values and strength in R&D, such a conversion may entail short-term competitiveness challenges. Responding to these challenges requires a dedicated R&I programme in the hands of a dedicated mission agency, building on EU regulatory leadership and enabling the EU to export its best practices and mobilize international engagement.

3.2.2. Governance for a sustainable Europe[6]

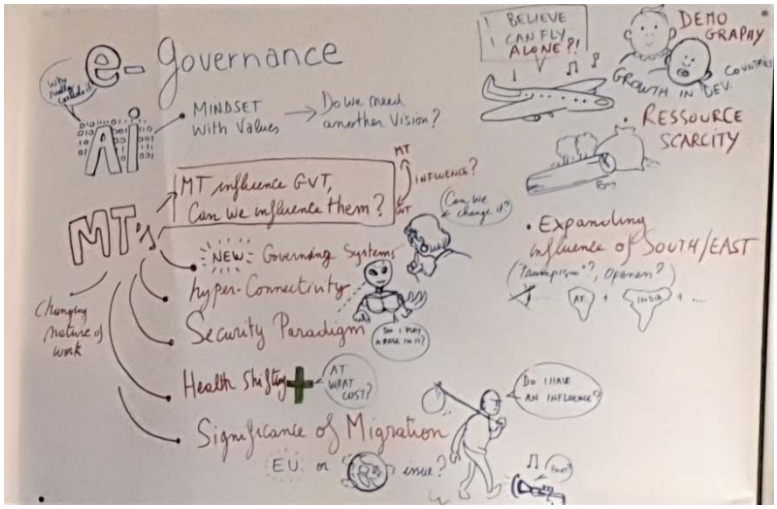
Achieving the SDGs challenges both national and transnational governance. It imposes targets that need to be aligned with electoral promises, it forces monitoring administrative actions and their effects, and it sets a direction for improving both the means of monitoring and the performance of government in specific directions. Given the state of art on how people and organizations respond to incentive systems, these are formidable challenges for institutions at the global, but also at the EU and national levels.

People and governments are faced with increasingly complex, fast unfolding, problems that span organizational boundaries, and defy policy solutions. Governance in the context of increasing interdependence, increasingly diverse, aware and engaged publics, fast diffusing information and opinions, requires agility and anticipation. Within the EU there is a need to strengthen the consistency between different policies, to use better science and knowledge and to integrate strategically different policy sectors. Systemic risks are threatening the integrity of our biosphere and geopolitical and technological developments expose Europe to asymmetric risks. The current demarcation of policy responsibilities and stakeholder communities result in incumbency bias, short-termism, and governance failures (including markets, democratic institutions and other forms of governance of commons) which turn risks into threats. All policies need to surrender their borders to cross-policy networks and to become involved with collective foresight. Transparency is critical, as decisive problem solving, even at its most collective, deliberative forms, does not always provide win-win solutions. Social sciences and humanities combined with new ways of monitoring and data

[6] This is a synthesis of a series of suggested R&I responses to long term challenges with the following titles: a) new governance for the EU and its territories; b) agile anticipatory governance; c) preserving biodiversity: systemic policy-making; d) AI governance for sustainable development; e) empowering individuals: data, privacy, security and freedom

generation (e.g. intergenerational accounting) can improve anticipation and policy deliberation.

Governance needs to evolve together with the development of a body of knowledge on how performance can be defined and monitored, and what its implications are for citizens and the environment. The EU has considerable expertise and institutional capacity although gaps in engagement with citizens is a weakness. At the EU level, concepts of subsidiarity, EU added value, support and conditionality are challenged. An R&I programme on governance models for sustainable development can help understand some of the fundamental questions on democratic organization and sustainability, and support a broad social dialogue on new governance models for industry and the public sector. There is an important need to focus on the problems of "the commons" and to experiment with new approaches to overcome them, including different incentives' structures and systematic measurement of results in terms of environmental and biodiversity preservation. There is a major need to improve the assessment of fixed costs involved in major investments for sustainability. At the same time achieving the SDGs requires a substantial effort to shape the regulatory environment, including regulatory science, in a way that leads to sustainability. The utility of traditional tools (taxation, regulation) that have proven to work to obtain short term results needs to be maximised and new technologies can enable more productive regulatory science.



AI is expected to be particularly impactful in knowledge generation and governance. Because of this importance, AI is associated with new societal risks. All EU policies are concerned, by the need to develop a better understanding of intelligence, human enhancement and human performance, and how AI could help deliver the SDGs. R&I is needed to improve data quality and availability and to enable large scale curation of data. Smart regulation is required to ensure rapid advances in data quality and availability without endangering privacy or without the negative consequences of privacy loss. Because of the potential importance of AI, its governance and its diffusion should be promoted in multi-national and multi-sectoral contexts, in agreement and cooperation of stakeholders. The EU has a developed regulatory framework for data and considerable relevant scientific capacity. It lags behind in financial resources and the corporate might of US and Chinese leadership in AI investment. The impact of the regulatory framework on the development and deployment of AI is subject to controversy, and so is the attitude of the public towards AI applications, especially in the security field.

Managing the balance between liberty and security requires sustained observation of relevant phenomena by reliable platforms. Forensic science and observation technologies support control and accountability, and advances in understandings of causes and effects create new liabilities. In this context, empowering individuals and finding the right balance between liberty and security, becomes a challenge. A European effort is needed, to build capacity and a protective environment for use of personal data, while safeguarding the privacy and protecting vulnerable individuals. Such an effort could be structured around an EU network

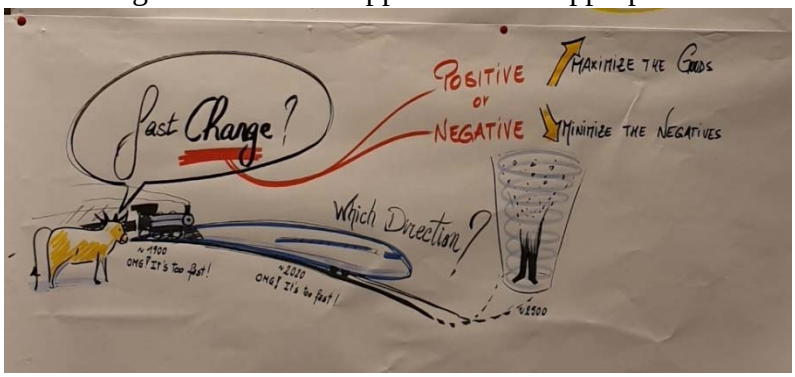
for coordinated action, aiming to strengthen the decision capacity and empowerment of citizens to make informed and responsible decisions.

The key characteristics of this programme could be a) the diversity of knowledge bases concerned – from social science to forensics and cutting edge technology, and b) the need to link those knowledge bases with policy-making. EU governance needs more knowledge. Analytical research into institutional learning is needed as well as normative experimentation on how to bring knowledge into government. An R&I programme is needed on methods and models of governance that places emphasis on participation of actors across the EU territory, that allows monitoring of emerging local systems. Participatory R&I tools would need to be developed and exchanging experience in such participatory methods would be encouraged across Europe and with other countries in the world. The effort to build agile anticipatory governance in Europe could be spearheaded by a loose network of research institutions built around a European research programme.

3.2.3. Innovation for inclusive sustainability[7]

Achieving sustainability requires a great many changes, and innovation can and should be mobilized. There is a need to strengthen risk taking in EU R&I allowing support for unconventional ideas. One of the challenges is learning in policy: we need a method for learning from policy experimentation and for maintaining memory, in order to really learn to assess technological risks and opportunities as well as business risks and opportunities. The current R&I support systems are neither inspiring nor challenging, finding difficult to stimulate novel unconventional ideas. The challenge is to stimulate risk-taking in innovation, in the same way that the ERC has stimulated excellence in science across the EU. This is partly related to financial markets and partly related to culture, education and learning.

Demographic ageing and the changing inter-generational balances are key drivers of labour, consumer and financial markets. As demographics, aspirations and technologies change there is a need to explore the changing needs and preferences for social protection and understand the implications of ageing, automation and AI for both work and social protection, as well as for participation in work, employment and society. Developing policy experiments and social innovations to support transitions through life-long learning and educational institutions; reassessing the levels of support and the appropriate conditions for public goods such as a healthy environment, health care and education; and reassessing the responsibilities of companies towards workers, can be parts of the work of a network to build a strong, Europe wide, evidence base on social innovation, and public goods provisions.



Learning has become easier and increasingly necessary. New tools enable, and rapidly changing circumstances require, ubiquitous learning, not only in a technical sense but also in

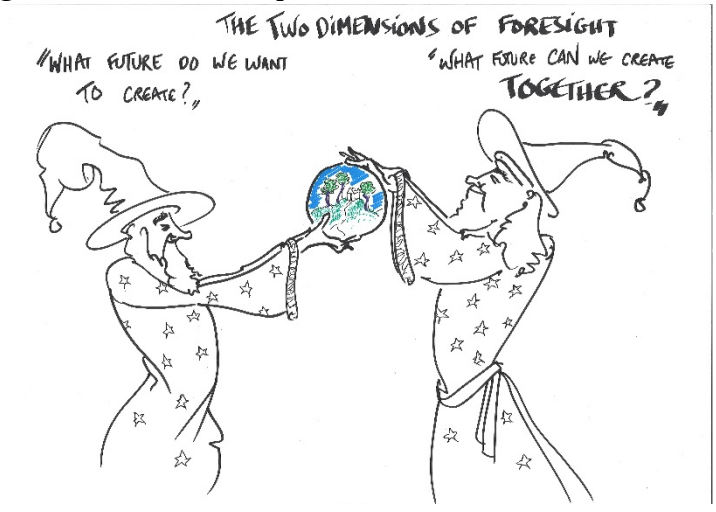
[7] This is a synthesis of a series of suggested R&I responses to long term challenges with the following titles: a) inspiration: wish and will; b) innovation for inclusive society; c) back to school/ ubiquitous learning; d) sustainable finance for social protection

terms of transmission of culture and civilization, values, ethics and intercultural competencies. Such a programme relates to all policies, which involve incentivising particular type of behaviours – health, environment, energy, climate, but also all policy directly concerned with innovation - education, industry, growth, and employment. While it is important to utilise the potential of education to achieve lasting change in society, there is little EU level experience in that. A programme of experimentation with social innovation through education and ubiquitous learning across the EU can elevate 'going back to school' to the very important social activity that it should be.

The challenge is to bring on radical market-creating innovations while minimizing negative externalities, in terms of environmental costs and in terms of generating unwanted inequalities. Inequality, real and perceived, exacerbates social tensions, undermines democratic governance, and jeopardises social wellbeing. Rising inequalities in opportunity for economic gains and social mobility are compounded with rising health inequalities. The trend for increasing diversification of inequalities makes them more difficult to measure but not less real in people's life. The issue concerns directly EU education, health, environment and social policies, including those for gender equality. R&I can help understand the forces that lead to inequality, including the role of technology choice in inequality, and the potential of using technological innovation to combat inequality. Research can help strengthen the sustainability of welfare models, and promote social innovation and work models that improve social participation. This is very important in a workforce of an extended age-range. As sustainability issues globally force the world to think of welfare, the EU has the moral high-ground to lead the world effort to reduce inequalities, which is fundamental for a stable society. A research programme including networks of research institutes can form the backbone of this global effort.

3.2.4. The European programme for a peaceful future

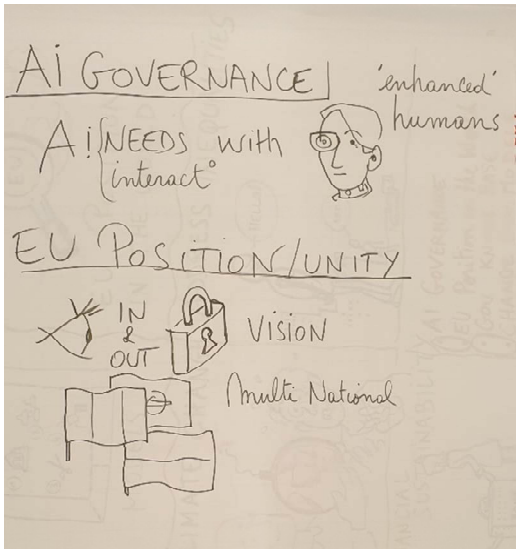
Security is fundamental for the effort to sustainability. The security of Europe concerns the security of everyone in Europe. Insecure, unsafe and insufficiently protected citizens cannot be empowered to pursue fulfilling lives and contribute to society. In an environment in which external and internal threats appear increasingly intertwined, the boundaries between peacekeeping and policing become blurred and the need for flexible and effective global governance is as important as the need for community engagement with security. The relationships between science, technology, peace and security are also changing. Military and civilian technologies depend more and more on each other. As people and organizations are becoming more powerful and capable to affect, benefit and harm others, the balance between liberty and security is continuously renegotiated, this within the boundaries of human rights. At the boundaries of human reach expand there are new potential fields of conflict.



A peaceful future is the heart of the EU and at the heart of every EU policy. Fundamental understandings on potential sources of conflict and conflict resolution are important for

ensuring a peaceful future. So are our ability to use scientific findings on causes without bias, and our ability to prevent crime and gains from conflict. Cyber-security, forensics, and research at the forefront of dual-use technologies are fundamental. The need to manage carefully interfaces with defence and law enforcement agencies makes a focal point (a "pole" or an institute) suitable for this type of work. This would have to be the centre a network of national institutes, and organize a broad R&I programme to contribute to a peaceful future.

3.2.5. European programme for humanist technology



As technical systems become more and more prominent in people's lives, redefining important aspects of organizational and social life (with technical systems as actors), they pose profound challenges to people's sense of identity as well as to inter-generational social and cultural cohesion.. Ethical issues become important political concerns and value conflicts arise on issues such as human performance and enhancement and the redefinition of the "sick – healthy – high performing / enhanced" space. Biology and biotechnology combining with IT / AI are at the forefront of the changes. The issue concerns all policies from justice and human rights, through health and communication, to mobility, environment, and R&I. Understanding the reshaping of identities, the emerging ethical issues and their regulatory and economic implications, requires important social sciences and humanities research. Issues of privacy, human rights, appropriate technology and ethics are important for the development of technical systems, and may redefine the space for health, safety and security regulations. Fast changing societal ethics combined with fast changing technology is a space ripe for social innovation. Europe is competitive in the science of both AI and biotechnology, but relatively weak in relevant market-positions. It has a highly developed regulatory environment, which is sometimes perceived as controversial for its restrictions to some commercial practices. Developing appropriate policies requires an important large-scale integrated approach that combines ethics and regulation with cutting edge technology and innovation as well as the strength to drive social innovation, not only in Europe, but worldwide. Such concentration could be served by an organizational entity, be it a centre or an institute, around which an important educational programme could be built not only for managers and engineers, but also for budding geniuses of younger generations.

4. By way of an epilogue: does the long-term view make a difference?

There are many different ways of conceptualising the long-term. Economists are trained to think of the long-term as an unspecified future in which all factors of production and costs are variable – a future that we juxtapose to the short term in static comparisons. There is no continuity between the short term and the long term. In foresight, we try to think of trends, but, similarly to economics, we use the long term future to create a different perspective on today.

In the 32 years since the Brundtland report, we have begun to think about the rights of future generations. Yet, asserting those rights, agreeing on how to balance them with the rights of

currently living generations, and thereby evolving a kinder and more morally elevated existence, remains assigned to the long-term.

The message of recent foresight exercises, especially the IPCC, is that what is often thought as the long-term is in fact much closer than we think, and that we need to act now. Whilst "acting", rarely implies doing research, research is much more productive in producing options for solving long-term problems, than in fighting current fires.

Thus, whilst in the workshop, because of the methodology followed, many important challenges that can benefit enormously from EU R&I were cast aside as medium-term challenges, there is little doubt that the foci identified as long-term are important as there was remarkable degree of convergence between the different conversations.

Amongst the long-term challenges, climate change figures ominous. In December 2018, according to the IPCC, we had 12 years to avoid catastrophic climate change. Now we have 11 years and 9 months. Humanity must act now, and Europe must lead it.

A 'Moon-Shot' for sustainability is needed to safeguard the integrity of our biosphere from the perils of climate change and the associated risks to our biosphere and our socio-economic systems. This should be the central concern of R&I policy for beyond 2030.

Such undertaking will need an environment of colleagues, researchers, policy-makers, citizens, competitors and suppliers that could collectively supply the innovation ecosystem that will propel Europe to leading the world towards sustainability.

In the context of such a Moon Shot, it is important to give due weight to Europe's security needs, the effort to ensure a peaceful future and the need to embed humanistic principles in technology development.

Will the EU take these issues on, and if so, how? It is now up to the Commission services to discuss whether these challenges – and the responses proposed - form part of their vision of Europe post 2030, and whether the R&I policy agendas proposed form part of their common view of EU R&I policy. This is where foresight comes in, highlighting plausible and challenging futures. And this is where foresight exits, leaving the discussion of political goals and means to take its course.

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This report summarises the outcomes of a workshop on R&I policies in February 2019. It was part of an effort of the foresight correspondents' network of the European Commission to develop a shared view of EU R&I policy based on a common vision of Europe after 2030. It sought to explore sustainability transitions that Europe has to undergo to achieve sustainability, identify important long-term challenges in that context, and reflect on possible implications for EU R&I policy.

The workshop was structured its discussion on the needs of the biosphere, on the needs of people, on innovation and on governance. It evidenced the need to join up our different policies and our visions of a stable, sustainable Europe, and bring innovation, supply and demand, with the public and policy-makers pulling together in the direction of sustainability.

The Commission services will discuss whether these challenges – and the responses proposed form part of their vision of Europe post 2030, and whether the R&I policy agendas proposed form part of their common view of EU R&I policy.

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