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The mission of the JRC-IPTS is to provide customer-driven support to the EU policy-making process by developing science-based responses to policy challenges that have both a socio-economic as well as a scientific/technological dimension.

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Table of Contents

I. Executive Summary

There is a clear and growing need for the capacity to anticipate change to be embedded in policy. This is critical not only to be able to respond and adapt to new situations before they occur, but also to shape the future, building upon mutual understanding and common visions to be jointly pursued.

For policy responses to address all the pressing current global challenges, especially when these are seen separately from one another, is clearly a demanding task. Institutions face greater complexity and difficulty in providing solutions in due time. In particular, this is true when the policy focus extends beyond the challenges that societies face today, seeking to anticipate future challenges and transform them into opportunities.

This is the rationale for the report "Facing the future: time for the EU to meet global challenges" based on a study carried out in the course of 2009 by the Joint Research Centre, Institute for Prospective Technological Studies (JRC-IPTS) for the Bureau of European Policy Advisors (BEPA) of the European Commission.

The aim is to provide a comprehensive picture of the main trends ahead and possible future disruptive global challenges, and to examine how the EU could position itself to take an active role in shaping a response to them. The work described in this report brings a fresh perspective, by linking widely accepted quantified trends towards 2025 and beyond with experts' and policy makers' opinions on the likely consequences of these trends and wild cards.

The methodology used combines an extensive analytical review of recent future oriented studies, followed by a wide online consultation of the identified issues, and use of multi-criteria quantitative analysis (Robust Portfolio Modelling) to prioritise the resulting issues. Key issues were then presented and discussed in a workshop with selected experts and policy makers. This report presents policy messages for the EU with a view to enabling a transformation of present and future challenges into opportunities and can serve as an input for shaping the vision for the EU in 2020, proposed by the Commission's President in his political guidelines for the next Commission.

Based on the criteria of urgency, tractability and impact, the expert workshop identified three challenges with a global scope, but which require action at EU level, to be selected. These are:

- The need to change current ways in which essential natural resources are used – due to the non-sustainable human over-exploitation of natural resources. The most well known effects are: climate change; loss of biodiversity; increasing demand for food; deepening poverty and exclusion due to continued exploitation of the natural resources; energy and water scarcity leading to competition and conflict; mass migration and threats in the form of radicalisation and terrorism.

- The need to anticipate and adapt to societal changes – including political, cultural, demographic and economic transformations in order for the EU to develop into a knowledge society. The main dimensions related to this challenge are: economic growth mainly depending on increases in productivity; ageing societies increasing pressures on pensions, social security and healthcare systems; flows of migrants from developing to developed countries; empowerment of citizens through enhanced education; barriers to the social acceptance of innovations due to lack of understanding of technological possibilities

and related consequences; and inability to keep up with the speed and complexity of socio-economic changes.

- The need for more effective and transparent governance for the EU and the world – with the creation of more transparent and accountable forms of governance able to anticipate and adapt to the future and thus address common challenges, and to spread democracy and transparency on the global level. Related to this challenge are: the fading of borders between nations with the problems of (especially neighbouring) developing countries increasingly affecting the EU; single policy governance approaches which can no longer cope with global issues; and the lack of balance in representing nations in global fora.

Based on the above challenges, the main policy issues to be considered at EU level are:

- Policy alignment towards sustainability – including the need to align all relevant policy domains to achieve: a reform in the agri-system; a reduction in the EU's dependency on resources; an increase in levels of education and social awareness; appropriate and effective management of migration flows resulting from climate change, the aspiration to a better quality of life, and labour market needs of especially ageing societies; and a change in the policy paradigm based on GDP to an updated system which also considers ecological flows and stocks.

- Social diversity and ICTs towards citizen empowerment – including the need to: build new incentives to facilitate and strengthen relationships between different social systems; develop the necessary means to enhance education on the use of ICTs in conjunction with other technologies; improve the quality of education by, among others, fostering competition within and between EU national education systems; regulate the healthcare system by tapping into new technologies to allow equal access for all; develop radically new and far more efficient forms of social protection; and enhance regional specialisation through the formation of regional RTDI (Research, Technological Development and Innovation) clusters.

- Anticipation of future challenges to turn these into new opportunities – including the need to: embed forward looking techniques in EU policy making; foster mutual understanding through ongoing and inclusive dialogue both within the EU and worldwide to build shared values, common visions, actions, and smart regulations; enable effective and adaptive international organisations to become a reality; establish partnerships between industry-government-society; clarify at global fora the role and status of the EU and balance its representation in international organisations; and foster (e)participation and (e)democracy through the use of web 2.0 and advanced technologies.

The foresight approach employed in this study contributes to policy making by supporting a continuous and shared approach to understand the present in all its complexity, to look at different future possibilities and to shape a joint direction to follow, considering different stakeholders' points of view. This can be coupled with a periodic evaluation of what has or has not been achieved to enable policy to correct deviations and to continually adapt to and re-shape upcoming new situations. It is believed that such an approach, linked to other forward-looking techniques and tapping into evidence-based research and quantitative elements, would be critical to enable EU policy making to become more adaptive and able to anticipate and address change.

II. Acknowledgements

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III. Main Report

1. Introduction

The aim of this report is to highlight the main conclusions of the study "Facing the future: time for the EU to meet global challenges" carried out by JRC-IPTS in 2009 for the Bureau of European Policy Advisors (BEPA) of the European Commission.

This study is in line with the EC's political agenda for 2010 and beyond. Its objective is to provide an overall picture of the main challenges and trends ahead, and to examine how the EU could position itself to take an active role in shaping a response. It complements an earlier meta-study of the European Commission named "The World in 2025: Rising Asia and Socio-Ecological Transition"[1].

Following an overview of the methodology applied, this report explains the criteria used to identify three key challenges to be tackled at EU level. The multiple dimensions of each challenge are then articulated and evidence is brought to the forefront. For each challenge, the main issues for EU policy making are set out.

The conclusions are then presented in the form of policy messages and opportunities for the EU with regards to the selected global challenges. In general, the report highlights the need for a change in attitudes and perspectives, and for building a foresight culture within EU policy making.

It should be noted that forward looking processes of interacting around individuals' opinions, whether or not based on quantitative evidence, should be adaptive. Hence, results cannot be expected overnight and the use of foresight should not be a one-off exercise. It requires an ongoing and inclusive approach that can continually adapt to socio-economic changes along the way. In doing so, policy making can reap the benefits of bringing together different stakeholders' points of view of how the world can and should evolve, and develop smart policies and regulations that must be continuously assessed and modified according to new situations and emerging challenges.

2. Methodology

The work was undertaken by JRC-IPTS, with the support of external experts. The approach developed and employed in this study comprised six main phases.

i) Selection of areas of analysis

Six areas of analysis were identified and refined together with BEPA, namely: demography, migration and health; economy, trade and financial flows; environment, energy, climate change and agriculture; research, innovation and (e)-education; (e)-governance and (e)-social cohesion; defence and security.

ii) Review and synthesis of forward looking reports

A broad ranging and comprehensive scan of forward-looking reports looking towards 2025 and beyond, and with potential relevance to EU policy making was conducted by JRC-IPTS. The aim was to select around 20-25 forward-looking reports in each of the above mentioned six areas. The selected reports were, in general, recently published, covered more than one of the subsectors of an area, had a global scope and were produced

1 Study carried out by EC DG RTD Directorate L – Science, Economy and Society – for BEPA. http://ec.europa.eu/research/social-sciences/pdf/the-world-in-2025-report_en.pdf.

using a participatory approach. In total, 129 such reports were reviewed by JRC-IPTS and external experts[2] to identify existing and emerging trends as well as rare events and related facts, timeframes, drivers, weak signals and, in particular, impacts on Europe and European policies. Based on the reviews, around 400 issues that may shape the future were identified, and complemented with some issues from the FTA 2008 conference survey[3]. In addition, syntheses of each of the six areas were prepared, which can be found at http://foresight.jrc.ec.europa.eu/bepa.html.

iii) Online stakeholder survey

The objective of the survey was to engage a wider community of experts in forward looking practice and specific policy fields to identify both the most relevant and the most disruptive issues as well as to generate additional issues. Around 270 experts assessed all issues identified in the above review phase. The criteria for assessment were: novelty, probability of occurrence by 2025 and relevance for EU policy making. The issues assessed through the survey and the additional issues provided by the survey participants can be found at http://foresight.jrc.ec.europa.eu/bepa.html.

iv) Multi-criteria analyses

In order to determine the most relevant issues, the survey results were analysed in terms of the above three criteria. This analysis was undertaken using Robust Portfolio Modelling (RPM)[4], with the support of the research team of Professor Ahti Salo at the Helsinki University of Technology. Three different analyses were conducted: (i) mean-oriented RPM analyses[5]; (ii) variance-oriented RPM analyses[6]; and (iii) rare-event oriented RPM analyses[7]. The analysis results provided a quantitative basis for the expert workshop discussion and for the identification of challenges cutting across different policy areas.

v) Expert workshop

A two-days workshop was organised to group these identified challenges into overarching clusters, hereafter referred to as global challenges, and to examine the policy implications for the EU related to these global challenges. In addition to BEPA and JRC-IPTS participants, 19 experts from around the world and 22 representatives from several Directorates General of the European Commission took part in the workshop. It is important to mention that experts were requested to prepare for the workshop by familiarising themselves with the results of the previous phases and by developing their individual proposals for discussion.

With the emergence of a wide variety of challenges related to the future of the world in 2025, three criteria were used to prioritise and select the most important ones to be tackled at EU level:

- Urgency: does the challenge provoke a likely impact that requires urgent actions at EU level?

- Tractability: can solutions to challenges be identified and implemented, and does the

2 Effie Amanatidou, Anette Braun, Ville Brummer and Mika Mannermaa supported JRC-IPTS in reviewing four out of the six areas.

3 During the International Seville Conference on Future-Oriented Technology Analysis (FTA) a survey was conducted on Big Picture Trends, Drivers and Discontinuities Looking Forward to 2025. The particularly novel issues from this survey were added to the issues collected from the literature review.

4 Könnölä T., Brummer V. and Salo A.: Diversity in Foresight: Insights from the Fostering of Innovation Ideas, Technological Forecasting and Social Change 74/5 (2007) 608-626. J. Liesiö, P. Mild and A. Salo: Preference Programming for Robust Portfolio Modeling and Project Selection, European Journal of Operational Research 181/3 (2007) 1488-1505. See also, http://www.rpm.tkk.fi/.

5 Mean-oriented analysis identifies issues that many respondents consider respectively (with decreasing weight) relevant (highest weight), novel and probable. As relevance has the highest weight, issues identified in this analysis seem to be more relevant for EU policy making.

6 Variance-oriented analysis identifies issues on which respondents' views differ with regards to respectively (with decreasing weight) novelty, relevance and probability. In this analysis, issues are identified which respondents could not agree upon and therefore seemed interesting to be debated.

7 Rare-event oriented analysis identifies issues that respondents consider to be improbable but novel and relevant. The issues that come up in this analysis are unlikely to happen but have disruptive consequences in case they do happen.

EU have the institutional capacity to act upon this challenge?

- Impact: are the actions to be taken by the EU expected to have a major global positive impact?

Based on these criteria, three challenges with a global scope were selected at the end of the expert workshop for further discussion.

vi) Synthesis and compilation of the final report

This final report draws together the results of the five previous phases to define and analyse the main challenges and their implications for Europe and European policies.

3. Main challenges for the EU

A number of global challenges relevant for the EU were identified. These challenges comprise several interesting issues where the EU can consider an active policy role to shape a positive global response. By doing so the EU would be in a position to ensure that its current citizens and the next generations can enjoy the benefits of a world with sustainable economic growth and improved quality of life for all.

To shape proper policy responses that address all the pressing current global challenges, especially where these can be disconnected from one another, is clearly a demanding task. Moreover, the focus should not only be on the challenges that societies face today, but also to enable the anticipation of possible future critical challenges so that they can be effectively addressed before they occur, thus transforming them into opportunities rather than another pressing problem.

With this in mind, both current and possible future disruptive challenges which are critical to the EU were brought to discussion at the expert workshop. The main objectives of this discussion were to re-organise the findings of the literature review and the analysis of the online survey into clear challenges, to prioritise the challenges that need to be currently tackled by the EU in order to secure a better future for all, and to translate them into possible implications for EU policies.

In this way, three challenges with a global scope were selected at the end of the expert workshop. Their multiple dimensions and an assessment of the type of EU actions needed are articulated below.

3.1 Challenge 1: Need to change the current ways in which essential natural resources are used

This challenge centres on the need to change the ways in which essential natural resources are used globally in order to secure assets for future generations and prevent (or avoid) the crossing of tipping points (the point at which environmental impacts would be irreversible).

This global challenge relates to the human over-exploitation of basic natural resources, which are essential for societies to function and evolve in a sustainable manner. Current conditions and patterns of behaviour need to be reflected, and policy actions supporting the shift towards sustainable ways of living could be fostered and strengthened. The long term sustainability is key to ensure not only economic growth but also a better quality of life for all, current and future generations. This depends on the intelligent use, conservation and renewal of natural resources and ecological systems.

The multiple dimensions of the challenge

All human activities both depend on and have an impact on natural resources. Food production, for example, is highly dependent on water and land, and its processing and distribution dependent on energy. All industrial activity starts by extracting natural resources and then assembles them in different ways to add economic value, while using energy and generating waste along the chain.

The chain ends with the disposal of final goods. Even the provision of services impacts on natural resources when taking a holistic view along the whole life-cycle.

Economic growth has largely relied on the overexploitation of essential natural resources and hence ultimately caused the disruption of natural cycles. Techno-institutional lock-in[8] (i.e. path-dependencies in the use of existing resources and capabilities and the respective inertia for change in physical infrastructures and institutions) may be an important factor which compounds and intensifies human impacts on nature since it creates barriers to the search for sustainable alternatives to existing processes and infrastructures as well as to behavioural change. The most well known effects are climate change and loss of biodiversity.

Climate change and its manifold effects

While some issues are still subject to debate, there is a widespread consensus among scientists and governments on the causes and main impacts of climate change. Today it is quite clear that climate change derives mainly from human activities leading to anthropogenic greenhouse gas emissions (mainly CO2) such as industrial development, motorised mobility, extraction of natural resources and carbon-intensive industrial production. The increase in overall temperature has already had widespread effects on: water and other natural resources, agriculture and food security, ecosystems and biodiversity, human health, and migration patterns.

It is widely accepted that while over the last century the average global temperature increased by 0.74°C, the best estimates for additional warming during the current century is projected to be from 1.8°C to 4.0°C, with the concentration of greenhouse gases (mainly CO2) rising above 500ppmv[9] by 2050[10,11]. At the same time, the effect of global warming will be felt more strongly from 2025, with an increase in the mean temperatures between 0.4°C and 1.1°C. The temperature rise could even be significantly quicker and higher[12].

The impact of climate change is projected to include a significant rise in the level of the world's oceans together with the melting of glaciers and changes in ocean currents. Low lying coastal areas could become completely submerged increasing human vulnerability in other areas. Floods and droughts could affect millions of people leading to significant movements of migrants, refugees and internally displaced people[13].

Rising temperatures have already started to alter the Earth's climate, with a range of consequences, including for: water resources; agriculture and food security; ecosystems; and human health. Climate change together with the unsustainable use of land and water are driving land degradation, including soil erosion, nutrient depletion, water scarcity, salinity, chemical contamination, and the disruption of biological cycles. Climate related desertification reduces availability of fresh water, fertile soil, forest and vegetation. The cumulative effect is to threaten biodiversity and food security as well as carbon fixation and storage.

The economic costs of climate change are a major uncertainty. Conservative estimates[14] predict a range of global GDP reduction of

8 Könnölä, T. & Unruh, G.C. (2007). Really Changing the Course: The Limitations of Environmental Management Systems for Innovation. The journal of Business Strategy and the Environment 16(8), 525 - 537. http://lib.tkk.fi/Diss/2006/isbn9512282097/article3.pdf.

9 PPMV = Parts Per Million by Volume.

10 Global Environment Outlook (GEO4) – Environment for Development, United Nations Environment Programme (UNEP), 2007.

11 Climate Change 2007: Synthesis Report – An Assessment of the Intergovernmental Panel on Climate Change, 2007.

12 Llewellyn, J. (2007) The business of climate change – challenges and opportunities. Lehman Brothers.

13 Vital Water Graphics – An Overview of the State of the World's Fresh and Marine Waters. United Nations Environment Programme, 2008.

14 Climate Change 2007: Synthesis Report – An Assessment of the Intergovernmental Panel on Climate Change, 2007.

between 0 and 3% by 2030, assuming that Earth's temperature will not rise by more than 2-3°C, with poorer countries affected disproportionately. At national levels, climate change will cut revenues and raise spending needs, causing deterioration of public finances. The cost of extreme weather alone could reach 0.5-1% of world GDP per annum by the middle of the century. At the same time, markets for low-carbon energy products are likely to be worth at least €500bn per year by 2050, and perhaps much more[15].

The invisible disaster of water scarcity

Although water is not yet considered a scarce resource globally, its distribution and availability are very uneven, both geographically and through time[16]. The per capita availability of fresh water is declining globally, the impacts of which will be felt more intensely between 2025 and 2050. This is partly due to climate change and partly due to excessive withdrawals and contamination of surface and ground water.

According to the World Economic Forum (WEF)[17], there is a dramatic increase in water scarcity in many parts of the world. From 1900 to 2000, global fresh water withdrawals grew nine fold with a fourfold population increase. According to the OECD[18], 2.8 billion people, or 44% of the world's population, live in areas of high water stress and this is expected to rise to 3.9 billion by 2030. Around 50 countries are currently facing moderate or severe water stress and the impact of year-round or seasonal water shortages is expected to increase. If present trends continue, the livelihoods of one-third of the world's population will be affected by water scarcity by 2025 and two thirds of people in the world will be subject to water stress by 2050 (WEF Initiative).

Water scarcity is closely linked to agriculture. Currently, 70% of global fresh water withdrawals are used for agriculture (up to 90% in developing economies) but inefficiencies in water use are high. Traditional irrigation in most water-scarce countries consumes only a fraction of the water it withdraws (about 50%); the rest is wasted or evaporates. The increasing lack of water will also affect agricultural land use and 55% of the world's population will be dependent on food imports by 2030 as a result of insufficient domestic water (WEF Initiative).

The IPCC assumes that 150 million "environmental refugees" could exist by 2020. The human, economic and political implications of a mass movement due to water scarcity could be extreme.

Water scarcity and the increase of contaminated water have profound implications for ecosystem health, food production and human well-being. Contaminated water remains the greatest cause of human sickness and death on a global level. Global grain harvests will be threatened as will the livelihoods of many people. This is on top of the billion or so people who do not have access to adequate water supply today (WEF Initiative). Although the economic effects are profound, the political impacts of water scarcity are both gradual and local, and government response is hitherto weak and fragmented. There is no critical event for national governments to react to.

WWF[19] describes water scarcity as an "invisible event". The first signs of water stress are experienced through the degradation of natural ecosystems that depend substantially on the availability of fresh water. The second sector

15 STERN REVIEW: The Economics of Climate Change, 2006.
16 Living Planet Report 2008, World Wide Fund for Nature (WWF), 2008.
17 World Economic Forum Initiative: Managing Our Future Water Needs for Agriculture, Industry, Human Health and the Environment – The Bubble is Close to Bursting: A Forecast of the Main Economic and Geopolitical Water Issues Likely to arise in the World during the Next Two Decades. World Economic Forum (WEF), 2009.
18 OECD Environmental Outlook to 2030, Organisation for Economic Co-operation and Development (OECD), 2008.
19 Living Planet Report 2008, World Wide Fund for Nature (WWF), 2008.

that will feel the effects of water stress is the agricultural sector. For many species the pace of climate change and the resulting reduction in water availability is too rapid: with 3°C of warming, 20-30% of land and water species could face extinction.

The reduction of species and other impacts on biodiversity

The reduction in land, freshwater and marine biodiversity is more rapid than at any time in human history. The great majority of well-studied species are declining in geographical distribution, abundance or both. Although the decline in the area of temperate forest has been reversed, with an annual increase of 30.000 km2 between 1990 and 2005, deforestation in the tropics continued at an annual rate of 130.000 km2 during the same period. Genetic diversity of agricultural and other species is widely considered to be in decline. Over the past 35 years alone the Earth's wildlife populations have declined by a third (Living Planet Index, WWF).

There is a global decline of marine and freshwater fish availability due to overexploitation of aquatic systems, as well as to climate change and contamination. Eutrophication of inland and coastal waters caused by excessive nutrient loads from sources such as agricultural fertilizer use leads to sporadic major fish kills and threatens human health and livelihoods.

Terrestrial and aquatic ecosystems are also being altered at an unprecedented rate. Humanity's demand on the biosphere (i.e. production and consumption of natural resources for food and drink, energy or materials and infrastructures, and the disposal of associated waste products) has more than doubled over the past 45 years as a result of population growth and increasing individual consumption, and currently exceeds the planet's regenerative capacity by about 30%. If our demands on the planet continue at the same rate, by the mid-2030s we will need the equivalent of two planets to maintain our lifestyles[20].

Humanity could be in the direction of crossing tipping points. For example, WWF's "business as usual" scenario shows that annual carbon emissions will more than double by 2050 under the assumption of rapid global economic growth and a shift to a balanced mix of energy sources. Moderate United Nations estimates show global population growing to 9 billion over the same period, while FAO projections show increasing consumption of food, fibre and forest products. Furthermore, if present management schemes persist, fisheries are projected to decline by more than 90% by 2050 (WWF Living Planet Report).

Therefore, changes in biophysical and social systems may continue even if the forces of change are removed, as evidenced in the stratospheric ozone depletion and the loss of species. WWF points for example to the possible global devastation of bee populations that could cause worldwide declines in crops requiring pollination.

The rising competition over energy resources

With the current pace of economic globalisation and no change in government policies, the world primary energy demand is expected to grow by 40% between 2007 and 2030, in which fossil fuels account for 77% of the overall increase in energy demand by 2030[21]. Coal overtook oil in 2003 as the leading contributor to global-related CO2 emissions, and will consolidate this position through to 2030 driven by power generation. Global energy-related carbon dioxide emissions are projected to increase more than 50% between 2004 and 2030. In spite of the growing demand for coal, oil will remain the most sought-after

20 Living Planet Report 2008, World Wide Fund for Nature (WWF), 2008.
21 World Energy Outlook 2009, International Energy Agency (2009).

fuel source, whilst natural gas consumption should continue to increase[22].

A possible global energy shortage due to an increasing demand and consumption will lead to a rise in global competition for energy resources as well as a greater dependency between nations, with the EU dependency on oil imports exceeding 90% in 2030[23] and dependency on overall energy imports rising to 66,6% by 2030[24]. Hence, energy and oil will play a key role in future power relations and defence policies.

Increased demand for food

The World Bank estimates that demand for food will rise by 50% by 2030 as a result of growing world population, rising affluence, and the shift to Western dietary preferences[25,26]. This will place more pressure on water for agriculture. Within the food sector, the most influential trend is that the global food prices are growing in real terms. The strongest effect of high food prices is that the poorest countries will not be able to afford decent food or the minimum to maintain its basic needs for survival.

In spite of the steady performance of Europe's agro-food system during the last decades, it appears that the European Union is now at the beginning of a major disruption period in terms of international competitiveness, climate change, energy supply, food security and societal problems of health and unemployment[27]. Disruption means fast change, resulting in both positive and negative impacts. Therefore the main challenge facing agro-food actors is the speed of adaptation and proactive responses to secure a European lead in this area.

Poor countries will be affected disproportionately

Climate change, water scarcity and lack of food at affordable prices will be important factors in the increase of illness and death rates in developing countries[28], through, for example: malnutrition; injury due to extreme weather events; diarrhoeal diseases; increased frequency of cardio-respiratory and other diseases. Falling farm incomes due to decreasing availability of water and land will increase poverty and reduce the ability of households to invest in a better future, forcing them to use up savings just to survive[29].

According to the UN[30] and UNEP[31] the poor suffer more from climate change, especially in dry lands which support some 2 billion people, 90% of whom living in developing countries. Less developed countries are also suffering more the effects of resources scarcity and the forecast is that this trend will lead to a deepening in poverty and exclusion (unequal access to natural and economic resources) linked to an unsustainable exploitation of the natural resources still available in these countries. This will ultimately lead to deterioration in the natural balance for the world as a whole.

Furthermore, natural hazards and catastrophes, such as droughts and floods, may appear more often. They are also likely to have wider impacts in developing nations and in weak and failed

22 OECD Environmental Outlook to 2030, OECD (2008).
23 95% according to European Energy and Transport: Trends to 2030 – Update 2007, European Commission, Directorate-General for Energy and Transport, 2008; In between 90-95% according to World Energy Outlook 2008, OECD, 2008; 91% according to World Energy Outlook 2009, International Energy Agency, OECD, 2009.
24 European Energy and Transport: Trends to 2030 – Update 2007, European Commission, Directorate-General for Energy and Transport, 2008.
25 World Development Report 2008, World Bank, 2007.
26 World Development Indicators 2007, World Bank, 2007.
27 Foresighting Food, Rural and Agri-Futures, European Commission, DG Research, 2007.
28 IPCC (2007): Climate Change 2007 – Synthesis Report. An Assessment of the Intergovernmental Panel on Climate Change; UNEP (2007): Global Environment Outlook – The fourth Global Environment Outlook: environment for development (GEO-4).
29 UNDP (2007): Human Development Report 2007/2008 – Fighting Climate Change: Human Solidarity in a Divided World. United Nations Development Programme.
30 Trends in Sustainable Development: Agriculture, Rural Development, Land, Desertification and Drought. United Nations (UN), 2008.
31 Global Environment Outlook (GEO4) – Environment for Development, United Nations Environment Programme (UNEP), 2007.

states, due to their lack of ability to manage crises and mitigate the consequences, such as famine, pandemics, and riots[32]. These, together with climate change, water scarcity and lack of food at affordable prices pose increasing pressures to the EU such as mass migration, and threats in the form of radicalisation and terrorism.

The way forward

These and other consequences linked to human pressures on natural resources are likely to increase dramatically in the near future. The current environment and financial crisis together with the imminent threat of new global pandemics (e.g. Influenza A H1NI, "swine flu") has to be seen as an alert for effective actions to transform the way in which natural resources are used globally and to balance global cooperation and competition. However, an effective global response to climate change and resource scarcity will depend on creating the conditions for international collective action.

In this regard, many governments have, for example, established and adopted the 2010 biodiversity target to reduce the rate of loss of biodiversity at global, regional and national scales (target set out by the Convention on Biological Diversity and endorsed by the 2002 World Summit on Sustainable Development[33]). However, current policies and economic systems do not incorporate the values of biodiversity effectively in either the political or the market systems, and many policies that are already in place are yet to be fully implemented or enforced.

How then should we deal with the need to feed the world population taking into consideration changes in diet, environmental degradation, disruption of energy supplies, new global pandemics, and approaching tipping points? Moreover, how can economic value be assigned to biodiversity such as pollination or water?

As mentioned above, there is a need for global agreements on trade, values and sustainability to enable a transformation in the way in which natural resources are used globally so that we can secure assets for future generations. This entails both international partnerships (i.e. between nations and international institutions globally) as well as partnerships between governments, industry and overall societies. In fact, international organisations need to be strengthened to better achieve global agreements (cf. challenge 3).

The EU is in a position to drive change by example and by fostering the understanding of different points of view worldwide with the aim of both building common visions based on globally accepted values, such as human rights, as well as of enabling the definition of common regulations and juridical approaches. However, this cannot be enforced and is based on dialogue. Critical in this respect is the political will to change and to become more accountable to citizens (cf. challenge 2). Moreover, there is also the need to build an institutional adaptive capacity (cf. challenge 3) and related dynamic structures to deal with change and disruptive elements such as pandemics and floods.

The main driver for measuring economic growth and wealth, which is reflected in policy decisions, should thus change from GDP to measures that account also for biodiversity or ecological flows and stocks, and thus internalise current externalities[34]. In the same way in which

32 The State of Food Insecurity in the World – High Food Prices and Food Security: Threats and Opportunities, Food and Agriculture Organization of the United Nations (FAO), 2008; Foresighting Food, Rural and Agri-Futures, European Commission, DG Research, 2007.

33 http://www.worldsummit2002.org/index.htm.

34 Other than GDP and GNP, there are currently alternative measures of domestic income, such as national income, personal income and disposable personal income. Another example is the green gross domestic product (green GDP) which is an index of economic growth with the environmental consequences of that growth factored in (Green GDP Accounting Study Report 2004 was issued jointly to the public by the State Environmental Protection Administration of China

research is needed to enable a change in policy driver from GDP to ecological flows and stocks, industry could learn more from nature and establish processes which emulate ecological cycles. Hence, analogous technical cycles[35] can be established to give human-made materials and precious organic molecules life through reuse/recycling, which could also be driven by renewable energy, to establish closed-loop manufacturing processes[36]. It is important to underline that businesses play a crucial role in tackling climate change and resource scarcity, as well as in fostering responsible consumption to take place. Therefore, global partnerships between industry-government-society are critical, and governments and international organisations can enable the framework conditions and juridical power (cf. challenge 3) to ensure that the above partnerships are developed and that industry plays its role within global societies.

3.2 Challenge 2: Need to anticipate and adapt to societal changes

This challenge focuses on the need to adapt to and cope with political, cultural, demographic and economic transformations to enable the EU to fully become a knowledge society.

Business, demography, migration and overall societies are generally changing at a much higher speed than public institutions and related decision making processes. Legal frameworks, social security systems, education and the models of healthcare have difficulties to keep up with the pace of these transformations. This hampers innovation and economic growth, and puts high pressure on natural resources and on the ability of institutions to cope with societal transformations. Beyond the consequences already mentioned in challenge 1 above, within the EU there are, for instance, now increasing concerns on how to provide equal access to healthcare and how to become a so called knowledge society.

The multiple dimensions of the challenge

The age structure of the EU population is projected to change dramatically in the coming decades due to the dynamics of fertility, life expectancy and migration. Ageing societies will have economic consequences: the cost of trying to maintain pensions and health coverage will squeeze out expenditures on other priorities, such as defence and the development of the knowledge society. Moreover, the likely change in the balance of world economic and political power may also constrain the efforts towards the knowledge society.

Decline in European working-age population affecting economic growth

The European young population (aged 0-14) is projected to decline gradually from 2020 onwards. According to EUROPOP2008 population projections[37], the working-age population (aged 15-64) will start to decline as from 2010 and will drop by 15% over the whole projection period (2008-2060). The elderly population (aged 65 and above) will increase

(SEPA) and the National Bureau of Statistics of China (NBS) on Sept. 08, 2006). Also, social indicators covering a broad range of components of well-being highlight significant cross-country correlations with GDP per capita in several cases, but insignificant correlations between changes in GDP per capita and in various social outcomes (Alternative measures of well-being, OECD social, employment and migration working papers no 33, 2006). A good overview on the Measurement of Economic Performance and Social Progress is given by the report of the correspondent Commission chaired by Professor Joseph E. Stiglitz (2009).

35 Jacobs (2001) defends that business economic sustainability goes through the mimicry of common biotic phenomena. This is an approach called 'bio-mimicry' where scientists try to develop productive processes through the observation of nature. In this way, companies should learn with the processes of nature to adapt and translate them into business processes (Cagnin, 2005 – cf. footnote 36).

36 An Information Architecture to Enable Business Sustainability. University of Manchester PhD Thesis, Cagnin, 2005; Eco-innovation: When Sustainability and Competitiveness Shake Hands, Hampshire, Palgrave-McMillan, Carrillo-Hermosilla, J., del Río, P. & Könnölä, T. 2009.

37 EUROPOP2008 (EUROpean POpulation Projections, base year 2008) convergence scenario which contains statistical information on EU population projections (Eurostat). Data comprise the EU27 Member States, Norway and Switzerland.

very markedly throughout the projection period, rising from 85 million in 2008 to 151 million in 2060 in the EU[38].

These demographic trends are expected to have a major impact on the supply of labour in the EU. While there is still high potential for increasing employment through increased labour force participation, notably of women, immigrants and older workers, it can be expected that within around one decade, rising employment rates will no longer be sufficient to compensate for the decline in the working-age population in the EU. As a consequence of these trends economic growth will mainly depend on increases in productivity. This happens in a situation where there is a worldwide explosion of information and a consequent fragmentation of knowledge, both of which are expected to increase significantly following the rhythm of globalisation[39].

Ageing increasing pressures over EU social security, pension and healthcare systems

The number of very old people (aged 80 years and above) is projected to almost triple from 22 million in 2008 to 61 million in 2060, which will have a wide-ranging impact on economic growth, affecting savings, investment, consumption, labour markets, pensions, taxation, the need for healthcare services and intergenerational relationships[40]. In a situation of deteriorating public finance, the cost of pensions and healthcare will be put under high pressure. At the same time, increasing awareness of opportunities in healthcare raises the expectations of citizens, who want the best available care at affordable prices. The most consensual trends ahead are that equal access to healthcare will get stronger support among EU citizens by 2025, and that healthcare costs related to the prolongation of human life will begin to enter the public debate in the EU.

In this respect, the effect of technological innovations can be double-edged. Some new technologies may create new treatments that are more complex and expensive, and that are only affordable by a small part of society. However, technologies can also make existing treatment cheaper and more efficient, such as by applying bioinformatics, robotics, computer assisted surgery, self-care and e-health services and by focusing more on preventive strategies. Self-care and e-health services risk, however, to exclude that part of society that lacks the necessary skills or means to use ICT, as may be the case for aged, low-skilled, disabled or poor citizens, reinforcing and extending inequalities in access to healthcare.

Population ageing influences family composition and living arrangements, housing demand, epidemiology, the need for extended healthcare services, and, partly, migration trends. It places increasing pressure on infrastructures, the environment and social cohesion efforts. In 2005, 27.7% of all households were single person households[41]. A large part of these single person households belong to people over the age of 80. Due to population ageing, the number of single and two-person households can be expected to increase considerably. Also about one third of people living in single-parent families are at risk of poverty, compared to 16% of the entire population[42]. Furthermore, as current national social security systems tend to focus mainly on cash benefits, the trend towards single households puts an additional pressure on public finance.

38 European Communities (2008): The 2009 Ageing Report. European Economy 7/2008.
39 João Caraça (2008): 2025, A World too different from today? High Level Expert Group: The World in 2025. Brussels: EU.
40 European Communities (2008): The 2009 Ageing Report. European Economy 7/2008.
41 Demography Report 2008: Meeting Social Needs in an Ageing Society – Commission staff working document SEC(2008) 2911.
42 Demography Report 2008: Meeting Social Needs in an Ageing Society – Commission staff working document SEC(2008) 2911.

More in general social security models in the EU face the challenge of creating a work friendly environment while simultaneously offering high quality social protection to combat social exclusion. The organisation of this social protection varies considerably among the EU Member States. This includes among others big differences in the way labour market integration is addressed in the models, but also in social insurance replacement rates, that range from 100% of lost earnings to below 20%. In addition the financing of these models depends on the sharing of funding responsibilities and on the number of future tax payers, which makes inclusion of as many people as possible, including retired citizens, on European labour markets a very important issue[43].

While the EU is ageing rapidly, the number of young people willing to migrate to the EU continues to increase, particularly in the EU's wider neighbourhood. A major proportion of the world's poor population lives on the EU's doorstep and proximity plays a role in migration decisions. Net migration flows to the EU are projected to be concentrated in a few destination countries[44]: Italy (12 million cumulated between 2008 and 2060), Spain (11.6 million), Germany (8.2 million) and the UK (7.8 million). Besides this trend of continuing flows of migrants from developing to developed countries, forced migration[45] due to environmental hazards such as floods, earthquakes and pandemics, and due to failed governance and armed conflicts in neighbouring states of the old Soviet Union states or the Middle East may increase rapidly. Migration is increasing the social mix inside the EU, which can give rise to mounting tensions between different nationalities.

43 European Social Models, Protection and Inclusion, Institute for Futures Studies, Palme J., Nelson K., Sjöberg O., Minas R., 2009.

44 European Communities (2008): The 2009 Ageing Report. European Economy 7/2008.

45 Global Environment Outlook (GEO4) – Environment for Development, United Nations Environment Programme (UNEP), 2007.

Knowledge society and lifelong learning

The shift to a knowledge society in combination with increasing heterogeneity in the EU risks creating a dual society, excluding a large group of non-ICT competent people. This shows an increasing need to invest in human and physical capital. On the demand side, the growing international nature of trade and business creates the need for new skills and competences, often combined with conventional industrially relevant knowledge. This leads both to the destruction of old jobs and the creation of new ones, and requires capabilities to unlearn outdated competencies and to learn new ones. On the supply side, evidence shows[46] that education systems are currently adapting only slowly to the learning society. As a result more and more learning takes place in different contexts and locations, with a growing emphasis on informal learning, training services that link offers to business results, and so forth. Along with the internationalisation of business, learning markets are becoming more global, leading to the need for learning systems both to become globally competitive and to be able to cope with people from many different nationalities and cultural backgrounds.

Cyber infrastructure developments will lead to new learning models necessary for lifelong learning in the distributed and networked learning environment. Lifelong learning, through both formal and informal mechanisms, will be an essential part of the workforce of a cyber-infrastructure-enabled society[47]. Complex systems will be developed with linked social, economic, and political growth tied to access to "learning by doing". Multi-faceted learning networks will be possible due to communication and transportation capacity provided by technology. Hence, lifelong learning will become the norm and both public and private sectors acknowledge the importance

46 School's Over – Learning Spaces in Europe in 2020: An Imagining Exercise on the Future of Learning. EUR 23532 EN, JRC-IPTS, 2008.

47 National Science Foundation (2007): Cyberinfrastructure Vision for 21st Century Discovery. Arlington, NSF 2007-28.

of education for economic development[48]. While people are expected to diversify the individual knowledge obtained throughout their lives to remain competitive[49], regions seem to need to bring together all necessary interdisciplinary capabilities to specialise towards a knowledge-oriented sector.

In fact, one effect of the knowledge society is the global competition and the tendency of regions to specialise in one or more specific areas of activity in order to increase their global competitiveness. The process of specialisation towards knowledge-oriented sectors is already taking place in many regions. Silicon Valley in the US is an archetypical example of a region that breeds strong clusters in many high-tech domains. Due to clusters, many European regions have developed competitive advantages in specialised activities such as financial services (London), petrochemicals (Antwerp), flowers (Holland), and biopharma (the Danish-Swedish border region). Successful clusters have also significantly increased their global reach – attracting people, technology and investments, serving global markets, and connecting with other regional clusters that provide complementary activities in global value chains[50]. Individual regions may get more specialised in specific clusters becoming more different but also more connected. Regions that will not specialise may be in danger of falling behind.

Research becoming more and more multidisciplinary

New converging technologies that emerge from multidisciplinary collaboration are expected to drastically change all dimensions of life: social, economic, political, and personal[51]. Most applications that are likely to be widely diffused in 2025 will combine different technologies such as biotechnology, nanotechnology, materials technology and information technology. Nanotechnologies, for example, will highly affect sectors such as medicine, energy, manufacturing, instrumentation, food, water, the environment and security. The effect of biotechnology has hitherto been highly concentrated in the pharmaceutical and agrochemical sectors, leaving great possibilities for industrial biotechnology unexploited[52]. The convergence of these new (miniaturisation) technologies is leading to promising applications.

Moreover, the whole field of life sciences could become a very important research area for the EU in the coming decades, as there are no strong global differences on the specific technology level and competitive positions are still largely undefined in this field. In addition, social-environmental factors play an important role in this field, and Europe is very open to these factors.

Multidisciplinarity requires a new mode of research, taking advantage of the advances in information technology. Advanced computing and simulation tools, distributed wired and wireless observation centres and interdisciplinary teams permit research on phenomena that cannot be observed by controlled experiment. Apart from the need to build a cyber infrastructure with global standards, a system of open-source innovation and a mix of skills will be needed to establish virtual research organisations. In the future, Europe could lead these new ways of collaborative research. In an alternative scenario, the traditional paradigm of research and innovation could still predominate in the EU by 2025, with the new research methods being first implemented by another region of the world, e.g. an Asian country.

48 OECD (2006): Think Scenarios – Rethink Education. Paris, OECD.
49 UNESCO (2005): Towards Knowledge Societies. Paris, UNESCO Publishing.
50 European Communities (2007): Innovation Clusters in Europe. DG Enterprise and Industry report.
51 National Intelligence Council (2001): The Global Technology Revolution – Bio / Nano / Materials Trends and Their Synergies with Information Technology by 2015.
52 Creative system disruption: towards a research strategy beyond Lisbon. Key Technologies expert group. European Commission - DG RTD Directorate K – Social sciences and humanities; Foresight, 2005.

Human life will be greatly extended, giving growing importance to lifelong health and health innovation around the globe. Together with learning and wellbeing, healthcare may be one of the most important markets of the world in the 21st century, ruled by the principles of personalised, predictable and preventive medicine and self-care. Healthcare technologies will gain in importance worldwide, however with different applications for each country. Some applications of this kind, that are likely to be diffused on a global scale in 2020, are targeted drug therapies and increasingly accurate diagnostic and surgical methods using biological materials and processes.

Space technology programmes in Europe are also receiving more and more political attention in recognition of the growing strategic value of space technologies. There are a number of potential applications in the field of communications, earth observation, navigation, space tourism (which may become a huge market), solar energy, microgravity and lunar extraction. Satellite-based location and navigation services are also growing rapidly. It is estimated that 2.5 billion people will use navigation systems (for example GPS) in 2020[53]. Additionally, public interest in space is growing among western citizens, after many years of scepticism. With consolidation of the market, many companies might leave the industry, allowing the strongest players to strengthen their position in the markets.

Business moving from intensive use of natural resources into serving knowledge society

The knowledge-based economy supports the transition from the intensive use of natural resources to building competitiveness by providing solutions to individual needs through the generation, circulation and exploitation of knowledge.

In the realm of manufacturing, the use of biological inputs, energy sources and processes is likely to be distributed on a global scale by 2025, since biotechnology is expected to be more widely diffused into other areas than the pharmaceutical and agrochemical sectors[54]. At the same time production is likely to be global and based on a networked division of labour. The move towards a knowledge society includes breakthroughs in submicron manufacturing and enterprise simulation and modelling. Suppliers will increasingly become flexible providers of systems integration and solutions rather than merely manufacturers of products. Structural change towards services in Europe is likely to continue over the next decades, albeit at a slower speed. Three quarters of jobs in the EU are likely to be in services[55] by 2020. Growth is expected in selected areas of high-tech manufacturing, particularly pharmaceuticals, and the network industries. Optimization and diagnosis programmes will improve and evaluate productivity, reducing the costs incurred over the total lifecycle of products. Manufacturers will aim to deliver solutions directly to the end-user cutting out all intermediaries in the process.

Asia might become the world's most important provider of manufacturing goods, and by 2025 the centre of global manufacturing production could shift to Asia[56]. If this happens, it is possible that the global economic power also shifts to the East and China by 2020 with firms globally seeking both stability and yield.

However, manufacturing could remain the most important driver for Europe's exports by 2025. European manufacturing industry could continue to play a major global role in a context where the crucial assets will be knowledge and

53 Space 2030 – Exploring the Future of Space Applications, OECD (2004).

54 Creative system disruption: towards a research strategy beyond Lisbon. Key Technologies expert group. European Commission - DG RTD Directorate K – Social sciences and humanities; Foresight, 2005.

55 COM(2008) 868 final - New Skills for New Jobs: Anticipating and matching labour market and skills needs.

56 TNO (2007): The Future of Manufacturing in Europe.

skills. By 2025 Europe's share in the overall global manufacturing production and trade could be about 20% (much higher than its share in population), and manufacturing could contribute more than 15% to value added in Europe[57]. The boundaries between services and manufacturing activities would have been blurred because of ongoing transformations of business activities along the value-chain.

Although employment in many new EU Member States still relies to a great extent on agriculture and manufacturing, there are clear signs that this is changing rapidly. By 2020 the general shift in Europe away from the primary sector (especially agriculture) and traditional manufacturing industries towards services and the knowledge-intensive economy is likely to continue. Strong positive trends are expected[58] in business services (such as IT, insurance or consultancy), health care and social work, distribution, personal services, hotels and catering, and to a lesser extent education. This shift is expected to shape new job profiles such as Old Age Wellness Manager, Vertical Farmer, Nano-Medic, Climate Change Reversal Specialist or New Scientists Ethicist[59].

Emerging markets will dramatically change the global geopolitical and economic map

In relation to globalisation it is expected by 2025 that the world will comprise many more large economic powers. China, India, Japan, Korea, Malaysia, Indonesia will take on greater significance in the global economy. China is commonly supposed to become the major world exporter in 2025 and South Asia alone could be producing 38% of global wealth by that time, compared with 24% now. Such a jump forward would put the new Asian economic pole on a par with OECD countries which should produce about 40% of world output by then[60]. Asian competition will also extend to the far reaches of the value added realm.

The development of eastern and southern Asia is a trend worth investigating further as it can lead to major changes on the global geopolitical and economic map. The Asian giants as well as other developing states continue to outpace most "Western" economies, and their huge consumer-driven domestic markets become a major focus for global business and technology. If this continues there may be a modification in the balance of power in the area of research and innovation, with knowledge-intensive activities increasingly moving towards these regions.

The way forward

Policy-makers could provide the right framework for the qualification of knowledgeable workers, innovation, creativity and flexibility that will be needed to be able to reap the benefits of such a profoundly reshaped knowledge-intensive environment. Most importantly, the EU should become and remain an attractive and competitive place to work and live in to attract and retain skilled workers and to minimise brain-drain.

Therefore, a harmonised approach to manage and welcome highly-skilled migrants to the EU is beneficial both for economic and social development. Migration of young and skilled people to the EU can also ease the pressure on the sustainability of public finances. This should however take into account the effect on the development gap. Immigration can have a positive impact on the economy in both the country of origin and the EU. Returning migrants can make a positive contribution to the economies in their home countries, as they will bring back improved

57 cf. EFMN Foresight Brief No. 137.
58 COM(2008) 868 final - New Skills for New Jobs: Anticipating and matching labour market and skills needs.
59 Talwar R. and Hancock T., The shape of jobs to come: Possible New Careers Emerging from Advances in Science and Technology (2010 - 2030), Fast Future Research.
60 European Ideas Network (2007): The World in 2025 - How the European Union will need to respond; cf. National Intelligence Council (2008): Global Trends 2025 – A Transformed World.

skills and, often, savings. At the same time, efforts should be undertaken to increase the professional qualifications of legally resident migrants and their opportunities for social inclusion[61].

Innovation in learning systems, focusing on learner-centred education, is a key success factor for economic growth, social inclusion and participation of citizens of every age and with different backgrounds and cultures in the knowledge society. European policy-making should focus on increasing the competition within and between national education systems on a global scale, and re-explore its content, learning models and roles in lifelong learning.

Many legal frameworks are missing, others are outdated. An example is the set of digital networks being used as a basic element of the knowledge society. The full use of these networks (e.g. for e-healthcare) requires common policies, technical rules and standards. This entails inter alia the creation of a safe cyber citizenship, the development of network rules and a governance system in order to protect private data and to maintain and extend the neutrality of the global network. Knowledge is increasingly fragmented, privatised and commercialised, and has been made to some degree exclusive by the adoption of intellectual property rights. These rules have been built for the industrial society, but need to be updated in order to adapt to current needs of open source sharing of information, and to anticipate to potential future needs[62].

In the knowledge society, passive consumers can become active producers in the creation of new goods, services and relationships, through self-generated personalisation, marginalising the division between supply and demand. EU policies could create a real innovation environment, using the social and cultural diversity of EU citizens as a competitive advantage. To this end, government strategies need to facilitate and strengthen relationships between different social systems such as politics, university, industry and representatives of civil society.

3.3 Challenge 3: Need for more effective and transparent governance for the EU and the world

This challenge comprises the need for the EU to create more transparent and accountable governance structures and processes that can adapt to and anticipate the future, and to use this capacity to do likewise at global level in order to address global and common challenges and to spread democracy and transparency all over the world.

In addressing challenges 1 and 2 above, the required changes in governance constitute a critical success factor. Because of the importance and complexity of developing improved governance, this is a challenge in itself. A key question is what constitutes good governance, and inspiration for the current context can be drawn from the definition formulated by UNDP[63] in 1997:

"Good governance is, among other things, participatory, transparent and accountable. It is also effective and equitable[64]. And it promotes the rule of law. Good governance ensures that political, social and economic priorities are based on broad consensus in society and that the voices of the poorest and the most vulnerable are heard in decision-making over the allocation of development resources."

61 Through the EU Social Protection and Social Inclusion Process, the European Union coordinates and encourages Member State actions to combat poverty and social exclusion, and to reform their social protection systems on the basis of policy exchanges and mutual learning. As such, it underpins the achievement of the Union's strategic goal of sustained economic growth, more and better jobs, and greater social cohesion by 2010.

62 Higher Education Looking Forward: An Agenda for Future Research. European Science Foundation, 2008.

63 United Nations Development Programme, Governance for sustainable human development - A UNDP policy document, January 1997 (http://mirror.undp.org/magnet/policy/chapter1.htm).

64 Equity: All men and women have opportunities to improve or maintain their well-being, including not only income, but also access to education by everyone, etc.

Existing governance systems and processes at both European and global levels appear to be no longer sufficient to tackle current interconnected challenges, and may need to move closer towards the UNDP definition. The reasons for this are explained below.

The multiple dimensions of the challenge

Current governance systems are incapable of tackling current and future global interconnected challenges

Political authority is held by national governments, which find it increasingly difficult to deal with transnational problems, as the current systems and procedures available to solve them are usually national. The speed and scale at which decision making is needed goes far beyond the capacity of existing national systems[65]. At the same time fragmentation and decomposition of national states can be expected to continue and accelerate[66]. With regards to international agreements, the European Union has been at the forefront in combating climate change and has played a key role in the development of the two major treaties addressing this issue (the United Nations Framework Convention on Climate Change and its Kyoto Protocol[67]). However, such agreements are often organised around single issues, and do not acknowledge the interdependencies of global issues. Global negotiations on climate change cannot be separated from innovation, poverty and exclusion, the economic downturn and international trade. Copenhagen attempted to revise the Kyoto Protocol, and to set up a new legal arrangement addressing four themes (mitigation, adaptation, technology transfer and financing), thus widening the scope of the former agreements. Although some elements of these themes are included in the Copenhagen Accord, it is not a legally binding global climate treaty that can succeed the Kyoto Protocol. In general, current systems of transnational and global governance are still based on diplomatic bilateral and multilateral approaches. Without a constitutional basis or a mechanism to ensure coherence, small advances by each partner in the agreement could result in a big loss for sustainable, effective global governance[68].

The challenges of developing countries increasingly become EU challenges

Progress in achieving the Millennium Development Goals to halve extreme poverty between 1990 and 2015 faces multiple threats[69]. Rapidly rising food prices have increased the proportion of people going hungry in developing countries to 17% in 2008, making the target of 10% in 2015 far from realistic. In 2009 it is estimated that the number of people living in extreme poverty (less than €0.90 a day[70]) will have increased by between 55 and 90 million, compared to before the economic crisis.

Rapidly growing populations create additional barriers to achieving the development goals in many low-income nations. Urban areas of developing countries will account for nearly all the population growth predicted over the next 50 years[71]. The majority of people will live in large conurbations, with profound consequences for policy-makers in addressing poverty, crime and community relations and a limited state ability to reform healthcare, infrastructure and economics. Many developing countries also face brain drain, low science-innovation links and an ever-widening technological gap with OECD countries due to chronic underinvestment in R&D over the last two decades. This further undermines their capacity to become self sustainable, and increases

65 Florini A, The Coming Democracy, 2005.
66 Theys, Le monde en 2025: les 4 transitions, 2008.
67 http://unfccc.int/kyoto_protocol/items/2830.php.
68 Enrique Rueda-Sabater, Vijaya Ramachandran, and Robin Kraft. 2009. "A Fresh Look at Global Governance: Exploring Objective Criteria for Representation." CGD Working Paper 160. Washington, D.C.: Center for Global Development (http://www.cgdev.org/content/publications/detail/1421065/).
69 The Millennium Development Goals Report 2009, United Nations.
70 The report states $1.25 a day (calculation with average exchange rate 2009; ECB).
71 World Development Report 2009, World Bank, 2008.

the risks of creating more new failed states and of armed conflicts and terrorism in the future.

Furthermore, the misuse of natural resources is likely to have a disproportionate effect on many developing countries. If large scale migrations resulting from climate change and water scarcity indeed take place, the need for humanitarian assistance will rise to an unprecedented level, and international law would need to recognise this type of refugees. The new EU Agency on asylum, which should come on stream in 2010, could also deal with this kind of issues, including protracted refugee conditions resulting from natural disasters[72]. However, natural disasters and failed states usually create internally displaced people[73] who do not cross any international border. If current trends continue, these countries will continue to lack the means to address the consequences, let alone their causes. The limited ability of developing countries to fight climate change and to develop a more sustainable future also limits the capacity of the world as a whole to do so.

Increasing natural catastrophes and a rising number of failed states are also potential sources of pandemics. The World Bank estimated that combating avian flu in poor countries would cost more than €0.95 billion[74]. The effects of pandemics like AIDS, tuberculosis, malaria and cholera on the African continent will also have a considerable impact on economic growth in that continent and in the world as a whole.

As regards trade, the current international trading system is unbalanced against the interest of developing countries[75]. This can result in loss of income opportunities for both developed and developing countries, if the system is allowed to deteriorate and eventually proves incapable of preventing countries from turning back to protectionism.

It appears that the challenges developing countries are facing will increasingly affect the whole world, including the developed regions. This means borders between European internal and external governance start to fade, as many problems with consequences on the EU will have to be addressed globally. These common challenges cannot be addressed without a global co-operation that goes beyond offering development aid.

Governance increasingly shifts towards empowerment, e-participation and e-governance

Mainly thanks to ICT related innovations there is an increasing shift towards empowerment in governance. The use of internet is now moving towards the use of Web 2.0, with applications such as social networking, blogs, wikis, tagging, etc and this supports a move towards e-governance systems. The private sector has already discovered the wide set of benefits this technology brings to business. A recent McKinsey Quarterly survey shows that 69% of businesses worldwide report measurable benefits of internal and external use of Web 2.0, and that companies will continue to invest in this technology despite the current recession[76]. Governments and public service agencies have also started to use these tools. However, the benefits for governments are different, ranging from services that are more personalised, faster, easier to use, to those enabling more effective social networking, citizen engagement and collaboration with the community. Overall, these technologies increasingly allow people to get

72 COM(2009) 66 final: Proposal for a Regulation of the European Parliament and of the Council: establishing a European Asylum Support Office.

73 Some 26 million internally displaced persons around the world at the end of 2008, 2008 Global Trends: Refugees, Asylum-seekers, Returnees, Internally Displaced and Stateless Persons– UNHCR, June 2009.

74 Avian and Human Influenza: Financing Needs and Gaps. World Bank, 2005. The report states $1.2 billion (calculation with average exchange rate 2005; ECB).

75 Meeting Global Challenges, International Cooperation in the National Interest, Report of the International Task Force on Global Public Goods, 2006.

76 McKinsey Global Survey Results: How Companies are benefiting from Web 2.0, McKinsey & Company, June 2009.

what they need from each other, thus changing the rules of the game for governments[77].

The possibilities of the next generation of web technology, Web 3.0, will allow for wide-scale ubiquitous seamless networks, networked and distributed computing, open semantic web, artificial intelligence, etc. This is expected to create intelligent mass-collaboration networks and platforms bringing together all kinds of actors. This will facilitate bottom-up, user driven and massive social collaboration, which in turn is likely to influence and steer policy formation and e-governance decisions[78].

These developments are expected to impact on transparency, accountability, new forms of law enforcement, privacy, the rise of new countervailing powers and the development of a networked and intelligent government[79]. Increased transparency will increasingly offer possibilities to citizens to exert effective control over their governments, and may also transform government culture, towards opening up their traditionally quite closed and hierarchical organisational cultures. ICTs may force governments to continuously account for their policy and decision making, while also providing them with effective tools to fight corruption. As a result, both private organisations and citizens could be increasingly involved in law enforcement tasks through e-participation.

These transformations will also include challenges related to accessibility for all, protection of privacy, the creation of a safe cyber citizenship, etc. It can allow the development of strategies and techniques for better organisation within networks without government intervention. This can lead to a form of 'non-representational democracy', where the democratic processes are decoupled from governmentality and from the constraints of market and state interests[80]. Governments will use more co-regulation, where citizens and corporates are increasingly involved in the development of new regulations, thus broadening the knowledge/experience base for increasingly complex decision making, improving the transparency and predictability of government activity and significantly reducing their information costs[81]. These changes are expected to not only lead to governmental transformation within the EU and its Member States, but also to impact on how governance will be shaped in other regions of the world, and at global level. Some see a major possibility for the Chinese people to successfully "leapfrog" into a new political future by incorporating current technologies, allowing them to better approximate true democracy[82]. Future forms of global governance may thus depend more on citizens' participation, in order to better guarantee that decisions taken are rightly understood, accepted and implemented taking into account transparency and accountability.

Finance and trade become more global and less European

Emerging markets, such as Asia, Latin America, Russia, Eastern Europe and Africa have been rapidly developing their financial assets in recent years (about €19 trillion in 2006)[83]. New power brokers, especially petrodollar investors and Asian central banks play an increasingly important role in the world's financial markets and their activities represent a structural shift in global capital markets. Also hedge funds and private equity have become new power brokers, but

77 Web 2.0 and the Next Generation of Public Service, Accenture, 2009.
78 eChallenges e-2008 Workshop on ICT for Governance and Policy Modelling, Stockholm, 23 October 2008.
79 Frissen V. et al., The Future of eGovernment - An exploration of ICT-driven models of eGovernment for the EU in 2020, JRC-IPTS, 2007.
80 Internet governance: towards a non-representational democracy, Knahl and Cox, 2008.
81 Germany 2020, new challenges for a land on expedition, Deutsche Bank, 2007.
82 India, China and Future of Democracy, Murata T. in Democracy and Futures, Mannermaa M., Dator J. & Tiihonen P. eds., 2006; Amanatidou E., EFMN Brief 133 - The Role of the EU in the World, Amanatidou E., 2008.
83 McKinsey Global Institute: Mapping Global Capital Markets, McKinsey & Company, 2008; (calculation with average exchange rate 2006; ECB).

their future role is less clear. New power brokers' total assets grew rapidly since 2000 and stalled in 2008 to over €8 trillion[84]. They are expected to remain a significant force in global capital markets, which poses a wide set of risks related to asset price inflation, non-economic motives of state investors, systemic risk from hedge funds that may lead to create contagion across unrelated asset classes or trigger the failure of banks that lend to them and credit risk from private equity. The ongoing financial crisis has shown that such systemic risks can have contagious effects. Future similar events are to be expected if no better regulatory and supervisory framework at global level is put in place. On the other hand, such framework risks to overregulate and to stifle innovation, if it is not well balanced[85].

Shifts in power are also to be expected in the area of research and innovation. Estimations on the future evolution of R&D are very scarce. In 2004, World Gross domestic Expenditure on R&D (GERD) was expected to double over the next 20 years, rising from €629 to €1,320 billion (on a constant euro basis). The percentage claimed by the US would decrease down slightly from 36.6% to 33.0%, while EU-15 would see its share fall from 22.3% to 17.5%. China would rise to 14.9% and industrial Asia to 24.1% (Japan, Korea, Taiwan, Indonesia, Thailand, Singapore and Malaysia)[86].

While the volume of global trade should double over the period 2008-2025 (despite a temporary deceleration during the 2009 recession, and if no major disaster occurs outside the economic sphere, such as massive terrorist attacks requiring tighter border security procedures), the European dependence on oil imports is likely to increase further and exceed 90% in 2030[87], while North Sea oil reserves will be exhausted if production continues at its present rate. Securing reliable and uninterrupted access to raw materials will also be increasingly important to EU competitiveness and thus critical to be considered by European policy makers. By 2050, the EU will be highly dependent on imports of "high-tech" metals such as cobalt, platinum, rare earths, and titanium[88], while China's raw material demand will be growing rapidly with enormous environmental and economic consequences[89].

The way in which global players will develop their relative power depends on the scenario for the future. Due to the economic crises, signs of a possible rise of protectionism become stronger. A deepening of the long term effects of the current financial crisis could lead into a world characterised by division, conflict, currency controls and a further stagnation of global markets by 2020, and a global economic shock and monetary disruption after 2020. This would lead global service providers to hold capital locally thus creating local exchange trading systems and increasing the global financial instability. Such disruptive events could either lead to renewed incentives for international financial cooperation and risk management or to rapid shifts in the global geo-economic powers that could further stall globalisation.

The shape global governance will take depends on how global players will develop

How global players will face global challenges in the future will depend on the scenario envisaged for their development. Three possible types of scenarios can be distinguished: an optimistic, pessimistic and moderate one. In an optimistic scenario the EU continues to have

84 McKinsey Global Institute: The New Power Brokers, McKinsey & Company, 2007; The new power brokers: How oil, Asia, hedge funds, and private equity are faring in the financial crisis, 2009. (calculation with average exchange rate 2008; ECB).

85 High level BEPA conference on global governance, world prosperity and development, European Commission, Bruxelles, 12-13 May 2009, Draft proceedings (http://www.forum.eastonline.it/files/GLOBAL_FINANCE.pdf).

86 ANRT, Opération FutuRIS, 2004.

87 See footnote 23.

88 COM(2008) 699: The raw materials initiative – Meeting our critical needs for growth and jobs in Europe.

89 COMMON WEALTH: Economics for a Crowded Planet, Jeffrey Sachs, 2008.

an important role in the world in facing global challenges and continues its integration and enlargement to actively promote development and stability in its neighbourhood. China will increase its geopolitical integration with a major role in the exchange of goods, services, investments and ideas provided that it succeeds in executing financial, legal and administrative reforms and improving individual rights and civil liberties[90]. India will also increase and establish its role in the world if it can set and achieve long-term development goals and effectively manage its ambitions to become a global power with sensitive handling of regional dynamics[91]. In similar lines, Russia can increasingly become a growth engine for the Eurasia and Central Asia region in case of gradual but eventually wide reaching governance and market reforms[92]. On the international scale Russia is seen to strengthen its ties with the EU and to some extent with the US, while its relationship with China is good in the context of the supply of energy. The GCC[93] countries see themselves as innovation hubs by 2025, and enjoy regional stability which provides the opportunity to focus on enhancing their human capital at all levels and investing heavily in education while proceeding carefully with political and institutional reforms to support their growing economies and societies[94]. However, all these 'optimistic' scenarios for 2025 also presuppose global growth peaking in 2008 with a real GDP growth rate of around 4%. Currently, this is certainly not the case with the global recession that has spread in all developed states and affected, among others, oil and gas prices and consequent demand.

The possibility of an ongoing recession is defining the 'pessimistic' scenarios for the global players. Anticipated to occur around 2010-2014 and built on different reasons such as a lack of trust undermining international cooperation and trade integration, it is associated with increasing international isolation and protectionism. Governments in Europe and North America, suffering from growing economic demands and domestic pressures are seen to adopt a protectionist behaviour blocking attempts by Chinese corporations to invest and trade[95]. Economic demands and domestic pressures lead the US, and the rest of the developed world, to withdraw from international engagements in India[96]. In the GCC countries the recession is associated with geo-political shocks in the Gulf region and falling demand for oil, which prevents them from identifying opportunities for enhancing the prosperity of their populations[97]. Russia's 'pessimistic' scenario is also associated with poor levels of investment in infrastructure, neglected institutional reforms, capital flight, increased corruption, ineffective leadership and a decline in the competitiveness of domestic industries. Russia's external relations are seen to deteriorate as Russia unsuccessfully attempts to recreate an imperialist state, further alienating its neighbours, and eventually turns inwards, becoming more and more isolated[98]. In similar lines with the rest of the global powers, the pessimistic scenario for the EU refers to an increasingly inward-looking EU characterised by a European shield against the winds of global change[99]. This is mainly driven by fears and concerns about the emerging power of the new actors in the world scene and taking protectionist measures to stop their growth. In this sense Europe turns to define itself by the degree to which it is closed to flows of products and capital from the rest of the world rather than by its stance on the global rules governing these flows[100]. If global recession is combined with

90 China and the World: Scenarios to 2025, WEF, 2006.
91 India and the World: Scenarios to 2025, WEF, 2005.
92 Russia and the World: Scenarios to 2025, WEF, 2006
93 Gulf Co-operation Council Countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.
94 The Gulf Cooperation Council (GCC) countries and the World: Scenarios to 2025, WEF, 2006.
95 China and the World: Scenarios to 2025, WEF, 2006.
96 India and the World: Scenarios to 2025, WEF, 2005.
97 The Gulf Cooperation Council (GCC) countries and the World: Scenarios to 2025, WEF, 2006.
98 Russia and the World: Scenarios to 2025, WEF, 2006.
99 Fragmented Power: Europe and the global economy, Bruegel think tank, Sapir A. ed., 2007.
100 Fragmented Power: Europe and the global economy, Bruegel think tank, Sapir A. ed., 2007.

a range of other events, including inter-state conflict, domestic unrest and natural disasters, the world might eventually realise that meaningful collaboration is the only way forward.

Should the global crises be effectively handled before such trends and impacts become dominant, then the 'moderate' scenarios of development include increasing collaboration to coordinate diplomatic and economic policies for the GCC countries[101], and continued development but gradual decrease of China's international competitiveness[102] and unsustainable economic development for India[103] due to failure in both countries to implement the necessary reforms for sustainable development. Russia will continue to leverage its natural resources, to the detriment of the full development of other sectors and is seen as a stable and reliable oil provider on the international scene[104].

The way forward

Different global players will offer different governance models

There are diverse views on the role that the EU can play as a model in global governance. Some argue that the US is likely to keep a leading role in global governance, thanks to its strong position in the Atlantic hemisphere and its deep ties to the Asian hemisphere[105]. Other factors impacting its leading role are the horizontal social structure, the culture of entrepreneurship and innovation and the emergence of a new generation of 'First Globals' that forge connections around the world[106].

The future role of the EU in global governance is strongly connected to its ability to speak with one voice in global fora. Literature suggests that barriers for the EU to do so are: the degree of national (or shared) competence in an area; the strictness of an international institution's rules of participation; the weakness of the EU's coordination mechanisms; the heterogeneity of Member States' preferences; and the weakness of the collective identity[107]. The potentially increasing role of the EU in the world is also associated with the course that EU integration and enlargement takes. Some see that the agenda of the EU is now swiftly changing from building institutions and shaping enlargement to using these institutions to cope with global challenges. As a variation to this scenario, continued enlargement will coexist with the focus on global challenges and EU integration. In an alternative scenario Europe is seen as an 'open gravitation area' with varied membership. EMU[108] has continued to grow but the EU itself has entered a path of consolidation regarding integration. A convincing concept below the level of full EU membership links the countries on the fringes of Europe economically and politically to the EU. Those Member States wanting closer integration have taken advantage of the scope to deepen their cooperation. Finally the future role of the EU in global governance will also depend on the extent to which it continues to serve as a laboratory for solutions to global challenges, and succeeds in offering blueprints for global solutions that have been tested at EU level, such as the blueprint that was prepared for the Copenhagen deal[109] and the proposal of the High Level Group on Financial Supervision in the EU[110] for a better regulatory and supervisory framework both at EU level and at global level.

101 The Gulf Cooperation Council (GCC) countries and the World: Scenarios to 2025, WEF, 2006.
102 China and the World: Scenarios to 2025, WEF, 2006.
103 India and the World: Scenarios to 2025, WEF, 2005.
104 Russia and the World: Scenarios to 2025, WEF, 2006.
105 America's Edge – Power in the Networked Century, Anne-Marie Slaughter, 2009.
106 America's Hedge, Power in the networked century, Slaughter in Foreign Affairs, 2009; The Future of American Power - How America Can Survive the Rise of the Rest, Zakaria in Foreign Affairs, 2008.
107 Bruges Regional Integration & Global Governance Papers - 'Patchwork Power' Europe? The EU's Representation in International Institutions, Sieglinde Gstöhl, United Nations University and College of Europe, 2008.
108 Economic and Monetary Union.
109 COM(2009) 475/3: Stepping up international climate finance: A European blueprint for the Copenhagen deal.
110 Report of The High-Level Group on Financial Supervision in the EU, chaired by Jacques de Larosière, Brussels, 25 February 2009.

The growing strength of the emerging markets increases pressure to integrate them more closely into international coordination processes, such as the UN, WTO and IMF[111]. On the other hand, Europe as a whole is overrepresented in global economic institutions[112]. However, many rising superpowers such as Russia, China, the Middle-East and some Latin American countries have differing traditions in democratic governance, which may cause pressures to democracy elsewhere. Western norms and values as the foundation of the global system could also be challenged by radical religious identity politics that could emerge as a powerful counter ideology with widespread appeal.

In this context of differing democratic traditions, the EU may also have an increasing role in the world, based on the argument that EU's institutional architecture can be a model for new forms of governance for many developing states[113]. Some consider the European model, which relies heavily on so-called 'soft power', to be especially influential in the developing 'BRIC' countries, offering a model of capitalism that delivers prosperity, security and greater levels of equality to its citizens, in contrast to the US model where the winner takes it all[114]. The EU model also allows tiny nations to leverage their influence, and to choose between joining the union or starting a regional association to overcome a 'unipolar' world[115]. Others argue that many developing states in need of improved governance structures will find a better match in the well established Indian model, because of its long tradition of liberal representative government and the many similarities with emerging democracies in Africa, Central Asia, South Asia, the Middle East, and Indonesia and the Philippines[116]. Zakaria[117] argues that the US are creating the first universal nation, while European societies seem not to be able to take in and assimilate people from unfamiliar cultures, especially from rural and Islamic regions. The combination of this soft power with its hard power is seen as a unique advantage of the US to play a crucial role in world affairs.

4. Conclusions

The central objective of this report is to contribute both to the way in which the EU can look ahead, and also how it could, in a proactive way, shape a better future for all its citizens, and the world in general. Identifying and examining emerging challenges, their main elements, and their often complex interactions are key steps to achieve this.

The work described in this report brings a perspective on the most pressing global challenges, linking widely accepted quantified trends towards 2025 and beyond with experts' and policy makers' opinions on the likely consequences of these trends and emerging wild cards. The methodology used combines desk research and a range of participatory and quantitative methods as previously described, and represents an important direction for the future development and application of foresight methodologies, particularly their role in the decision making process. In so doing, it identifies possible actions for EU policy making to change the way in which the EU could be affected by these challenges. It also highlights that these actions can be considered at both the global and EU levels. Actions taken at EU level could serve as an example of how global governance could be developed and evolve in the near future.

111 Germany 2020, new challenges for a land on expedition, Deutsche Bank, 2007.
112 Fragmented Power: Europe and the global economy, Bruegel think tank, Sapir A. ed., 2007.
113 EFMN Brief 133 - The Role of the EU in the World, Amanatidou E., 2008.
114 M. Leonard, Why Europe Will Run The 21st Century, 2005.
115 M. Leonard, Why Europe Will Run The 21st Century, 2005.
116 EFMN Brief 133 - The Role of the EU in the World, Amanatidou E., 2008; India, China and Future of Democracy, Murata T. in Democracy and Futures, Mannermaa M., Dator J. & Tiihonen P. eds., 2006.
117 Zakaria F. The Post-American World, 2008.

To advance policy design and implementation, it is critical to build a global balance between cooperation and competition, to strengthen multi-actor partnerships and global agreements based on dialogue and on shared values and common regulations. Likewise, it is essential to enable international organisations that equally represent all nations to be vigilant and to enforce widely accepted juridical approaches. Furthermore, there is a need for alignment of policies in different areas. For example, policies for energy, climate, food, water and transport are very much interdependent.

Developments such as a cultural shift from individual to collective values, to account for biodiversity or ecological flows and stocks instead of using GDP as a measure for policy design and growth, to increase governments' transparency and accountability, and to empower citizens through new ways of learning, interacting and communicating, which can be supported by ICTs (e.g. to construct a more networked world and a ubiquitous healthcare), are so far not sufficiently well addressed in current policy and decision making processes.

In more concrete terms, the following three areas may require EU policy making to focus its attention:

1- Policy alignment towards sustainability

The current economic crisis has already shown that the paradigm in which the market will guide humanity in an optimal direction is failing. While the market may be a good means for innovation development, without regulation[118] market forces may lead to further (over) exploitation of existing resources and an increase in the gap between rich and poor, with the consequences already described above. Moreover, the market is unable to fully anticipate future damage caused by climate change and other socio-ecological crises. The model of unconditional economic growth must be reconsidered, moving towards a more sustainable one, taking into consideration the current limitations (financial and trade crises, climate change, etc.) and the need for urgent political decisions.

There is also the need to shift the scope of actions from the local to a more global scale, from the particular and specific to a more holistic approach to the complexity of situations, arising from interconnected challenges. Action is required on the local and regional levels, and this must be aligned with global values and agreements. Glocalisation, or the "think globally and act locally" approach, has already been proposed in the United Nations Conference on Environment and Development in Rio de Janeiro 1992 through the Agenda 21 document consensually approved by more than 170 nations that so far no national government has been able to fully implement through aligned policies and proper governance systems.

Furthermore, a harmonised approach to support the growth of developing economies and the development of the capacities needed to sustain themselves, as well as to welcome high-skilled immigration to the EU would be beneficial both for economic and social development, as well as for more intelligent global use of natural resources[119].

To move in this direction, policy making may consider:

- reform of the EU agri-system with the creation of aligned policies (e.g. transport, agriculture, international relations and education) to secure food for increasing EU demand, as well as to support less developed countries both to share the benefits of being part of a global food production system and to sustain themselves, thus ensuring the availability of natural resources for future generations globally.

118 E.g. consideration of external costs, profit limit for companies, benefit or salary top limits.

119 This is partly reflected in the COUNCIL DIRECTIVE 2009/50/EC of May 25 2009 on the conditions of entry and residence of third-country nationals for the purposes of highly qualified employment.

- alignment of policies for energy, climate, food, water and transport to reduce EU's dependency on these resources by supporting the production of energy based on a range of renewable, low-carbon and high-efficiency technologies, as well as infrastructures which need to be adapted and operate in interconnected (global) grids whenever possible.

- fostering education and increased social awareness by aligning education and RTDI policies to enable the participation and ownership of individuals (rather than consumers) in decision making processes and to increase social understanding of existing technologies (e.g. GMOs, nuclear energy) and research into new or alternative solutions towards sustainability.

- alignment of migration, climate, external relations, education, RTDI, social security and health policies in order to manage migration flows related to climate change as well as an ageing society which urges the EU to support the building of global structures for cooperation and support for developing countries in tackling poverty and climate change, as well as in bringing these countries up to higher levels of development and education.

- alignment of economic, environmental, social and industrial policies to enable a change in the policy driver from GDP to an updated system considering also ecological flows and stocks, and regulate industry so it is able to establish closed-loop manufacturing processes as well as to foster open-source and user-centred innovation.

2- Social diversity and ICTs towards citizens' empowerment

Policy alignment and political will are necessary to allow full transparency and social participation, and thus to change the ways in which individuals and businesses behave. EU policies could embrace the multicultural and social diversity of EU citizens as a competitive advantage, and move away from traditional compartmentalisation of different policy realms towards alignment based on dialogue and new ways of communicating and interacting with different stakeholders.

Channels to facilitate communication and dialogue with all citizens can be created by adopting a strategic agenda for developing democratic participation. The EU is now in a leading position to foster (e)participation and (e)democracy enabled through education and the way of communicating and engaging with different stakeholders. This requires smart regulations from the public sector, based on improved understanding and anticipation of the behavioural and cultural changes.

Ageing societies coupled with evolving migration patterns, the shift to a knowledge society and a possible change in the world's economic and political powers present new risks but also offer new opportunities. A large group of non-ICT competent people risk being excluded from a knowledge-intensive environment which is likely to increase poverty in the EU and in the world in general, and widen the development gap between rich and developing nations. This shows an increasing need to invest in human and physical capital by enabling individuals to build new skills and competences, often combined with conventional industrially relevant knowledge. The destruction of old jobs and the creation of new ones will require capabilities to unlearn outdated competences and to learn new ones.

Hence, equal and affordable education for all is paramount, which also depends on the social inclusion and participation of citizens of every age and with different backgrounds and cultures, including immigrants, in the knowledge society. Such an education and learning environment would enable individual knowledge diversification and the building of RTDI regional clusters based on the necessary interdisciplinary

capabilities that enable specialisation in specific knowledge-oriented sectors. Multidisciplinarity and open user-centred innovation would allow the combination and exploitation of new and old technologies as well as between different sciences (i.e. social and life sciences), leading to potentially new applications and new ways of organising manufacturing, which could ensure sustained economic growth linked with the conservation and renewal of natural resources.

However, social understanding and acceptance of research and innovation linked to legal frameworks for technological development could limit controversial research (e.g. GMOs) and its resulting applications. In the future, innovations could be limited more by societal acceptance than by technological possibilities, calling for a structural debate on what is desirable and what is not, as well as on the values underlying these innovations.

At the same time new economic and political global powers are arising due to their increasing capability to re-shape manufacturing, research and innovation globally. The consequence is that the flow of financial, natural and knowledge resources can shift increasingly to Asia and other currently developing regions in the near future.

Finally, the promotion of health and well-being, regardless of age, is a precondition for economic wealth and improved quality of life. The same is true for innovation, which needs to be user-centred, with research tackling societal challenges, as well as citizens participating in industry decisions from the design phase of products and services.

To move in this direction, EU policy making may consider:

- building new incentives to facilitate and strengthen the platform of interactions between different realms of social life including politics, institutions, civil society, universities, educational institutions, and industry in order to develop joint decisions and approaches to deal better with common challenges and opportunities.

- developing the necessary means to enhance education for the use of ICT in conjunction with different technologies supporting universal access to knowledge, with full information on government decisions, facilitating participation in public debates, enhancing government accountability, and enabling the production and delivery of services that hitherto were collectively provided.

- fostering competition within and between EU national education systems on a global scale in order to improve quality and move closer to a learner-centred educational system, which is key for EU economic growth and social inclusion.

- regulation of the healthcare system tapping into new technologies to allow equal access to healthcare, including remote healthcare, and technical means of preventing disease and maintaining health in daily life, regardless of age, being this a precondition for economic wealth and improved quality of life.

- incentives for research focusing in the convergence of new (miniaturisation) technologies, which can lead to promising industrial applications and thus improved competitiveness in the future.

- development of radically new and far more efficient forms of social protection that combine protection from poverty with a high degree of flexibility and geographical and intersectoral mobility which allow people to stay longer in the labour market regardless of age.

3- Anticipation of future challenges to turn these into new opportunities

As long as it is possible to anticipate the causes of any economic, social or environmental

crisis, society is in a position to address them beforehand, either to deal with the likely consequences or even to transform them into opportunities. However, if the causes are not fully recognised, crises are inevitable. Emerging shortages of food, water and other resources, by demographic trends and human activities, will have far reaching economic and social consequences, and thus becoming multilevel global challenges.

Governments and companies usually react to changes by trying to adapt rather than being able to manage them properly, let alone being able to anticipate and welcome change. Multiple factors influence the ways in which the future will evolve and existing institutions have not yet been able to develop a fully systemic view of current and possible future situations to be prepared to properly shape the future. There is a latent need to position the EU within adaptive and dynamic global institutions in order to achieve global governance structures capable of addressing global and common challenges.

In this context, to consider undertaking foresight initiatives on global challenges at regular intervals is critical to build a common understanding of current situations and to translate these into common visions of the future of the world to be pursued jointly. To build a continuous and shared approach to understand the present, to look at different future possibilities and to shape a direction to follow, coupled with an evaluation of what has or has not been achieved from time to time to correct deviations and to continually adapt to new situations would help to give evidence for taking action by policy-makers. Taking no action is a conscious decision and may often be the wrong one.

To move in this direction, EU policy making may consider:

- embedding foresight as an inherent part of EU aligned policy making to enable the continual anticipation of future complex situations in order to develop smart regulations based on the common understanding of the present and how the future can evolve, and an agreement of the direction to follow. EU Member States and regions could be encouraged to do likewise, as well as other parts of the world.

- development of the necessary means to establish global partnerships between industry-government-society, with international organisations that enable the necessary framework conditions and juridical power to ensure that the above partnerships are developed and that industry plays its role within global societies.

- fostering the appreciation of different points of view both within Europe and worldwide to build shared values and common visions. This is key to start building international adaptive organisations and related dynamic structures, which are necessary to develop global agreements (i.e. set the right framework conditions and regulatory models) and joint actions.

- to this end, making clear at global fora what the EU stands for as an institution as well as who and what it represents. It could also consider reviewing the scale of its representation in international organisations to better balance their composition and effectiveness.

Finally, to enable a clearer understanding of the possible pathways to tackle the highlighted challenges in this report, scenarios could be developed in order to support shaping strategic agendas, decisions and policies, and at the same time to support building ownership of results so that these can be fully implemented. In addition, a periodic assessment of these scenarios would be necessary to update and adapt these in view of the latest world developments, and to support a trend-based, anticipatory intelligence able to guide sustainable development.

IV. Bibliography

- 2008 Global Trends: Refugees, Asylum-seekers, Returnees, Internally Displaced and Stateless Persons, UNHCR 2009.
- 2009 Aging report, European Commission – DG ECFIN 2009.
- 2025, A world too different from today?, Caraça J. 2008.
- A Fresh Look at Global Governance: Exploring Objective Criteria for Representation, Enrique Rueda-Sabater, Vijaya Ramachandran, and Robin Kraft 2009.
- Achieving High Performance in a Rapidly Aging World , Accenture 2005.
- Alternative Measures of Well-Being - OECD social, employment and migration working papers no 33, OECD 2006.
- America's Edge – Power in the Networked Century, Slaughter in Foreign Affairs 2009.
- Analysis of the European Food Industry (IPTS), Martin Banse, Eleni Kaditi, Scott McDonald, Sherman Robinson, Johan Swinnen 2008.
- An Information Architecture to Enable Business Sustainability, Cagnin C. 2005.
- Au delà de la mondialisation libérale AMIN 2008.
- Avian and Human Influenza: Financing Needs and Gaps, World Bank 2005.
- Being Human: Human-Computer Interaction in the year 2020, Microsoft Research Ltd 2008.
- Brief 133 – The Role of the EU in the World, Amanatidou E. 2008.
- Brief 42 – Emerging S+T Priorities in the Triadic Regions, Farhi F., Lecoq D., Steinmueller K., Eerola A., Einav A. 2007.
- Brief 48 – 2020 Living in a Networked World, Reutter W. 2007.
- Brief 90 - Global Technology Revolution 2020, Silberglitt R., Antón P. S., Howell D. R., Wong A. 2007.
- Brief 92 – OPEC Long-Term Strategy, Popper R. 2007.
- Brief 137 – The Future of Manufacturing in Europe, Brandes F. 2008.
- Bruges Regional Integration & Global Governance Papers - 'Patchwork Power' Europe? The EU's Representation in International Institutions, Gstöhl S. 2008.
- Chief of transformations conference report, NATO 2008.
- China and the World: Scenarios to 2025, World Economic Forum 2006.
- City 2030 (EFMN), Reutter, W.2007.
- Climate Change 2007: Synthesis Report – An Assessment of the Intergovernmental Panel on Climate Change, IPCC 2007.
- Comparison of Long-term World Energy Studies (IPTS), Schade B. and Wiesenthal T. 2007.
- Competitive Cities in the Global Economy, OECD Publishing 2006.
- Construire l'Europe Politique, 50 propositions pour l'Europe de demain, 2004, Strauss Kahn on initiative of the EC 2004.
- Cosmic Vision Space Science for Europe 2015-2025, European Commission – ESA 2005.
- COUNCIL DIRECTIVE 2009/50/EC of May 25 2009 on the conditions of entry and residence of third-country nationals for the purposes of highly qualified employment, Council of the European Union 2009.
- Creative system disruption: towards a research strategy beyond Lisbon, European Commission – DG RTD Directorate K – Social sciences and humanities; Foresight 2005.
- Cyberinfrastructure Vision for 21st Century Discovery, US National Science Foundation 2007.
- Democratising the future, Philips, 2007.

- Demography Report 2008: Meeting Social Needs in an Ageing Society - SEC(2008) 2911, European Commission 2008.
- Digital Ecosystem Convergence between IT, Telecoms, Media and Entertainment: Scenarios to 2015, World Economic Forum 2007.
- Diversity in Foresight: Insights from the Fostering of Innovation Ideas, Könnölä T., Brummer V. and Salo A. 2007.
- Dix défis pour la France, Besson E. 2009.
- Driving forces, World Economic Forum 2009.
- eChallenges e-2008 Workshop on ICT for Governance and Policy Modelling, Stockholm Workshop 2008.
- Eco-innovation: When Sustainability and Competitiveness Shake Hands, Hampshire, Palgrave-McMillan, Carrillo-Hermosilla, J., del Río, P. & Könnölä, T. 2009.
- Economic relations with regions neighbouring the Euro area in the "Euro time zone", ECB 2002.
- Economics for a crowded planet, 2008, Sachs J. 2008.
- Emerging Science and Technology priorities in public research policies in the EU, the US and Japan, European Commission - DG RTD Directorate K – Social sciences and humanities; Foresight 2006.
- Engineering & Construction: Scenarios to 2020, World Economic Forum 2007.
- Environmental Outlook to 2030 (OECD), OECD 2008.
- Europe 2025: Discovering the future through action as well as analysis, Mulgan 2008.
- European Energy and Transport: Trends to 2030 - Update 2007, European Commission - DG TREN 2008.
- European Energy Sector, EMCC – Eurofound 2008.
- European Population Projections, base year 2008, Eurostat 2008.
- European Social Models, Protection and Inclusion, Institute for Futures Studies 2009.
- European Union - the next fifty years , Financial Times 2007.
- Europe's Demographic Future, Berlin Institute for Population and Development 2008.
- Foresighting Food, Rural and Agri-futures, European Commission - DG Research 2007.
- Foresighting Food, Rural and Agrifutures in Europe (EFMN), Cassingena Harper, J. 2008.
- Foresight on Information Society Technologies in the European Research Area (FISTERA), European Commission - JRC-IPTS 2006.
- Fragmented Power: Europe and the global economy, Bruegel think tank, Sapir A. ed. 2007.
- Freedom, Security, Privacy –European Home Affairs in an open world, The Future Group 2008.
- Future Food 6 Final Report, UNIDO 2009.
- Future Jobs (EFMN), TNO 2008.
- Futures Review, Sandford, R. & K. Facer 2008.
- Germany 2020, new challenges for a land on expedition, Deutsche Bank 2007.
- Global Climate Policy for 2030 and beyond (IPTS), Russ P., Wiesenthal T., Van Regemorter D., Carlos Ciscar J. 2007.
- Global Environment Outlook 4 (UNEP), UNEP 2007.
- Global Trends 2025: A Transformed World, NIC 2008.
- Global Trends and Actors Shaping European Security (D2.3), CMI for the EC 2008.
- Governance for sustainable human development , UNDP 1997.
- Green GDP Accounting Study Report 2004, State Environmental Protection Administration of China (SEPA) and National Bureau of Statistics of China (NBS) 2006.
- Growing old gracefully - How to ease population ageing in Europe?, Centre for European Reform 2008
- Healthcare Technologies Roadmapping: The Effective Delivery of Healthcare in the Context of an Ageing Society (HCTRM), JRC-IPTS/ESTO 2003.
- Higher Education Looking Forward: An Agenda for Future Research (2008), Relations between Higher Education and Society (2007), ESF 2007/08.

- High level BEPA conference on global governance, world prosperity and development, European Commission - BEPA 2009.
- Horizons 2020, A though-provoking look at the future, Siemens, 2004, 286p, Siemens 2004.
- Human Development Report 2007/2008, UNDP 2007.
- Humans in Outer Space (ESF), ESF/ESPI 2007.
- India and the World: Scenarios to 2025, World Economic Forum 2005.
- India, China and Future of Democracy, Murata T. in Democracy and Futures, Mannermaa M., Dator J. & Tiihonen P. eds., Murata T. 2006.
- Innovation Clusters in Europe, European Commission - DG ENTR 2007.
- Interim report on security implications, NATO 2008.
- Internet governance: towards a non-representational democracy, Knahl and Cox 2008.
- IPCC, 2007, IPCC Fourth Assessment Report: Climate change 2007, IPCC 2007.
- Is the European project viable?, High level expert gourp 2008.
- Le monde en 2025 – Indicateurs Défense et Sécurité: vers davantages d'insécurité, High level expert gourp 2008.
- Le monde en 2025: les 4 transitions, Theys 2008.
- Limiting Global Climate Change to 2 degrees Celsius. The way ahead for 2020 and beyond - COM/2007/0002 final, European Commission 2007.
- Literature review on energy foresight, European Commission – JRC-IPTS 2006.
- Living Planet Report 2008, World Wide Fund for Nature 2008.
- Malthus' Revenge, Soete 2008.
- Mapping global capital markets: Fourth annual report, MCKinsey Global Institute, 89p, 2008, MGI 2008.
- Mapping the Global Future, NIC 2004.
- McKinsey Global Institute: Mapping Global Capital Markets, McKinsey & Co. 2008.
- McKinsey Global Survey Results: How Companies are benefiting from Web 2.0, McKinsey & Co. 2009.
- Meeting global challenges - Zedillo, International task force on global public goods 2006.
- New Skills for New Jobs: Anticipating and matching labour market and skills needs – COM(2008) 868 final, European Commission 2008.
- OECD Environmental Outlook to 2030, OECD 2008.
- OECD Infrastructure to 2030: Mapping Policy for Electricity, Water and Transport (2007) - Chapter 1 (summary), OECD 2007.
- OPENING EDUCATION – 2020 and beyond – Future scenarios for education in the age of new technologies, Futurelab 2007.
- Opération FutuRIS, ANRT 2004.
- Preparing for China's Urban Billion, MGI 2008.
- Preference Programming for Robust Portfolio Modelling and Project Selection, Liesiö J., Mild P. and Salo A. 2007.
- Providing Security and Safety to Citizens (EFMN), Braun A.; Elsner N.; Hoffknecht A.; Korte S.; Rijkers-Defrasne S.;Teichert O. 2008.
- Quantitative Scenarios for the Future of Manufacturing, CPB 2008.
- Really Changing the Course: The Limitations of Environmental Management Systems for Innovation, Könnölä T. and Unruh G.C. 2007.
- Regional Innovation Strategies in Europe (EFMN), Hafner-Zimmermann S. 2008.
- Proposal for a Regulation of the European Parliament and of the Council: establishing a European Asylum Support Office – COM(2009) 66 final, European Commission 2009.
- Report of The High-Level Group on Financial Supervision in the EU, Jacques de Larosière 2009.
- Roadmap Robotics for Healthcare (EFMN), TNO 2008.

- Russia and the World: Scenarios to 2025, World Economic Forum 2006.
- Scenarios for future scientific and technological developments in developing countries 2005-2015, European Commission - DG RTD Directorate K – Social sciences and humanities; Foresight 2006.
- School's Over: Learning Spaces in Europe in 2020: An Imagining Exercise on the Future of Learning, European Commission - JRC-IPTS 2008.
- Security of Energy Supply (EFMN), Lechtenböhmer, S. et al. 2008.
- Shell Energy Scenarios to 2050, Shell 2008.
- Social Vision toward 2025, NISTEP 2007.
- Space 2030 - Exploring the future of space applications, OECD 2004.
- SPACE EXPLORATION 2025: GLOBAL PERSPECTIVES AND OPTIONS FOR EUROPE, European Space Policy Institute 2008.
- Stepping up international climate finance: A European blueprint for the Copenhagen deal – COM(2009) 475/3, European Commission 2009.
- Stern review on the economics of climate change, HM Treasury 2006.
- Synthesis Paper - The Future of Key Research Actors in the European Research Area, European Commission - DG RTD Directorate C – European Research Area: Knowledge-based economy 2007.
- Technology and Innovation in Financial Services: Scenarios to 2020, World Economic Forum 2007.
- Technology Foresight towards 2020 in China: the Practice and its Impacts, Mu et al 2008.
- The 2009 Ageing Report. European Economy 7/2008, European Commission – DG ECFIN 2008.
- The bird of gold: the rise of India's consumer market , MGI 2007.
- The Business of Ageing, Llewellyn, J.& Chaix-Viros C. 2008.
- The Business of Climate Change, Llewellyn, J. 2007.
- The Business of Climate Change II, Llewellyn, J.& Chaix C. 2007.
- The Coming Democracy, Ann Florini 2005.
- The Defence Industry Sector - what future?, EMCC - Eurofound 2006.
- The Future of American Power - How America Can Survive the Rise of the Rest - Zakaria in Foreign Affairs, Zakaria F. 2008.
- The Future of eGovernment - An exploration of ICT-driven models of eGovernment for the EU in 2020, European Commission - JRC-IPTS 2007.
- The Future of Manufacturing in Europe, TNO 2007.
- The Future of Pensions and Healthcare in a Rapidly Ageing World: Scenarios to 2030, World Economic Forum 2008.
- The Future of the Global Financial System - A Near-Term Outlook and Long-Term Scenarios, World Economic Forum 2009.
- The Global Technology Revolution - Bio / Nano / Materials Trends and Their Synergies with Information Technology by 2015, NIC 2001.
- The Gulf Cooperation Council (GCC) countries and the World: Scenarios to 2025, World Economic Forum 2006.
- The health and social services sector - what future?, EMCC - Eurofound 2003/04.
- The international financial system in 2025, Portes 2008.
- The Millennium Development Goals Report 2009, UN 2009.
- The Millennium Development Goals Report 2008, UN 2008.
- The Millennium Project - Global Energy Scenarios (2006), Glenn, J.C. & T.J. Gordon 2006.
- The New Global Puzzle - Gnesotto and Grevi, European Institute for security studies 2006.
- The New Power Brokers, MGI 2007.
- The new power brokers: How oil, Asia, hedge funds, and private equity are faring in the financial crisis, MGI 2009.

- The Post-American World, Zakaria F. 2008.
- The Raw Materials Initiative – Meeting our critical needs for growth and jobs in Europe - COM(2008) 699, European Commission 2008.
- The shape of jobs to come: Possible New Careers Emerging from Advances in Science and Technology (2010 - 2030), Talwar R. and Hancock T. – Fast Future Research 2010.
- The State of Food Insecurity in the World, FAO 2008.
- The World in 2025, European Ideas Network 2007.
- The World in 2025: A Challenge to Reason, Gaudin, T. 2008.
- The world in 2025: Demographic issues, Beets 2008.
- The world in 2025: Focus on Russia, Kuklina 2008.
- The world in 2025: Macroeconomics, growth, trade, Fontagné 2008.
- The World in 2025: Rising Asia and socio-ecological transition, European Commission – DG RTD Directorate L – Science, economy and society 2009.
- The World in 2030, Hammond, R. 2007.
- The world market of energy sources by 2025, National Energy Commission Chile 2005.
- Think Scenarios, Rethink Education (OECD), OECD 2006.
- Thoughts on governance and Power in the world system, Tsoukalis 2008.
- Towards Knowledge Societies, UNESCO 2005.
- Towards the gardening of the planet in the period of anthropocene, The world as socio-bio-space, future options and challenges, Svedin U. 2008.
- Towns & Communities in 2020, Centre for Future Studies 2004.
- Trends in Sustainable Development, UN 2008.
- US Families 2025 (EFMN), Montgomery A. 2008.
- Vital Water Graphics, UNEP 2008.
- Water Initiative, World Economic Forum 2009.
- Web 2.0 and the Next Generation of Public Service, Accenture 2009.
- Why Europe Will Run The 21st Century, Leonard M. 2005.
- Workshop on The Future of International Migration to OECD Countries , OECD 2008.
- World Development Report 2009, World Bank 2008.
- World Development Report 2008, World Bank 2007.
- World Development Indicators 2007, World Bank 2007.
- World Economic Forum Initiative: Managing Our Future Water Needs for Agriculture, Industry, Human Health and the Environment, World Economic Forum 2009.
- World Energy Outlook 2009, International Energy Agency 2009.
- World Energy Outlook 2008, International Energy Agency 2008.
- World Energy Outlook 2006, International Energy Agency 2006.
- World Health Report 2007, WHO 2007.
- World Health Report 2008, WHO 2008.
- World Population Ageing 2007 Sum, UN 2007.
- WWF, Living Planet Report, WWF 2008.

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