

**State of the art of international
Forward Looking Activities beyond 2030**

Paper drafted for the European Commission
DG Research and Innovation (Social Sciences and Humanities)

Anette Braun

including inputs from several members of the "Global Europe 2030-2050" Expert Group

Düsseldorf, August 2010

Contents

INTRODUCTION	3
AIMS AND MANDATE OF THIS PAPER	5
THE SOCIAL DIMENSION IN FLA 2030/50	8
THE GEOPOLITICAL DIMENSION IN FLA 2030/50	16
THE ECONOMIC AND TECHNOLOGICAL DIMENSION IN FLA 2030/50	20
THE ECOLOGICAL DIMENSION IN FLA 2030/50	26
OUTLOOK AND POTENTIAL TOR FOR THE EXPERT GROUP (REPORT)	30
SUGGESTIONS FOR FURTHER WORK	31
ADDITIONAL COMMENTS AND INSIGHTS FROM THE EXPERT GROUP	35
FOOTNOTES	43

Introduction

Forward Looking Activities have a long tradition in the European Commission since the creation of the "Cellule de prospective" of Jacques Delors in the eighties. Such exercises are currently supported by the 7th Research Framework Programme (FP7) and are integrated in the thematic field "Social Sciences and Humanities" of the Directorate-General for Research and Innovation.

The Forward Looking Activities are being carried out within the European Union research projects, tenders and expert groups.¹ The main objective of the "Global Europe 2030-2050" group is to conduct both quantitative and qualitative analyses. It aims at providing well-grounded connections between challenges and visions as well as options for action on which policies can be built in the next decades. This long-term dimension helps to anticipate, predict, evaluate and project. It could inspire new policies, provide evidence for policy making to understand and shape the world of tomorrow.

The tasks of this Group of experts are firstly to review and build on existing European and international Forward Looking Activities relating to main changes and challenges that the world and Europe will have to face in the next thirty/forty years. Secondly, the group evaluates the underlying trends and tensions for the World and Europe up to 2030/2050 on the basis of a set of specific hypotheses as to establish a "business as usual" scenario. Thirdly, it aims at generating "alternative scenarios" of the World up to 2050 with intermediary steps at the end of each decade focusing on major potential transitions and disruptive factors ("Wild cards"). Finally, the experts highlight future European research priorities and European research governance that answer to the identified transitions and which would allow the EU to remain at the same time competitive and sustainable in the globalized environment.

This paper is the first of the "Global Europe 2030-2050" Expert group and looks at the state of the art in the field of international Forward Looking Activities beyond 2030. It takes into consideration the social, geopolitical, economic and technological as well as ecological dimensions.

In terms of changes in *society*, most Forward Looking Activities studies analysed seem to underline the importance of globalisation of which Europe is, alongside the United States of America, a driving force. The identity volatility combined with new migratory flows, inequalities of chances and fast urbanisation can lead to instabilities, new criminality and strengthened extreme ideologies. The demographic changes, such as ageing population, are expected to lead to increased demand for public expenditure, possible new wave of brain drain and a changed role of family.

On *geopolitics*, the state of the art shows shifts in global power from the West towards the East. The dependence on complex global systems will increase the risk of world-wide consequence. Fanatic religious, extreme environmental and dangerous nationalist ideological movements could remain significant. These do not have geographical limitations and democracy seems ill equipped

to face them. The hegemony of the USA will disappear and non-state actors fighting for influence in the international arena will get access to new types of weapons.

Economic and technical dimensions of the future two decades will be based on the foreseen doubling of global economy and tripling of global trade by 2030. This will imply an increase in the demand for energy with negative effects on the food production and distribution as well as water shortages. The continuous information and communication revolution will bring major advances in biotechnologies and proliferation of nuclear, biological and chemical weapons can be expected. Space could become a new area of competition not only between major state powers but also between private companies. Nevertheless, a lot of regions of the world will be left behind, most of them in sub-Saharan Africa and the non oil-producer Middle Eastern states.

Finally, referring to future *ecological* questions, this paper describes the possibilities for serious environmental crises such as rising ocean levels, habitat destruction, increased disease transmission and others. The "polluter pays" principle should be well established by all governments as to limit the increasing atmospheric greenhouse gas concentrations and carbon dioxide emissions. Climate change will amplify existing social, political and resource stress. It could affect agriculture and imply habitat loss, accelerating decline of native species.

If the picture of this state of the art of the Forward Looking Activities is quite dark, the next steps of the "Global Europe 2030-2050" work will aim at providing innovative measures and alternative scenarios to shape a better future in a changing world.

Domenico Rossetti di Valdalbero
European Commission, DG Research and Innovation

Aims and mandate of this paper

This paper - rather than to providing an in-depth meta-analysis - lists the themes and issues that gained political legitimization through forward looking exercises within the past 5 to 10 years. As such it presents the kick-off (baseline) working document for the "Global Europe 2030-2050" Expert Group.

The aim of this paper is to identify and collect forward looking studies (FLA)², visions and prospects from national, international, and corporate provenience focussing a time horizon 2030 and beyond,³ and to cluster and explore the collected material along four dimensions:⁴

1. The social dimension (such as aging, health, demography, ...),
2. The geopolitical dimension (including global power shifts, international terrorism, ...),
3. The functional dimension (including economics and technology); and the
4. The ecological dimension (including the three big critical trends of depletion, degradation and disruption).

This material is expected to enable the "Global Europe 2030-2050" Expert Group to draw upon various resources accumulated; to point to what has and has not been attempted; to avoid redundancies; to suggest fruitful/alternative routes for further exploitation; to establish good practice; and to identify current impasse.

The paper builds on the fruitful input of Leopold Summerer, Vasco Cal, Henri Bogaert, Tomas Ries, Daniele Archibugi, Nicole Gnesotto, Jaap de Zwaan, Ingo Rollwagen, Dragana Avramov, Helena Helve, Joyeeta Gupta, Heli Koski, Geoff Mulgan and Lionel Fontagné. Their input shall be particularly acknowledged.

A general observation concerns the strong concentration on "energy" and related issues (such as the optimisation of energy production and the transition to a low carbon economy) in FLA around the world.⁵

The complete inventory of FLA is presented in the Annex document to this paper. An *ad hoc* summary of the statements or visions made in the respective forward looking exercises is portrayed where available.

Methodological observations

The number of forward looking exercises conducted on European level up to date is exhaustive. Much of the major spectrum of activities on national level has been identified and depicted from the EFMN database.⁶ Beyond this forward looking activities from national governmental web sites, the major global organizations (UN, OECD, WHO, etc) as well as from corporations have been screened during the first quarter of 2010. For the EU forward looking activities a screening of (particularly) DG RTD activities and an in-depth examination of the visions from 118 ERA-Nets as well as from 38 Technology Platforms was undertaken.

This paper is hence, a compilation of a certain kind of formal futures studies of which only a few have been made with a clear perspective on the outcomes and the deliverables of each study. Many of the exercises integrated in this paper, whether economic or environmental, rely on distinct baseline scenarios and assumptions that are not always comparable to each other.

On the one hand, there are often no clear dividing lines between many topics in FLA, so that studies themes often overlap. On the other hand, many FLA are diverse in scope, objectives, institutional positioning and involvement of actors.

Most of the FLA revisited have not been oriented on delivering implications and action points. The existing studies seem to provide room for improvement concerning the analysis and integration of:

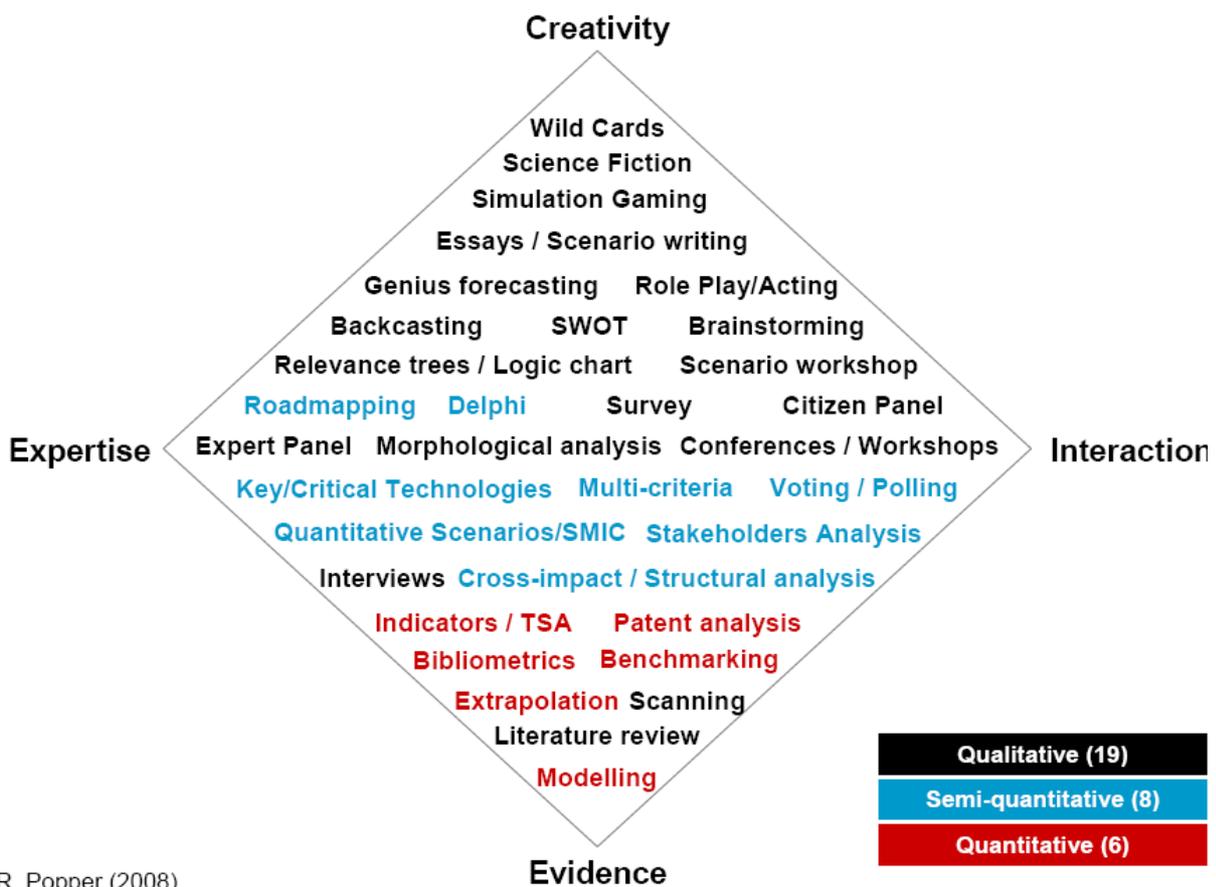
- The actors and agents;
- The social structures/actor configurations;
- The geographical/regional dimension;
- The historical dimension in horizon scanning;
- The temporal dimension in horizon scanning;
- The cognitive/epistemic dimension in horizon scanning;
- The likely shape of the economy in 2030;
- The issues, trends and possible system shocks overlooked in the existing studies.⁷

Another observation of revisiting the FLA for this working document refers to the measurement of big economies: the FLA integrated in this synthesis sometimes use different interpretations of market exchange rates (PPP,⁸ GDP ...) which is not always specified with the references. For instance, in chapter "Emergence of BRIC and E7" Pricewaterhouse and Goldman Sachs assume that PPP will converge to market exchange rates before 2050 which explains their vision on the size of China and other economies.⁹ PWC has developed a methodology for projecting the relative size in the period to 2050 of the 17 largest economies in the world in purchasing power parity (PPP) terms. These comprise the current G7 (US, Japan, Germany, UK, France, Italy and Canada), plus Spain, Australia and South Korea, and the seven largest emerging market economies, which we refer to collectively as the 'E7' (China, India, Brazil, Russia, Indonesia, Mexico and Turkey). The first important conclusion from the PWC report is that there is no single right way to measure the relative size of emerging economies such as China and India as compared to the established OECD economies. Depending on the purpose of the exercise, GDP at either market exchange rates or PPP rates may be most appropriate measure. In general, GDP at PPPs is a better indicator of average living standards or volumes of outputs or inputs, while GDP at current exchange rates is a better measure of the size of markets for OECD exporters and investors operating in hard currencies.¹⁰ For long-term investments, however, it is important to take into account the likely rise in real market exchange rates in emerging economies towards their PPP rates in the long run, although our modelling results suggest that, for countries such as China and India, this exchange rate adjustment may still not be fully complete even by 2050.

Suggestions to overcome these shortcomings for the Expert Group Report "Global Europe 2030-2050" are made at the end of this document.

Definition: Forward looking activities (FLS), whether reflexive or operational, qualitative or quantitative, participative or based on the expert’s opinions, have a long tradition in the European Commission and in many national governments, who support studies that allow them to better seize the challenges of the future. The term “forward-looking activities” (vs. “Foresight”/“Technology Forecasting”/etc..) therefore includes all exercises with a long term vision derived through qualitative, semi-quantitative and quantitative methods.

The Foresight Diamond



R. Popper (2008)

The social dimension in FLA 2030/50

Globalisation and its impact

"The term *globalisation* has been widely used to describe the increasing internationalisation of financial markets and of markets for goods and services. Globalisation refers above all to a dynamic and multidimensional process of economic integration whereby national resources become more and more internationally mobile while national economies become increasingly interdependent."¹¹

The debate around globalisation and its impacts abounds over whether globalisation is good or bad for the self, the family, the nation, and the world, and encompasses a potentially large number of areas.¹²

Some pessimists see increased interdependence as a terribly destructive trend, while optimists see a more diverse, better life for all¹³. Some people argue that the world is no more globalised than it was in the waning days of the British Empire, but some see an information revolution that is unparalleled in history and widespread in its implications.¹⁴ In economic terms, globalisation refers to the growing economic integration of the world, as trade, investment and money increasingly cross international borders (which may or may not have political or cultural implications).¹⁵

Europe (as the United State) is a great driver of globalisation, and can and should contribute to its shape.

"Now is our moment, now is our opportunity. In order for us to play our role, we must acknowledge global interdependence as the underlying reality of our times, while reinforcing our partnership. We need to think global and act transatlantic. We can build on what we have achieved:

- By re-invigorating the Euro-American economic and political relationship;
- By making the EU-US relationship more outward-looking, and making a conscious effort to engage more with third parties - including emerging powers such as China, India and Brazil;
- By combining our efforts to reform the architecture of international co-operation;
- By working together to mitigate climate change whilst achieving greater energy security;
- By joining efforts to achieve the Millennium Development Goals; and
- By creating a common transatlantic area of security".¹⁶

Multi-ethnic society

National identity will be hampered by three phenomena: the abolition of distances, which allows communicating directly and exists without reference to a community, the weakening of national symbols and the resulting loss of unifying identity, and the situation of identity volatility inherent to the globalizing dynamic. The rise of « multiple identities », based on origin, religion, values and shared interests may result in the setting up of new solidarities and lines of fracture with less reference to territories than before.^{17,18}

The concept of nation-state has proven to be highly successful and very resilient and one might add as drivers potential "reactions" of nation-states to such a trend; this is also related to the weakening of national cohesion factors such as national broadcast TV.¹⁹

While the revisited FLA give only a reference to individual countries (inter alia a number of member states of the EU) the "Global Europe 2030-2050" Expert Group discussion should be focused on trends and developments in the EU as a whole.²⁰

Migration flows

Migration flows are relating to conflicts based on the ethnic and religious tensions²¹ Migratory flows are both: as an asset (i.e. a contribution to the labour force, a counterbalance to aging populations and a contribution to the development of the countries of origin) and a liability (problems with integration, public concern). It implies control of flows, legal and illegal immigration.²²

The OECD performs projections for a number of European countries (Austria, England and Wales, Denmark, Germany, Netherlands, Norway, Sweden) which indicate that the proportion of foreign-born can be expected to grow to a much higher level than today - to between 15 and 32 per cent of the total population in these countries by 2050.²³

In view of the poor management of migration and integration of immigrants in the late 20th century, the immigration scenarios will build on the assessment of the integration capacity of different countries, and not only on the assessment of short term labour-market needs. The integration scenarios will take into account the already present stock of (badly integrated) immigrants, and people of foreign origin, needs for new immigrants according to different sectors of economy, their competences, age and family situation, and costs and benefits of immigration and integration in a longer term perspective. "Migration flows enrich a society and if managed well can provide the necessary diversity in both business and social life. If migration stops societies will stagnate. Illegal immigration may decrease as Europe becomes a less attractive place to go to. There may be illegal immigration from Europe to Asia/ Latin America. Language will not be a restraint for immigrants because of new translation software."²⁴

Maintaining national identity becomes more difficult as exposure to cyberspace leads to common interests and cosmopolitan cultures. "The share of foreign-born people of Western origin decreases in favour of rising proportions of non-Western citizens in the total population, as higher levels of such migrants and higher fertility kick in. Similarly, for the United States, minorities - currently roughly one third of the US population - are expected to become the majority in 2042; and already by 2023 minorities will comprise more than half of all children."²⁵

While these trends are of course not set in stone (zero-rate immigration policies for example would render them obsolete) they do point to a number of implications of rising levels of immigrant populations for the family of the future.²⁶

The city as the standard human habitat

By the 2030s, five of the world's eight billion people will live in cities. Fully two billion of them will inhabit the great urban slums of the Middle East, Africa, and Asia. Up to 2 billion people may live in slums. "Many large urban areas, especially in regions of the world suffering from poor governance, are likely to become centres of criminality and disaffection and may also be focal points for extremist ideologies."²⁷ Rapid urbanisation is likely to lead to an increased probability of urban, rather than rural, insurgency²⁸.

Urbanisation will remain a dominant feature also in the BRICs in the decades ahead. 57% of the BRICs population now live in urban areas, up from 42% in 1975. The urban population is projected to reach an average 68% in 2030— still lower than the current G6 average of 78%. Urbanisation brings environmental issues including water and air pollution, waste disposal and traffic congestion. These challenges will be especially acute in China and India, where the urban share is projected to jump from 41% to 61% in China and from 29% to 41% in India.²⁹

The worst affected cities may fail, with significant humanitarian and security implications. "A greater understanding of the dynamics of urban societies will be required if instability within these regions is to be identified and managed. New ideologies will emerge, driven by religion, ethnic differences, nationalism, inequality or a combination of these factors. Ideological conflicts are likely to occur and extremist groups may use violence to achieve political objectives".³⁰ Urban planners and decision-makers in many cities in Europe are facing these challenges.

Poverty

The proportion of the global population living in extreme poverty is likely to decline.³¹ "However, inequality of opportunity will be more apparent due to globalisation and increased access to more readily and cheaply available telecommunications. Global inequality is likely to be a significant source of grievance, possibly resulting in an increased incidence of conflict. This is despite growing numbers of people who are likely to be materially more prosperous than their parents. Demographic trends may also fuel instability, especially in the Middle East, Central Asia and sub-Saharan Africa having huge proportions of young adults with insufficient educational and occupational opportunities, and confronted with large inequalities in their home countries."³² Furthermore, social disparities between ethnic groups (and natives, and old and new immigrants) in multicultural societies will undermine social cohesion in Europe. Youth bulges are likely to provide a reservoir of disaffected young people. In particular, young males with limited economic prospects may be susceptible to radicalisation. "One open question to this issue is the perception of poverty and how it might change until 2030. The current view, dominated by measures directly related to the degree of participation into monetary market exchanges might not hold."³³

Demography and its impact

The World's population is predicted to rise to over 8.3 billion by 2029, driving increased demands for resources, with 60% urbanised and six billion living within 100 km of the coast.³⁴ Ninety-five percent of that increase will occur in developing countries. The more important point is that the

world's troubles will occur not only in the areas of abject poverty, but also to an even greater extent in developing countries, where the combination of demographics and economy permits populations to grow, but makes meeting rising expectations difficult.³⁵

However, according to the UN 2008 Revision (unlike in the past), growth rates are assumed to decline and eventually to turn negative.³⁶ In this case world population will start declining,³⁷ which constitutes a major change from a pattern that has lasted for centuries. Some projections see world population in 2100 population back to less than 6 billions.³⁸

Aging

By 2045 to 2050, people will live longer as life expectancy in Europe is expected to rise to 81.0 years from the currently estimated average of 74.6 years. Up to 2050 the share of the above 60 age group will be around 37 % in Europe (in absolute figures the increase will be from 161 million to 236 million). Accelerated population ageing will occur also in China as a result of increased longevity, from the current average age of 74 to 79.3 years of age. However, the ageing pace is determined above all by the past one-child policy. The share of the 60+ age group will increase in China from 12 % in 2010 to 31 % in 2050. In absolute figures this means an increase from 166 million to 440 million.³⁹

Within the 60+ age group, there will also be significant growth in the number of the 'very old', i.e. people aged 80 years and over. Whereas the very old constitute 3 % of the European population today, 11 of the former EU-15 Member States will have at least 10 % of their population aged 80 or over by 2050.⁴⁰

The absolute numbers of young people are forecasted to decline between now and 2030, in some cases quite sharply, as is their share of the overall population – for children up to 14 years of age by 8.5%, for young people of 15-24 years of age by 12%, and for young adults aged between 25 and 39 by 15.6%. In contrast, the numbers and share of the elderly will rise dramatically, the 65-79 agers increasing by 37% and the 80+ category by 54%.⁴¹

There are of course important regional and country differences. For example, the population of Japan is already in decline and is expected to fall further in the coming decades, while that of the US is forecast to expand from around 300 million today to about 440 million in 2050. In North America, the population growth will continue to be relatively strong and the age group 60+ will account for only 27 % of the total population. The total population of the EU-25 is projected to increase slightly (by 1.1 percent) between 2010 and 2030, but then to actually decline through to 2050 (after reaching a turning point in around 2025).⁴²

Population ageing means actually three phenomena: a low fertility rate, the regular extension of the life expectancy and the transition of the large cohort of the baby-boomer to the age of retirement. These demographic trends will be pursued in the near future up to 2050 and will induce several consequences or pressures on our societies:

- Growth will be limited by a shrinking number of the population of active age (unless age at retirement is increased, women's employment is facilitated, and immigration increases) employments;⁴³
- The average age of the working population will increase not only by the age structure of the working population but also because the age of retirement will increase with possible impacts on the ways work is organized and on productivity growth;
- Pressures will be exercised for more immigrations and will lead to further increases in the multi-culture of our societies;

“The number of elderly people will increase in comparison with the number of young people or people in prime age, accordingly, a larger transfer of added value will have to take place from the working population to the elderly, this will involve the transfer of resources operated by the government through various social systems, mainly pensions and health care, and the transfer of a larger part of the payments of investment returns to the elderly.”⁴⁴

“Actors such as terrorist organizations, wars, environmental catastrophes, and a global pandemic could eliminate large numbers of the population. Economic development especially of the advancement of women through access to education, to micro-finance, and to birth control contributes to reductions in birth rates in developing countries.”⁴⁵

The elderly will become one of the most frequent users of self-care and e-health services at home (“silver” or “grey” market)⁴⁶ disposing of mobile phones and having access to a computer at home. Nevertheless these future European seniors will form a very heterogeneous group concerning the IST-usage, skills and attitudes as well as in their lifestyles. It was estimated that the purchasing power of the 60+ generation in Germany amounts to some EUR 316 billion, contributing to nearly one third of the total private consumption. According to this study, this share will increase to 41 % by 2050.⁴⁷

Rising age-related public spending⁴⁸

In OECD countries, traditional sources of public finance alone will not suffice to meet future infrastructure needs, which are huge and growing. Especially with the rise of more glocal, smarter, specialized, riskier and more collaborative forms of economic value-creation and new forms of work, based on non-permanent contracts the functionality of social protection and savings (like in pension schemes) and capital-market based forms of savings for retirement are gaining prominence.⁴⁹

Where will new sources of finance come from and what role will the private sector play?

Will the financial, organisational, institutional and regulatory arrangements (the “business models”) currently in place be able to respond adequately to the complex challenges they face, and are they sustainable over the longer term?

Bridging the infrastructure investment gap will demand innovative approaches, both to finding additional finance, and to using infrastructures more efficiently and more intelligently through new technologies, demand management strategies, regulatory changes and improved planning.⁵⁰

Geographical coverage of broadband as a major public infrastructure will acquire centrality.⁵¹ Ageing populations will put increasing pressure on public spending (even though the situation will vary widely from country to country). In the OECD as a whole, health expenditures are likely to rise from an average of 6.7% of GDP in 2005 to double-digit figures by 2050, and pensions could climb on average by around 3 to 4 percentage points of GDP over the same period.⁵² For EU-25, for example, it is projected that age-related public spending will rise by 3-4 GDP points between 2004 and 2050, representing an increase of 10 percent in public spending. These upward pressures will be felt from 2010 onwards and will become particularly pronounced between 2020 and 2040. To the extent that especially pensions are financed largely by pay-as-you-go schemes, it seems clear that in some countries the burden of pension reforms will fall largely on younger generations.⁵³

“The age-related increase in public spending will be very significant in nine Member States (Luxembourg, Greece, Slovenia, Cyprus, Malta, Romania, the Netherlands, Spain and Ireland) with a projected increase of 7 p.p. of GDP or more. These Member States have so far made only limited progress in reforming their pension systems or have maturing pension systems. For a second group of countries – Belgium, Finland, the Czech Republic, Lithuania, Slovakia, the UK, Germany and Hungary - the age-related increase in public spending is more limited, ranging from 4 p.p. to 7 p.p. of GDP. Several of these countries have taken significant steps in reforming public expenditure systems that contribute to limit the increase in future expenditure. The pure demographic effect of an ageing population is projected to push up healthcare spending by between 1 and 2 % of GDP in most Member States between 2004 and 2050.”⁵⁴

Gender differences in ageing are considerable. In Europe women's life expectancy is currently more than 6 years higher than for men. In the age group of 60 years and over, there are 50% more women than men. Of people living alone at the age of 75+ more than 70% are women. The process of enlargement of the European Union is not expected to have a significant impact on the ageing process of the Union's population.⁵⁵

Self ownership of health and an increased responsibility for one's own health (direct information, of self-monitoring and self-treatment) and the active involvement of the population, regardless of age and functional ability, are expected to become an integrated part of the health system of the future.⁵⁶ Breakthrough technological innovations (e.g. new bio-tech pharmaceuticals) could also contribute to improve the future elderly health. Considerable savings on elderly care, and creation of a mass market and new employments, may be expected in the area of ambient assisted living (AAL) services, telecare, and other ICT based solutions.⁵⁷

Medical tourism is becoming a new and emerging international business that is gradually increasing in importance. [...] With higher costs and expertise, in the future, medical tourism is likely to be the new global trend for providing medical services. The rapid developments in medical tourism demands have left the policing and legislation behind.⁵⁸

Labour market, employment and brain drain

“Changes in the economy and the labour market might affect the organisation of tertiary education, notably the division of labour between different types of institutions, and raise issues for equity, access, teaching, etc.

Labour market changes can be envisaged from both quantitative and qualitative viewpoints: on the quantitative side, there are possible labour and skill shortages or oversupply, leading to changes in educational returns, etc.; on the qualitative side, future stakes are the kinds of skills that workers will need in the future and how tertiary education should contribute to their development.

The competition from emerging economies in highly skilled labour can also have a qualitative and quantitative impact on labour markets and tertiary education demand and supply in OECD countries.”⁵⁹

In Europe, “firstly, younger cohorts are declining and will continue to decline through to 2030 and 2050, suggesting less intense competition among young people for jobs. Secondly, although the working-age population will begin to decline from 2010 onwards, the total number of persons in work in the EU-25 will continue to increase until around 2017. Thirdly, more than two-thirds of this increase will be a result of higher numbers of women in work, older women being gradually replaced by better-educated younger women with greater involvement in working life. Similar trends can also be observed in other non-European OECD countries, including Japan and Korea.”⁶⁰

“After 2020, most countries are projected to have a shrinking labour supply over the period 2020 to 2060, except Cyprus (+19.8%), Luxembourg (+19.5%), Ireland (+11%), the UK (+9.2%), France (+3.1%) and Sweden (+2.2%). The projected decrease in the labour force after 2020 is to be ascribed almost exclusively to negative demographic developments, given that labour participation rates are projected to continue their increase.”⁶¹

“Increasing labour force participation rates in most countries and rising net immigration levels in some can only moderate the fall in employment caused by the ageing of the population and the negative population growth of the period 2020 to 2060. This means that Europe would move from having a ratio of nearly 4 elderly non workers for 10 workers in 2007 to a ratio of more than 7 to 10 in 2060. The labour input, measured by total hours of work in the EU is expected to fall by 12.9% between 2020 and 2060.”⁶² These trends reflect projected employment trends and a composition effect, due to the increasing share of employed persons working part-time (mainly due to the increase in women in employment who are more likely to work part-time). The ratio of children and young people to the working-age population is expected to shrink over the coming decades. This fact is pointing to fewer students relative to the working population and might indicate a potential for a small decline in public expenditure on education in the EU as a whole and in almost all the Member States.

The effects of demographic changes in Europe and other parts of the world (like South East Asia, China) and the increasing knowledge-intensity of economic value-creation will intensify the looming war for (academic) talent on a global and very local scale to 2030.⁶³ “It is very unlikely that the EU will be able to produce the scientists, engineers, medical doctors and other qualified professional profiles... There is the danger of a new brain drain, unless Europe gets ready to develop a sort of brain circulation in which it helps by providing education and training not just for

its own needs, but also for the needs of the developing countries that should ultimately provide the human resources...⁶⁴

How is the cross-border mobility of students, academics, educational programmes and institutions changing the higher education landscape and affecting country policies? And how will countries cope domestically with the mounting international pressures and competition? Will the division of labour between the academic sector and other sectors for innovation and science be transformed in a "knowledge economy"? Will (and should) academic research be concentrated in the future in a few higher education institutions? Will the "traditional" link between research and teaching continue to exist in the future? How does the evolution (and revolution) of science thanks to the computing revolution affect university research? And how does the growing internationalisation of science and research transform academic research?⁶⁵

Changing role of families

The fundamental scale and speed of changes within a single lifespan: people within Europe can be born and die in entirely different social, political, and material worlds. This is a historically unique situation and its implications have not yet been fully grasped. As longevity extends yet further for men and women, and families find themselves increasingly with four and even five generations in their midst, the question arises whether multigenerational ties will play out to the advantage or disadvantage of the family in terms of its functions, adaptability and resilience in the face of socioeconomic change.⁶⁶

While there is a trend to smaller, less complex households and family units, other changes mean that more and more people will have commitments and networks outside, both with more disparate kin and step kin and with friends and acquaintances. Other things being equal, time and distance constraints could be expected to result in less contact and cohesion within the family group. But modern technologies, mobile communications and computers, make such a future far less certain. Indeed, their impact is intriguingly ambivalent. Caring for the growing share of frail and sick elderly will pose considerable challenges for families in general, and for the female carers in the family in particular, since it is they who will be bearing the brunt of the responsibilities. This in turn could prove a major obstacle to getting women into or back to work and developing career paths. Full two thirds of the non-institutionalized elderly with long-term care needs rely solely on unpaid help, primarily from wives and adult daughters. Indeed, almost three-quarters of the primary caregivers are women; over 30% of carers are in the labour force, and two-thirds of these working caregivers report conflicts between jobs and care giving.⁶⁷

Shortfall of care staff and in particular limited time available to family members to provide long term sustained care may partly be compensated by already available ICT solutions in support of older people. This does not necessarily imply disengagement of family members, especially women. On the contrary ICT based solutions will enhance independence, autonomy and better quality of life of both elderly and family carers.

The geopolitical dimension in FLA 2030/50

Global crisis of democracy in society

The era out to 2050 will be a time of change.⁶⁸ This is likely to be characterised by instability, both in the relations between states, and in the relations between groups within states. During this timeframe the world is likely to face the reality of a changing climate, rapid population growth, resource scarcity, resurgence in ideology, and shifts in global power from West to East. No state, group or individual can meet these challenges in isolation, only collective responses will be sufficient. Hence, the struggle to establish an effective system of global governance, capable of responding to these challenges, will be a central theme of the era. Globalisation, global inequality, climate change and technological innovation will affect the lives of everyone on the planet. There will be constant tension between greater interdependence between states, groups and individuals and intensifying competition between them. “This mechanisms of this struggle to find a system of global governance will be influenced by the levels at which these decisions are prepared and taken: different decision levels (regional, national, supraregional) will result into different compromise spaces; the potential emergence of non-national, interest based, direct-democratic mechanisms to express opinions and way influences would provide an additional type of compromise”.⁶⁹ Dependence on complex global systems, such as global supply chains for resources, is likely to increase the risk of systemic failures.⁷⁰ Important is what Global democracy and governance means in its goals and sees as progress, and how it reflects people’s value judgments, priorities and aspirations. The effect of this can be in areas such as economic models, human rights and sustainable development.⁷¹

Religion and ideology

Ideological movements, based on religion and identity, will remain a significant factor. Religiously-based political groupings, radical environmentalists and extreme nationalists will all be features of global politics, as will states motivated by ideology. People will fight for their beliefs and these beliefs may not be geographically bounded. “The decline of Catholicism in Europe is matched by its progress in Asia, the diffusion of Protestantism in Latin America and Africa is impressive, but remains more limited in other areas, and the growth of Islam, contrary to popular preconception, has decelerated more than that of other religions (such differences also operate within a single religion or across smaller-scale contexts).”⁷²

Against the background of threats from organised crime, drug trafficking, terrorism, threats from places (the Middle East, the Balkans, the Caucasus, and the Mediterranean), horizontal threats (failed states, hunger, and poverty), democracy seems increasingly unable to represent adequately the body politic, and to deliver solutions to pressing social issues.⁷³

Projecting some underlying societal impulses and dynamics, single-issue movements based on religious orientations⁷⁴ will be more common posing challenges to decision-makers in the fields of social policy (integration policy), healthcare, education policy (e.g. faith-based schooling of “private” overseas suppliers” and their curricula).⁷⁵ Organized religion can also come to a key player in the process of transition and lead to new social contracts.⁷⁶

Redistribution of global power

Out to 2040, the locus of global power will move away from the United States and Europe towards Asia, as the global system shifts from a uni-polar towards a multi-polar distribution of power. This shift, coupled with the global challenges of climate change, resource scarcity and population growth, is likely to result in a period of instability in international relations, accompanied by the possibility of intense competition between major powers. The hegemonic dominance of the US will fade. The US is likely to remain the pre-eminent military power, although, in political, economic and military terms, she is likely to be increasingly constrained as others grow in influence and confidence. However, the rise of individual states, such as China, should not be considered a certainty given the nature and magnitude of the challenges they face, nor should their eventual influence be over-estimated. Instead there will be several states and institutions competing for regional and global influence, cooperating and competing within the international community.⁷⁷

Emergence of BRIC and E7

The 'reincarnation of the silk road' has been suggested as significant corridor for global commerce and financial flows. The silk road, the world's dominant trade route during the Middle Ages, from Middle East to China is reincarnated. By 2030 China will buy more than half of its oil from the Gulf region. Imports of Gulf oil by Asian nations (incl. India) are projected to rise at a rate of 3.7 per cent annually until 2030, accounting for almost half of the world's increased demand for oil.⁷⁸

Investors with long time horizons should look beyond the BRICs – there are many other alternatives worth considering (such as Vietnam or Nigeria) depending on the nature of the investment and the risk tolerance of the investor. The E7 emerging economies (Brazil, Russia, India, China, Turkey, Mexico, Indonesia) will by 2050 be around 50% larger than the current G7 (US, Japan, Germany, UK, France, Italy and Canada). China is expected to overtake the US as the largest economy in around 2025.⁷⁹ Nonetheless, Goldman Sachs argues that growth prospects in nominal terms (including real exchange rate appreciation)⁸⁰ will be limited for China due to rapid ageing and the demographic tailwind which will turn into a significant headwind. China has benefited from strong raw labour growth from the late 1970s until now, but the future demographic outlook suggests that the growth of the labour force will slow down and ultimately decline after 2030.⁸¹

India is now assessed as having the potential nearly to catch up with the US by 2050; the Brazilian economy could be larger than the Japanese economy by 2050; the Russian, Mexican and Indonesian economies could be larger than the German, French or UK economies by 2050; and the Turkish economy could be of similar size to the Italian economy by 2050.⁸²

At the same time European societies are coping with the transformation of the welfare state. Besides the social dimension of this transition, which raises pressing human issues (exclusion, poverty, disaffiliation, disenfranchisement, etc.), this transformation also entails a deep realignment of the technologies of government, a redefinition of the role of the state, and new boundaries of politics.⁸³

An interactive approach to all these problems is required, with combination of general principles and sector specific responsibilities: the private sector must invest in RTD and implement technological solutions and the public sector must promote and finance basic science for early stage technologies and solution oriented governance.⁸⁴

Competition and cooperation among conventional powers

Competition and conflict among conventional powers will continue to be the primary strategic and operational context for the Joint Force over the next 25 years. Some aspects of globalization, and the related rise of non-state powers, will pose difficulties to states in their efforts to preserve their status, but the state will endure as a major power broker into the 2030s. In the next 25 years, the relative balance of power between states will shift, some growing faster than the United States and many states weakening relative to the United States (thinking About China's Potential Military Power).⁸⁵

"The strategic balance of military power is likely to change as Asian states close the technological gap with the West in some areas, develop and maintain strong military forces, and produce and export advanced military equipment to allied states and proxies."⁸⁶ The majority of the technological breakthroughs are likely to be driven by the commercial sector, although technological adaptation in defence will continue at a rapid pace. Nonlethal, Directed Energy Weapons (DEW), space and cyber technologies will be available to a wide variety of actors, both state and non-state. Out to 2040, there are few convincing reasons to suggest that the world will become more peaceful. Pressure on resources, climate change, population increases, changes in age structures, and the changing distribution of power are likely to result in increased instability and likelihood of armed conflict. Total war, harnessing the full power of industrial states, war between major Western powers, and war between liberal democracies, are all unlikely. However, disagreements between major powers over borders influence and resources are probable. Such disagreements may lead to confrontation, including limited wars, where adversaries deliberately exercise restraint in the methods of warfare, their level of commitment or the objectives sought. Intra-state conflict will remain the most common type of conflict. The use of proxies is likely and conflict involving the proxies and partners of major powers is possible. Western militaries may become involved in coalition action against adversaries possessing significant military capabilities, with Western forces possibly fighting from a position of near-parity or even relative disadvantage. Apparently unsophisticated adversaries will have ready access to cheap, yet highly effective, technologies.⁸⁷

EU Security Issues

Maintaining European security requires a comprehensive approach both at national and European level. National security research and foresight activities are not adequately coordinated with the European level research programmes resulting in gaps and overlap between activities. There is an increased focus on the citizen as the object of security.⁸⁸

"The critical need for strong expeditionary forces trained in stability operations to enhance security through the many on-going crisis management operations that EU member states are engaged in, be it through the EU, UN, NATO, or coalitions of the willing, has to be underlined and is a key focus of defence reform programmes in the countries surveyed. There is increasing debate about whose responsibility the provision of security is: it has traditionally understood to be the domain of the state and national governments. However, at a time when, for example, critical infrastructure is owned mostly by private companies, this conception is too narrow and it becomes harder to allocate absolute responsibility upon private actors or necessarily dictate how they will

respond in a crisis situation. In resilience terms and terms of preparedness, ownership extends even beyond the private sector to the individual. Security has thus become the joint responsibility of the state and society at large including the private sector.”⁸⁹

The economic and technological dimension in FLA 2030/50

Economic Developments / Distribution of scarce resources

Using a base line of 2.5% growth for the developed world and 4.5% growth for the developing world, including China and India (a figure that grossly understates the present growth trajectory of these two nations), the world economy would double by the 2030s and global trade would triple.⁹⁰ Several economic scenarios for Europe until 2050 project the emergence of a strong Europe within a global economy, where international cooperation is prominent, while other scenarios feature limited international cooperation.⁹¹ Even within the most optimistic economic scenarios, there will be major areas of the world left behind. Between now and the 2030s, many of these areas will likely lie in sub-Saharan Africa and the Middle East (excluding the oil boom countries). Although both regions have maintained impressive growth rates over the past several years, those rates have not been sufficient to decrease unemployment.⁹²

Energy consumption

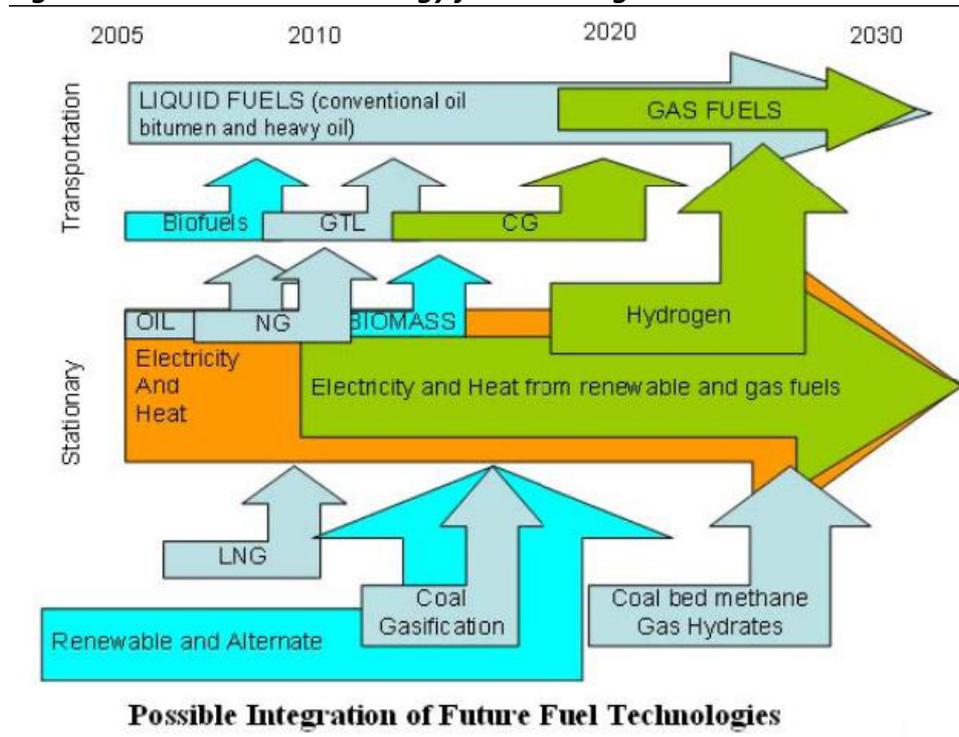
By 2030 there is expected to be a considerable increase in demand for energy. In particular gas will be of increasing importance as states struggle to maintain energy supplies. The majority of this gas will probably come from a few regions, namely the Arctic, Central Asia, the Persian Gulf (especially Qatar and potentially Iran), Russia and Africa. Many boundary disputes, such as those in the Arctic, Gulf of Guinea and the South Atlantic will become inextricably linked to the securing of energy supplies. The EU will be critically dependent upon energy imports.⁹³ To meet even the conservative growth rates posited above, global energy production would need to rise by 1.3% per year. By the 2030s, demand would be nearly 50% greater than today. To meet that demand, even assuming more effective conservation measures, the world would need to add roughly the equivalent of Saudi Arabia's current energy production every seven years. Fossil fuels will still make up 80% of the energy mix in the 2030s, with oil and gas comprising upwards of 60%.⁹⁴

Energy consumption levels are directly related to economic development, population size, final goods consumption, transportation intensity, and the provision of basic and more sophisticated services and to environmental impacts. The most important are: limited availability of fossil fuels in the long term; environmental degradation arising from exploration, extraction, refining and usage of petroleum derivatives; effects on economic growth of high oil and derivatives prices.

Europe represents today 20% of world energy consumption and might be less 12% by 2050.⁹⁵ Some paper seeks to explore some of the conditions under which energy policy could be formulated in and by the EU over the next 40 years⁹⁶ and suggest simultaneous and coordinated progress on many fronts – finance, technology, research and development (R&D), the development of adequate supply chains, change in generation mix and grid capability.⁹⁷ For instance, Shell⁹⁸ has proposed two scenarios highlighting two different ways the world may deal with the three unavoidable truths about the future of energy: the surge in energy demand, the end of easily accessible oil, and increasing environmental stresses.

The APEC roadmap⁹⁹ suggests path-ways of each fuel area, and merged issues related to the interaction of these into an integrated energy pattern.

Figure 1: Future Fuel Technology for APEC Regions



Source: Future Fuel Technology for APEC Regions

Oil shortage

Oil is forecast to reach peak consumption by 2020 or 2030, depending on pessimistic or optimistic scenarios. The robustness of the estimates has been questioned but current industry expectations are that by 2050 oil consumption will be lower than consumption in 2000 (141 EJ/year) in a 'pessimistic' scenario, and slightly higher in an 'optimistic' scenario. The food chain currently is largely dependent on non-renewable fossil fuel energy, and mainly on oil. The size of energy reserves (melting of the Arctic ice cap may substantially increase the availability of reserves; coal gasification and related technologies may be used to exploit still abundant coal reserves), and the depletion rate, but especially the global warming effects of continued reliance on fossil fuels, will affect strongly food production, distribution and consumption.¹⁰⁰

Siemens, Pictures of the Future, designed a picture on power grids in the year 2030: Harvesting electricity in 2030. A solar thermal power plant in the Moroccan desert covers 100 km², which makes it the world's largest installation of its kind. Using HVDCT lines, the electricity is transmitted as direct current at 1000 kV to the coast, where it transforms salt water into pure drinking water. From there, it is transmitted across the sea to Europe, where it provides clean power to many countries.

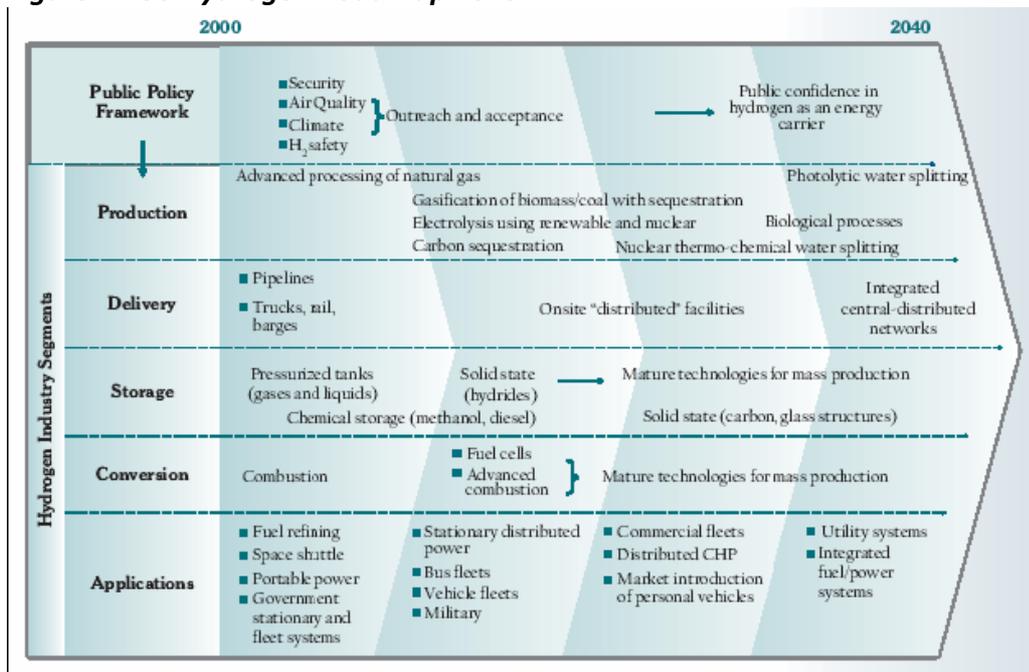
“What is referred to via the report by Siemens is a vision explored and researched since 15 years by some German researchers (including within the DLR) and especially Dr. Knies. It got to public attention recently via the Desertec consortium (<http://www.desertec.org/>) initiated by the later.

Along the same lines, space agencies have been exploring the options to generate energy in Earth orbits for terrestrial use. While most of these publications can be considered as optimistic regarding their time frame, the period to 2050 will likely see such applications emerging.”¹⁰¹

By 2030, the European Union could cover one quarter of its road transport fuel needs by clean and CO₂-efficient biofuels. A substantial part to be provided by a competitive European industry. This significantly decreases the EU fossil fuel import dependence.¹⁰²

It is suggested that hydrogen generated from diverse domestic resources can reduce demand for oil by more than 11 million barrels per day by the year 2040.¹⁰³

Figure 2: US Hydrogen Roadmap 2040



Source: *The US Hydrogen Roadmap 2040*

By taking a leading position in the worldwide market for hydrogen technologies, Europe could open new economic opportunities and strengthen its competitiveness. Introducing hydrogen into the energy system could reduce the total oil consumption by the road transport sector by 40% between now and 2050. “Comparing the spending for hydrogen production, supply and vehicles with the savings to be gained from replacing conventional fuel and conventional vehicles over time, the extensive and high-quality simulations of the project predict that the break-even point would be most likely reached between 2025 and 2035.”¹⁰⁴ The EC HyWays Roadmap estimates that in 2030 there will be 16 million hydrogen cars and the total cumulative investment for infrastructure build-up will amount to €60 billion.¹⁰⁵

Water shortage

As we approach the 2030s, agriculture will likely remain the source of greatest demand for water worldwide, accounting for 70% of total water usage. In comparison, industry will account for only 20%, while domestic usage will likely remain steady at 10%. “Per unit harvest yield, developed

nations are more efficient than developing nations in using available water supplies for agricultural irrigation and use far less than the 70% average.”¹⁰⁶ Improved agricultural techniques could further increase the amount of land under irrigation, and increase yields per unit of water used. By the 2030s, at least 30 developing nations could use even more of their water for irrigation.¹⁰⁷ Some reports identify supply- and demand-side measures that could constitute a more cost effective approach to closing the water gap and achieve savings in different countries.¹⁰⁸

Food shortage

“Global consumption of food has increased. In China, the volume consumed has more than doubled for almost all food types from 1990. In India and in Brazil the increase has been between 10% and 70% (according to different types of food). According to FAO projected population and socio-economic growth will double current food demand by 2050. To meet this challenge, cereal yields need to increase by 40%, net irrigation water requirements by 40-50%, and 100-200 million ha of additional land may be needed.”¹⁰⁹ In several FAO documents from 2008 the different dimensions of the food crisis have highlighted. “World food demand is expected to grow due to an absolute population growth (+ 3 billion by 2050) and an estimated 3-4 billion climbing the food chain, eating more grain intensive livestock products (some 37% of world grain harvest is used to produce animal protein); by 2050 global farm animal production is expected to double from present levels.”¹¹⁰ After two decades during which agricultural policies in the EU were devoted to decreasing production surpluses, a focus on quality, and the provision of goods and services beyond merely food and fibre production, the issue of ‘who will feed the world’¹¹¹ has emerged again with strength. In a speech to the Italian parliament in September 2008 the director-general of the FAO said that “we must mobilize US\$30 billion dollars a year in order to double food production so as to feed a world population of nine billion in 2050”.¹¹²

Humans have already doubled the flow of reactive nitrogen on the continents, and some projections suggest that this may increase by roughly a further two thirds by 2050. Food security will not be achieved by 2050, and child malnutrition is not eradicated despite increasing food supply and more diversified diets.¹¹³ Improvements and efficiencies in agricultural production are likely to meet much of the increased demand, given likely scientific advances that develop high-yield, disease resistant crop strains, combined with better land usage and improved irrigation. Some regions, such as Siberia and parts of Canada, may open up to wider cultivation. The oceans will be further exploited for protein, raising the demand for fishing rights in previously inaccessible areas, such as the Polar Regions.¹¹⁴

New Developments in Technology

New Developments in Technology are dramatically redefining the way we see and conceptualise the human body, and even life itself. Perhaps the most important trend in the area of science and technology is the continuing information and communications revolution and its implications. Although many pundits have touted the ability of information to “lift the fog and friction of war,” such claims have foundered on the rocks of reality. Key to understanding information technology in the 2030s is the fact that the pace of technological change is accelerating almost exponentially.¹¹⁵

Major advances in biotechnologies are redefining the boundaries of humanity itself and calling into question the distinction between artefact and nature/life&dead/organic/inorganic.¹¹⁶ Contrary to popular belief, the major socioeconomic effects of biotech in the mid-term will likely be in agriculture, not health.

There are increasing requirements for transcontinental infrastructure facilities. The Chinese government is planning to build 97 new regional airports by 2020 at an estimated cost of USD 62.5 billion.¹¹⁷

Acceptance and deployment of emerging technologies by the social services, and social interoperability of services will be a major challenge in the European Union.¹¹⁸

Modern weapons technologies

The proliferation of modern weapons' technologies, and probably Weapons of Mass Destruction (WMD), will generate instability and shift the military balance of power in various regions. Counter-proliferation initiatives are unlikely to be wholly successful, and nuclear weapons are likely to proliferate. Terrorist groups are likely to acquire and use chemical, biological and radiological weapons possibly through organised crime groups. Many states are likely to develop ballistic and cruise missiles capable of delivering Chemical, Biological, Radiological or Nuclear (CBRN) weapons, as well as conventional payloads. Ballistic Missile Defence (BMD) and other air defence technologies may mitigate some of the risk, but they are unlikely to remove the threat completely. Innovation and technology will continue to facilitate change. Energy efficient technologies will become available, although a breakthrough in alternative forms of energy that reduces dependency on hydrocarbons is unlikely. The most significant innovations are likely to involve sensors, electro-optics and materials. Application of nano-technologies, whether through materials or devices, will become pervasive and diverse, particularly in synthetic reproduction, novel power sources, and health care.¹¹⁹

Space: Extending the current economic frontier

From purely governmental activities during the first decades, space has gradually matured and a few areas have developed a substantial commercial basis, such as the telecom sector. Most space applications are however still largely dominated by governmental activities and government priorities. In the words of the OECD “[...] space business is not business as usual” for three main reasons: Governments set the rules and the conditions for space activities (including private ones) and tend to intervene heavily in their activities due to the strategic role of space and the dual-use character of technologies; furthermore, most research and development in space is financed or done by governmental entities; and finally, governments are the most important customers of space products and services.¹²⁰

By 2030 and until 2050, how much and what space business will be ‘business as usual’? Contrary to the very few space actors of the first 50 years of the space age, space technology is increasingly accessible to developing countries and purely commercial enterprises. Until 2030 and beyond, this is expected to evolve further: new actors with new commercial models and approaches are “everyday” entering the space domain and this could accelerate radically. Services from space

should be available worldwide in many more areas that might not be envisaged today. By 2030 to 2050 Earth orbits possibly up to the Moon can be expected to be part of an integrated widely accessible commercial activity zone, while the boundaries of the horizon of classical space science and exploration will have progressed further out into the solar system. Accompanying this current trend, the rules and regulations of outer space will have been adapted by 2030 and beyond, with a new, still to be found equilibrium between strategic defence, economic and societal needs.¹²¹

Bioeconomy

“An expected increase in elderly populations, both in China and in OECD countries, will increase the need for therapies to treat chronic and neurodegenerative diseases, some of which will be based on biotechnology. Many countries and healthcare providers will try to reverse rapidly increasing healthcare costs. Biotechnology provides possible solutions to reduce the cost of pharmaceutical R&D and manufacturing. Alternatively, biotechnology could improve the cost-effectiveness of health therapy, so that expensive treatments provide commensurate and significant improvements to health and the quality of life. Within the OECD region, biotechnology could contribute to 2.7% of GDP in 2030, with the largest economic contribution of biotechnology in industry and in primary production. The economic contribution of biotechnology could be even greater in developing countries, due to the importance of these two sectors to their economies. Some FLA assume an increasingly multi-polar world, with no single country or region dominating world affairs. They include plausible events that could influence the emerging bioeconomy. The results highlight the importance of international cooperation, and technological competitiveness in influencing the future. Complex scientific challenges and poorly designed regulations could reduce the ability of industrial biotechnologies to compete with other alternatives. For instance, rapid reductions in the cost of renewable electricity combined with technical breakthroughs in battery technology could result in electrical vehicles out-competing biofuel transport systems. Public attitudes could result in some biotechnologies not reaching their potential. An example is predictive and preventive medicine, where the advance of this technology could be limited by public resistance to poorly planned and intrusive healthcare systems, advances in genetic counselling and prenatal genetic engineering.”¹²²

The ecological dimension in FLA 2030/50

The consumption of ecosystem services, which is unsustainable in many cases, will continue to grow as a consequence of a likely three- to six-fold increase in global GDP by 2050 even while global population growth is expected to slow and level off in mid-century.¹²³ Population will continue to rise too rapidly and will constitute a mainly urban-based society). The rise in income will be greatest in Asia (economic centre of gravity). The gap in average income per person between rich and poor world will be narrowing, but the gap between the richest and poorest will be widening. There will be various severe environmental crises (rising ocean levels, habitat destruction, increased disease transmission, declined crop productivity, overfishing, declined water availability, increased natural hazards, changed ocean chemistry).¹²⁴

Increasing atmospheric greenhouse gas concentrations

Current global energy trends continue with increasing atmospheric greenhouse gas concentrations. “Coal overtook oil in 2003 as the leading contributor to global energy-related CO₂ emissions, and consolidates this position through to 2030. Developing countries account for over three-quarters of this increase in emissions, and they overtake the OECD economies as the biggest emitter shortly after 2010. China alone is responsible for about 39% of the rise in global emissions as a result of strong economic growth and heavy reliance on coal in power generation and industry.”¹²⁵ The global energy-related carbon dioxide emissions increase by 55% between 2004 and 2030, at an annual rate of 1.7% whereas the global primary demand is projected to grow by more than 50% between now and 2030, at around 1.6% per year. Fossil fuels remain the predominant source of energy to 2030, accounting for 83% of the overall increase in energy demand between 2004 and 2030. “Coal sees the biggest increase in demand in absolute terms, driven by power generation. Each year of delay in implementing adequate policies would have a disproportionately larger effect on emissions. Any delays in stepping up energy-related research and development efforts in the field of CO₂ capture and storage would hinder prospects for bringing emissions down after 2030.”¹²⁶ This is achieved primarily through: improving efficiency in energy production and use; increasing reliance on non-fossil fuels; and sustaining the domestic supply of oil and gas within net energy-importing countries.¹²⁷ A 100% renewable electricity supply would require an adequate market and infrastructure potential of natural resources, but in addition to renewables, there are other routes to achieving a low carbon future. Amongst the most significant, the expansion of nuclear power and the development of carbon capture and storage (CCS) for the burning of fossil fuels.¹²⁸

Rising temperatures alter Earth's climate

Emerging evidence suggests that the temperature rise could be significantly quicker and/or higher: “The free market fails to limit climate-damaging emissions sufficiently, because polluters do not have to pay for the damage they cause. A basic role of policy in such cases is to ‘internalise’ such costs into emitters’ cost structures – the ‘polluter pays’ principle.”¹²⁹

Climate change being a global issue, it also requires that national policies are mutually consistent; but some of the biggest emitting countries are not yet engaged in international agreements.

“However, political positions are evolving, and we see a greater than 50% likelihood that some sort of global emissions trading system will be in place within five years. Climate change will amplify existing social, political and resource stresses, shifting the tipping point at which conflict ignites, rather than directly causing it.”¹³⁰ Extant greenhouse gas emissions will result in global temperature increases out to 2040, which are likely to be unevenly distributed, irrespective of any agreement to limit future emissions. These temperature increases are likely to lead to significant environmental change that may, for example, include desertification in the Saharan margins and changes to rainfall distribution patterns within the monsoon belt of the Arabian Sea and South Asia. The frequency and intensity of extreme weather events will change, possibly with severe impact on low-lying coastal regions. Rapid glacial melt, particularly in the Himalayas, may exacerbate water management problems in China, India, Pakistan and Bangladesh. Disease carriers, such as malarial mosquitoes, are likely to spread into previously temperate zones.¹³¹

Climate change and natural disasters

The impact of global warming and its potential to cause natural disasters and other harmful phenomena such as rising sea levels has become a prominent—and controversial—national and international concern. Some argue that there will be more and greater storms and natural disasters, others that there will be fewer. In many respects, scientific conclusions about the causes and potential effects of global warming are contradictory.¹³²

Climate change is recognised by leading experts to be a truly new factor in the dynamic of conflict. It will have two major impacts on conflict. First, the operating environment will change, with increased desertification, melting ice caps, reduced water run-offs, higher ambient temperatures and more severe weather events. UK Armed Forces may need to be able to operate in areas of climatic extremes, from the Polar Regions to the desert. Second, and more importantly, climate change will affect large numbers of people, many of whom live in regions and states that will not be able to adapt quickly enough to avoid the worst effects. This is likely to create instability, especially in those states that are already vulnerable to other pressures.¹³³

Even with very strong expansion of the use of renewable energy and other low carbon energy sources, hydrocarbons may still make over half of global energy supply in 2050. Extensive carbon capture and storage would allow this continued use of fossil fuels without damage to the atmosphere, and also guard against the danger of strong climate-change policy being undermined at some stage by falls in fossil-fuel prices. “Estimates based on the likely costs of these methods of emissions reduction show that the annual costs of stabilising at around 550ppm CO₂e are likely to be around 1% of global GDP by 2050, with a range from –1% (net gains) to +3.5% of GDP. Even if the annual flow of emissions did not increase beyond today's rate, the stock of greenhouse gases in the atmosphere would reach double pre-industrial levels by 2050 - that is 550ppm CO₂e - and would continue growing thereafter. But the annual flow of emissions is accelerating, as fast-growing economies invest in high carbon infrastructure and as demand for energy and transport increases around the world. The level of 550ppm CO₂e could be reached as early as 2035.”¹³⁴ At this level there is at least a 77% chance - and perhaps up to a 99% chance, depending on the climate model used - of a global average temperature rise exceeding 2°C

Thanks to strong growth in the energy intensive industrial and transport sectors, China is projected to overtake the US in terms of carbon dioxide emissions by 2015. By 2030, China is expected to account for nearly one-quarter of the world total, compared with 19% in the US. At the other end of the scale, Russia's emissions are only projected to return to Soviet-era levels in 2030, placing it on a par with India, at 5% of the world total. Brazil will not be a major player; its share of world CO₂ emissions is forecast to remain steady at 1.4%.¹³⁵

Agriculture and habitat transformation

“In the Millennium Ecosystem Assessment Vision 2050, a further 10–20% of grassland and forestland is projected to be converted between 2000 and 2050 (primarily to agriculture). Habitat loss in terrestrial environments is projected to accelerate decline in local diversity of native species in four scenarios by 2050. Across all the scenarios, global water withdrawals increase between 20% and 85% between 2000 and 2050.”¹³⁶

By 2050, global water availability increases by 5–7% (depending on the scenario), with Latin America having the smallest increase (around 2%, depending on the scenario), and the Former Soviet Union the largest (16–22%)¹³⁷ Population growth, arable land and fresh water limits, and climate change have profound implications for the ability of agriculture to meet this century’s demands for food, feed, fibre and fuel while reducing the environmental impact of their production. Success depends on the acceptance and use of contemporary molecular techniques, as well as the increasing development of farming systems that use saline water and integrate nutrient flows.¹³⁸

Figure 3: Ecosystems and human well-being

Figure 1: The Millennium Ecosystem Assessment scenarios²³

Globalization	
<p>GLOBAL ORCHESTRATION: a worldwide connected society in which global markets are well developed. Supra-national institutions are well placed to deal with global environmental problems, such as climate change and fisheries. However, their reactive approach to ecosystem management makes them vulnerable to surprises arising from delayed action or unexpected regional changes.</p> <p>The scenario is about global cooperation not only to improve the social and economic well-being of all people but also to protect and enhance global public goods and services (such as public education, health, and infrastructure). There is a focus on the individual rather than the state, inclusion of all impacts of development in markets (internalization of externalities), and use of regulation only where appropriate. Environmental problems that threaten human well-being (such as pollution, erosion, and climate change) are dealt with only after they become apparent. Problems that have little apparent or direct impact on human well-being are given a low priority in favor of policies that directly improve well-being. People are generally confident that the necessary knowledge and technology to address environmental challenges will emerge or can be developed as needed, just as it has in the past. The scenario highlights the risks from ecological surprises under such an approach. Examples are emerging infectious diseases and other slowly emerging problems that are hard to control once they are established. Other benefits and risks also emerge from the inevitable and increasing connections among people and nations at social, economic, and environmental scales.</p>	<p>TECHNOGARDEN: a globally connected world relying strongly on technology and on highly managed and often-engineered ecosystems to deliver needed goods and services. Overall, eco-efficiency improves, but it is shadowed by the risks inherent in large-scale human-made solutions.</p> <p>Technology and market-oriented institutional reform are used to achieve solutions to environmental problems. In many cases, reforms and new policy initiatives benefit from the strong feel for international cooperation that is part of this scenario. As a result, conditions are good for finding solutions for global environmental problems such as climate change. These solutions are designed to benefit both the economy and the environment. Technological improvements that reduce the environmental impact of goods and services are combined with improvements in ecological engineering that optimize the production of ecosystem services. These changes co-develop with the expansion and development of property rights to ecosystem services, such as requiring people to pay for pollution they create or paying people for providing key ecosystem services through actions such as preservation of key watersheds. These rights are generally created and allocated following the identification of ecological problems. Because understanding of ecosystem function is high, property rights regimes are usually assigned long before the problem becomes serious. These property rights are assigned to a diversity of individuals, corporations, communal groups, and states that act to optimize the value of their property. We assume that ecological management and engineering can be successful, although it does produce some ecological surprises that affect many people due to an over-reliance on highly engineered systems.</p>
Reactivity	Proactivity
<p>ORDER FROM STRENGTH: a regionalized and fragmented world concerned with security and protection, emphasizing primarily regional markets, and paying little attention to the common goods, and with an individualistic attitude toward ecosystem management.</p> <p>Nations see looking after their own interests as the best defense against economic insecurity. They reluctantly accept the argument that a militarily and economically strong liberal democratic nation could maintain global order and protect the lifestyles of the richer world and provide some benefits for any poorer countries that elect to become allies. Just as the focus of nations turns to protecting their borders and their people, so too their environmental policies focus on securing natural resources seen as critical for human well-being. But, as in Global Orchestration, people in this scenario see the environment as secondary to their other challenges. They believe in the ability of humans to bring technological innovations to bear as solutions to environmental challenges after these challenges emerge.</p>	<p>ADAPTING MOSAIC: a fragmented world resulting from discredited global institutions. It sees the rise of local ecosystem management strategies and the strengthening of local institutions. Investments in human and social capital are geared toward improving knowledge about ecosystem functioning and management, resulting in a better understanding of the importance of resilience, fragility, and local flexibility of ecosystems.</p> <p>There is optimism that we can learn, but humility about preparing for surprises and about our ability to know all there is to know about managing socioecological systems. Initially, trade barriers for goods and products are increased, but barriers for information (for those who are motivated to use it) nearly disappear due to improving communication technologies and rapidly decreasing costs of access to information. There is great regional variation in management techniques. Some local areas explore adaptive management, using experimentation, while others manage with command and control or focus on economic measures. Eventually, the focus on local governance leads to failures in managing the global commons. Problems like climate change, marine fisheries, and pollution grow worse, and global environmental surprises become common. Communities slowly realize that they cannot manage their local areas because global problems are infringing, and they begin to develop networks among communities, regions, and even nations to better manage the global commons. The rebuilding is more focused on ecological units, as opposed to the earlier type of management based on political borders that did not necessarily align with ecosystem boundaries.</p>
Regionalization	

²³ Carpenter S. R., Pingali P. L., Bennett E. M., Zurek M. B. (eds), 2005, *Ecosystems and Human Well-being: Scenarios*, Volume 2, The Millennium Ecosystem Assessment, Washington DC. MA scenarios are differentiated in terms of: 1) global development (globalization versus regionalization); and 2) ecosystems management (proactive versus reactive).

Outlook and potential TOR for the Expert Group (Report)

Taking stock of the most important facets and orientations of the exercises integrated in this compilation of FLS some methodological notes may help guiding the Expert Group work, particularly to start with a well-formulated question guiding the exercise; to deliver implications and action points; and to focus on the dynamics of needs, desires, demands and capacities of systems to meet them. Beyond this it was observed that some issues seem to have been largely left out of the picture, which need to be integrated into the final Expert Group Report.¹³⁹

Starting with a well-formulated question guiding the exercise

Only few of the studies have been made with a clear perspective on the outcomes and the deliverables of each study. As a lessons learned, the Expert Group Report should be starting with formulating a question and the different contexts of use. Especially the focus on Europe in 2030/2050 it seems of utmost importance to formulate an overarching, research- and theorizing-guiding question, e.g. to define the interest of the European Commission and the different stakeholders of this process. A clarification of the recipients seems to be worthwhile to be able to modify the trend screening as well as the selection of trends and developments helping to frame the angle for drafting narratives. Another way for synthesis is to suggest the most compelling problems which may be requiring learning and solutions or settlements (often these are the most dynamic imbalances). Examples would include rising disability, climate change, very visible institutional failures (e.g. universities in Europe, joblessness).

Alternatively, the Expert Group could try to find out the places that are making the future, the lead markets, the consumer groups who are setting the pace for others. One variant of this approach would look at the consciously futuristic cities or towns like Hamarby, Vauban, Masdar; or at consumption patterns of today's teenagers and 20 "somethings" who will be in their middle age by the time our period begins.

Delivering implications and action points

Most of the studies have not been oriented on delivering implications and action points. The final Expert Group Report should try to integrate the action perspective, e.g. pointing on potential impacts or fields of impacts and fields of action and policies. This might help to handle the complexity embedded in the foresight process. In delivering implications, the Expert Group could also point to indicators to be able to monitor and to proactively counter some developments. To counter the risk of entailing short-termism and myopia, the Expert Group could define indicators, which may not contribute to the econometric-based analysis, but which seem to be important in the future.

Focussing the dynamics of needs, desires, demands and capacities of systems to meet them

Peoples' needs and desires include material needs for water, energy etc but also needs for love, friendship, health etc. These latter are becoming much more important in the economy, and of course much more important in public policy (for example the steady rise in the relative importance of psychological health relative to physical health). The ever greater emphasis on

wellbeing as a goal is part of this. The other side of the coin is capacities of systems to meet these needs and desires, whether those are markets or states. This takes us to questions of fiscal capacity, government effectiveness etc, but also the speed with which markets can deploy new technologies.

Suggestions for further work

The existing studies seem to provide room for improvement concerning the analysis and integration of:

- The situation in the EU-27;
- The actors and agents;
- The social structures/actor configurations;
- The geographical/regional dimension;
- The historical and temporal dimensions in horizon scanning;
- The cognitive/epistemic dimension in horizon scanning;
- The likely shape of the economy in 2030;
- The issues, trends and possible system shocks overlooked in the existing studies.

Identifying and integrating the situation in the EU-27

In the Expert Group Report, more focus on the position of the EU is needed. How will the EU look like in 2030-2050? There should be a reference to the position of the EU in this debate. It may be argued that the EU can develop into a stable and effective system of governance in the Eurasian region, serving as an example for similar constructions elsewhere in the world.

- Will it have achieved peace in stability not only in Europe, but also in the neighbourhood?
- Will the EU succeed in becoming a global player in world politics?
- What about the relationship between the US and the EU?
- Will the EU remain a successful model for regional cooperation?
- Will it be successful in developing a real CFSP as well as a CSDP? And, will such a model be copied elsewhere in the world?

If so, this might have positive consequences for peace and stability elsewhere in the world.

In the presented compilation of FLS there are sometimes references to the situation in individual countries, and among them a number of member states of the EU. However, the Expert Group Report should display the figures for the EU-27 or for Europe as a continent. A framework, for Europe as a whole, should be developed. An analysis of the situation in the EU and a concentration of the debate on the situation in Europe is needed with more focus on the specific position of the EU as a unique model for regional cooperation.

Identifying and integrating actors and agents

The revisited FLA seem to provide room for improvement concerning the analysis and integration of actors and agents, their capacities and capabilities. This is of utmost importance because impulses in and actors constellations and networks are closely interlinked: Certain political

mobilizations have been started by certain actors with certain interests. To ask the question, which actors are pushing which impulses, to define the set of relevant and seemingly not-so-relevant actors, may sometimes prove worthwhile to come up with better and better usable forms of foresight.

One can also ask what measure is able to get a sense of the world in the future: probably a proliferation of new kinds of data sets is required - many more on subjective experience as well as on social networks, degrees of connectedness etc. These may be more telling than the classic indicators suggested for modelling.

Identifying and integrating social structures/actor configurations

An important part of horizon scanning lies in following closely the changes to social structures. The coming of age of certain communities and power groups, like churches and the emergence of other communities and groups, so-called elected affinities like the red-shirts in Thailand, is an essential category for horizon scanning. Without asking the question which social structures, which social networks on the basis of which capacity (money, ideas) are predominant in certain countries and regions changes on the horizon cannot be easily perceived or integrated into horizon scanning. In this context it is most important not only to look at (existing) political institutions. In most developing countries with socio-political structures being in flux, being chronically unfrozen and subject to changes only looking at existing institutions may prove as a fallacy which e.g. hinders foresighters to perceive the emergence of new forms of solidarity and sociality, new forms of communities and community emergence – one of the aspects that could actually be most interesting also for actors in developed countries.

Identifying and integrating the geographical/regional dimension

Another important category to structure horizons for the scanning more thoroughly is to incorporate the geographical and regional dimension make more prominent. To be clear about the fact, in which geographical context with which interrelations to other legally, or politically defined regions certain actors and agents are defining and exerting impulses is sometimes decisive for encompassing horizon scanning (notion of 'beyond nation states'). The Expert Group could attempt to map both, the competitive and predatory dynamics, and the more collaborative ones. This applies not just to geopolitics but also to the economy: e.g. will other sectors become as predatory as finance became in the 2000s, and what responses will that elicit?

Identifying and integrating the historical and temporal dimensions in horizon scanning

Another important category is closely interrelated to defining the geographical and the socio-structural breadth of development. Most impulses and trends, developments which are seemingly unexpected root back in some form or the other, to history.

To open the horizon scanning for more breadth in the analysis it seems worthwhile to scrutinize paths (paths being defined here as stabilized social structures or heuristics/logics in business, politics and society), path-dependency and path-deviation of certain actors in different arenas.

The question, if actors e.g. in the field of energy technology are really deviating from paths, if they even shape new paths by introducing more decentralized, sustainably oriented forms of hybrid technological systems and formulating new political positions or building new capacities in the basis of for example social media technologies seems very interesting and in some ways inevitable for scenario-building.

In the same vein bringing time back into horizon scanning and scenario building seems important. Time and especially temporal logics, the pace of changes and the multitude of different speeds of developments on the basis of socio-structural forms of shaping of impulses or whole strands of (concerted) actions seems highly relevant. Especially in developing countries some processes like the build-up of infrastructure or the stabilization of political systems are paced differently. Most processes of institutionalization or the build-up of infrastructures – social, capital, energy and maintenance infrastructure, follow a different temporal logic. These differentials seem to be worthwhile to be covered in the Expert Group Report.

Identifying and integrating the cognitive/epistemic dimension in horizon scanning

Last but not least, the Expert Group Report needs to be refined concerning the “ideoscapes” – the realm of ideas. Ideas and ideational impulses should not be underrated in terms of their direct and indirect effects on the materialization of different trends and the take-up of certain technological systems. Especially new forms of imagined communities based on religion or based on stabilized, shared aspirations or also technological paradigms are important. Bringing ideas and the formation and development of ideas and ideologies back into horizon scanning may also help to structure or even aggregate some developments. This does not mean that developments should be largely aggregated, running into fallacies. Bringing ideas and ideational innovation as a part of innovation impulses back in the picture should only help to sensitize the experts in horizon scanning. Scrutinizing ideas and institutions simply helps to broaden the realm of the ‘thinkable’.

Identifying the likely shape of the economy in 2030 and beyond

Looking at the economy in 2030 (and beyond) and sector size (many anticipate health in its widest sense as the largest sector; education growing because of positive elasticity of demand; new categories of green industry).

The future has uncertainties. To deal with uncertainties, one needs redundancies in the system. For instance, the concept of nation state may change; the concept of state may not. States may provide citizens certain rights and responsibilities; but may no longer be a place of concentration of specific ‘nationalities’. This implies further that west and east will become geographical terms rather than concepts that capture a certain kind of ideology, religion and lifestyle. With emancipation and a greater “green” awareness, the world may be moving to a new concept – of ruralities or citurals – where people use modern technology to liberate them from living in cities. Technology may redefine the living space. This may be also consistent with the graying of society.

The EU might lose its academic edge over Asia. Asia will both invest in its students and possibly prevent brain drain. The best students may not wish to leave their countries as they have a better

future at home. If the developed countries do not invest in making the UN system better and in setting a good example to the developing world; the potential for institutionalization and incorporation will reduce and the options for control over the BRIC/ E7 will decrease. For Europe to survive in the 21st century it has to cherish and promote the ideals of governance – strong and centralized governance based on bottom –up informative processes. This is needed to control and steer social, ecological and technological processes from spinning out of control.

Identify issues and trends overlooked in the revisited FLA

- Changing jobs, skills and labour;¹⁴⁰
- Changing values and value formation;
- Trends in governance changes at the UN level but also at supranational, regional and local levels;
- Trends with respect to changes in education and research potential;
- Trends with respect to culture;
- Will technology define society or will society define technology?
- Security risks in technology (internet banking; internet communication, etc.).

Identify possible system shocks overlooked in the existing studies

- China may collapse as USSR did;
- Climate change may have major impacts that destabilize regions;
- There may be the rise of extremist nationalist governments within the EU;
- What if migration does not happen? Many immigrants may find it more attractive to move to the BRIC or E7 countries instead.
- BRIC is defined probably as an opposition to the EU/US if EU and US become less important, BRIC may not have much in common.
- Financial recession leading to financial conservatism.

Additional Comments and Insights from the Expert Group

Globalisation and its impact

Some parts of the developing world will be able to use globalization to improve their income leading to job losses in the western world. Outsourcing is one such example. Some parts of the developing world will exploit other parts of the developing world – to access their natural resources. Globalization will also tend to marginalize some parts of the developing world. Terrorism is not just aimed at the developed world; there is terrorism across the globe and will become a global concern.

Intellectual property becomes less protected as technologies leads to large-scale global copying;
Drivers: Indicators of financial integration Indicators of financial disintegration; Indicators of a rise of an alternative economic system; Indicators on outsourcing – who is outsourcing to whom, when, where and in which sectors; Increasing regulation and self-regulation; Extent of violation of IPRs; fields of violation; reasons for violation.

Indicators: Financial systems will dualize - one connected market and one unconnected market. Global competition among media; fight to control media by government. The idea of the *trias politica* may disappear.

The nature of infrastructure will change. Instead of an increasing grid for transport – less roads and rail infrastructure will become necessary with higher precision transport systems and automatic breaking systems; regulated uses of existing transport infrastructure and use of transport that does not require such intensive infrastructure such as modernized hovercrafts. Infrastructure will be accompanied by pay-as-you-use systems and pressure on government will decrease.

Drivers: Infrastructure density per system; Minimizing the infrastructure system – e.g. replace telephone lines by send masts in DCs. Greater regulation of infrastructure; Infrastructure minimalization through new technology; Sewer systems will become self-regulatory localized systems.

Indicators: Less visible infrastructure in 2050; less waste; greater recycling industry; focus on small is beautiful, self-contained, self supporting closed systems.

Multi-ethnic society

The rise of counter movements to counter the fragmentation of identity; The return to provincialism; The rule of law and democracy is put under pressure to cope with ethnic societies.

Drivers: Numbers and types of identities; Internet users; Rise in conflicts on resource use in countries; Rise in international conflicts on resource use; Rise in international court cases on resource use; Rise of nationalistic political parties.

Impact: Countries will become places of residence and not necessarily concentrations of specific nationalities; Disputes are increasingly addressed through court cases, rather than violence.

Migration flows

Besides an individual identity, the young also form a group identity and social identity based on their background community. This then reinforces their commitment to their own minority group. Drivers: Net migration data; Education levels of migration flows; Growth of translation software; Growth of cosmopolitan culture.

Impact: Pre-occupation with integration of new migrants will decrease. As social welfare schemes reduce, the role of migrants becomes less of a burden. As job mobility increases and as one person businesses increase via the internet, migration issues become less relevant.

Poverty

The impacts of climate change may have marginalizing impacts on the poorest; the absolute numbers of poor increase. Western societies may become relatively poorer as the impacts of the financial crises drag on for longer and as greying populations take their toll. Decline in ODA from west. The remaining ODA is not directed at MDGs or poverty reduction but more at securing investment opportunities in DCs. Increase in ODA from China, Middle East and India

Driver: Climate change impacts on poverty; Rise of gini coefficient within and between societies; ODA statistics – from whom to whom, why and in which sectors.

Impact: Poverty within China and India force these countries to revisit their economic model.

Poverty globally is likely to put pressure on democratic systems to change

Demography and its impact

Population growth may be accompanied by modern technologies that reduce the rate of growth of resources needed to meet basic needs. Mobile “all-in one iPod telephones” may replace many needs. China and India will have to invest in systems that meet the needs and aspirations of the populations but not necessarily in the way that the west did. Communist approaches must satisfy also the poorest in order to justify communism. New forms of social developments will take place in China and may be exported to other regions. Population growth is also seen as the wealth of the poorer countries – greater ingenuity and creativity will be unleashed. The development of pension and social security systems in developing countries may reduce the rate of growth of population.

Drivers: Numbers of top quality students in countries and regions. Numbers of top universities in countries and regions. Number of businesses that incorporate social responsibility into the company profile. Coverage of social security systems in developing countries.

Impact: Greater tensions in poorer areas till 2020; beyond 2020 greater investments and stability at least in Asia and Latin America. Chinese investment in Africa leads to different development models in Africa.

Aging

To counterbalance reduced numbers of students at universities and employment shortages, western economies will encourage larger multinationals that will move and operate outside the borders of the parent country. More brain drain towards the South where the new opportunities are. Entrepreneurial individuals will find new kinds of globally relevant employment via the internet. Skills will be at a premium. Age will not be a limiting factor – especially if it is an internet based skill.

As resources for social services decrease, western societies may be forced to become less individualistic and look at different combinations of family structure and internet support (e.g. via Facebook).

Drivers: Net migrations into Europe/ US/ Japan; Net brain drain into Europe /US/Japan; Brain circulation date; Growth of multinationals; Nature of home base of multinationals; Number of multinationals with flags of convenience; Rise of social networks on internet; Rise of new industries (to meet the needs of the aging); Impact; Levelling of economic differences between east and west; Levelling of differences between rich and poor; Nationality will become less important than other kinds of identity.

Rising age-related public spending

China is also in pressures of aging because of the one - child politics that has also lead to imbalance of gender - in some parts of the country as high as 130 boys to 100 girls – this has to be also an impact to the future.

Pharmaceutical companies will come under pressure to reduce the prices of their medicines and equipment – both from the developing world and from the aging in the developed world. Plus there will be competition from drugs marketed through the internet. Prices will normalize.

Senior citizens will provide a different kind of work and life ethic – protecting environmental and social values leading to a different social structure. Senior citizens will perform new kinds of socially relevant tasks – voluntary tasks such as supporting child care; swimming lessons; music lessons etc.

Drivers: Price of drugs worldwide; Healthcare marketed by internet; Health care costs; Life-long learning programmes for senior citizens; Data on activities of senior citizens; More TV programmes and YouTube programmes for entertaining and stimulating mental and physical activity amongst senior citizens.

Impact: Senior citizens will be seen as an important fabric of society; just as children; and not as a burden. Senior citizens will be more health conscious doing exercises, for example, on internet/ TV/ gaming promoted schemes. Social structure will change.

Labour market, employment and brain drain

Changing role of families has impact on social capital and consequently on the capacity of family life to develop values and moral for next generation. There is a link between cultural individualism and the emphasis on family values. Ethnicity and religion have strong implications for the formation of youth identities and social capital. Youth also develop their own individual values that differ from their parents' values.

As elderly people help in taking care of the children, and as internet allows for greater flexibility in work hours, women will participate more and more in the labour market. Brain drain will probably increase; the focus needs to be on brain circulation. One person businesses will increase; Retirement age will disappear; life insurances will disappear. There will be more jobs for elderly people. Artists and musicians may flourish as people still want first hand experience of the arts.

Drivers: Net migration of workers; Net brain drain; Outsourcing reaches a limit as salaries in other countries increase; New jobs for elderly;

Impact: Migration of talent to countries with highest opportunities; Competition amongst employers; Social service sector remains in the country; Financial services will be under strain to cope with competition from cheaper countries. The concept of shops/ malls may disappear. The arts and cultures may flourish.

What seems relevant here is how two different issues, namely demographic change on the one hand, and the generation of qualified human resources, are merged in a long term scenario. Decline in the absolute number of population in tertiary education in Europe, and huge increases in numbers in countries such as China and India, may generate quests for a European brain gain policy.

Changing role of families

Intellectual stimulation of the elderly via internet facilities will reduce brain deterioration.

Emotional stimulation of the elderly will take place via Facebook. Physical care systems may become more limited. The rise of home robots as health care substitutes. Females in the family will all probably be working so there will be limited carers in the family. Families may move closer to each other to increase proximity and social contact, if not physical care. Self supporting groups of elderly people will be formed to help each other in old age.

Drivers: Data on internet literacy of elderly; Data on profiles of internet users of the elderly; Data on home robots; Families will try and live in closer proximity and share some of the care activities – elderly care for the children; children provide company to the elderly. Women will become more emancipated. Data on women's employment. Men will have to share the caring role. Number of elderly moving into rural areas and forming self supporting communities.

Impact: Family structures may change; The elderly will become less isolated and this will stimulate them to be healthy longer. The quality of life of the elderly will improve.

Global crisis of democracy in society

Everything evolves faster than one thinks. Governments will have to work round the clock (no 9-5 systems) to cope with globalization. Perhaps wishful thinking, but I think the next twenty years are critical transition years and after that there should be greater stability at least at global level – with a more legally coherent system of regulation. Countries will want greater democracy at global level; systems of one country one vote will disappear in favour of more representative systems of democracy at global level. However, if governance systems do not cope with the rapidly changing IT, financial flows and environmental challenges, democratic governance may give to more corporate type governance systems for running countries.

Drivers: The drivers will be climate change impacts; Increased use of internet information and misinformation; Greater ability of groups to organize because of internet and new media; Need to control media and internet becomes more important; Voting rules will change.

Impacts: Solutions adopted within and in regional contexts in China and India may have global consequences. Internet becomes more regulated but “illegal internet” also flourishes. There should be a reference to the position of the EU in this debate. It may be argued that the EU can develop into a stable and effective system of governance in the Eurasian region, serving as an example for similar constructions elsewhere in the world.

Religion and ideology

In this context attention also should be given to the probability of having Turkey as a Member State of the EU respectively the influence such a membership can have on stability in the Euro Mediterranean and Middle East region. Religion has always been dominant through history; so there is no reason to think that this will not be the case anymore. However, internet may also secularize belief systems... Identity will remain important; but such identity issues will change as loyalties become transnational – because of the impacts of the internet; global movements of people; international marriages and adoptions. However, there may be a rise of extreme right wing religious groups in western economies as well.

Drivers: Population registered in religious organizations; Populations adhering to specific religions; Indicators of secularization; International marriages/ adoptions; Migration data; New identity indicators

Impacts: Nationality and religion may be less significant as identity elements than newer forms of identity. The technical possibility for non-geographically bounded interest and pressure groups based on common ideologies are likely to impact discussions on global topics.

Redistribution of global power

One of the key open questions directly related to this aspect is the real and the perceived/accepted need for global actions to global questions such as climate change?

Furthermore: this is already visible now and the period we are looking into is likely to be more affected by the reactions to this trend than by the trend itself. The new multi-polarity means also new international institutions, norms and “mental models” to reflect ideologically (c.f. human rights), politically and economically. More focus on the position of the EU is needed. How will the EU look like in 2030-2050? Will she have achieved peace in stability not only in Europe, but also in the neighbourhood? Will the EU succeed in becoming a global player in world politics? What about the relationship between the US and the EU? Will the EU remain a successful model for regional cooperation? One could also argue that the BRIC countries are likely to be unstable in this period as they try to deal with democracy within their very large economies. Domestic challenges may lead to a preoccupation with national rather than global affairs. China and India may be tempted to follow the lead of the US – unilateral leadership without always taking into account the views of other countries. There may be return to power in regional blocks – at supranational and regional level. Possible (quantitative) variables/indicators

Drivers: The EU and US may push for greater global controls over the BRIC countries;

Military expenditure may increase; International regulations may increase;

Impacts: Military competition; Regulatory competition – to see who can upload their national legislation onto the global arena.

Competition and cooperation among conventional powers

More focus on the specific position of the EU is needed. The EU as a unique model for regional cooperation. Will it be successful in developing a real CFSP as well as a CSDP? And, will such a model be copied elsewhere in the world? If so, this might have positive consequences for peace and stability elsewhere in the world. For China and India, domestic, regional as well as global arguments may fuel the need to invest in military power. Potential commercial breakthroughs resulting from military investments may be an attractive additional reason. Furthermore, extreme weather events resulting from climate change may call for ensuring a military strong enough also for civil defence activities. Lack of water and potential water conflict in the South Asian region may also reinforce the need for military investment.

Drivers: Numbers of extreme weather events. Per capita availability of water. Relationship between military expenditure and discoveries that are also commercially viable.

Impacts: Security will be focused not only on global military issues; but also on civilian issues – such as access to resources and support in times of stress. Perhaps warfare is less the goal; and instead it is merely “preparation for war is the best way to ensure peace” – theory of deterrent.

Energy Consumption

It is possible that there is a trend break. Climate change impacts may lead to a global breakthrough and agreements to focus on solar energy. Technological developments may drastically cut down energy consumption in production, distribution and waste processes. Focus on dematerialization and decarbonisation of society. Consumption behaviour changes to more

modest and environment conscious life styles. Spatial planning improves local consumption patterns.

Drivers: Increase in climatic disasters; Developments in energy technology; Developments in military technology may have beneficial spill-over effects; Better use of spatial planning tools

Changing consumer fads

Drivers: Number of climate related impacts and effect on economies; Degree of step-by-step legal agreement at global level; Climate change and air pollution liability court cases; Individual entrepreneurship selling small scale mobile energy sources that compete with large scale established vested interests. Countries and companies with Internalization of environmental costs; Impact: Energy consumption by productive and consumptive sectors reduces per unit output. Small scale self contained renewable energy systems develop globally. Production becomes energy efficient as size of products decreases. A new minimalist culture. Renewable energy breakthrough forced by climate change related agreements from technologies possibly developed in China.

Impact: Sustainable energy systems; Closed contained recycling units; Dematerialization and decarbonisation of society

Oil shortage

China and India will seek alternatives to oil imports; new developments; trend break;

Development of eco-cities and eco-communities;

Drivers: Rising price of oil; Security risks of oil imports;

Impact: Climate change agreements; A transition to non-oil based economies.

Water shortage

Water shortage will be the key driver; Technology in the military and ICT field as well as biotechnology developments

Drivers: Water shortage will be manageable; Eco cities give an impetus to local water recycling; Closed water consumptions units

Impact: Water pollution increases until about 2025 and then improves radically world wide.

Food shortage

Price of food may go up (water scarcity; use for bio fuels; internalization of ecosystem costs)

Cultural changes towards less food consumption and less waste in richer countries; Impacts are minimized via a combination of new knowledge; new awareness and consumer consciousness.

Health concerns; Energy consciousness; Water shortage; Growth in animal welfare groups; Rise of vegetarianism; Food shifts (from red meat to white meat).

Distributional issues will remain critical.

New Developments in Technology

The changing structure of labour market, employment and brain drain is partly related to the extension of ICT technologies and also to the degree of representation of women in labour markets. The increasing share of employed persons working part-time means flexibility in labour markets but also precarious jobs and insecurity increase. In EU27 countries third of 15 to 25 olds are not in education, employment or training (NEETs). This influences their work values and future expectations. The largest computer can do 70.72 trillion calculations per second and this is changing rapidly. Options can be tested rapidly through computers. ICT developments are taking place so rapidly that we may be living in the world of holograms, teleportation, home robots. Many production, design and service activities may be taken over by ICT products. ICT may displace jobs; leading to unemployment. Divide between ICT literate and illiterate

Drivers: The number of ICT users per year. Terabytes of information consumed per person per year.

Impact: Energy use will go up; Need for sustainable and affordable energy; ICT related diseases may go up (e.g. mouse arm of the past); Technologies may start to define social and business life; Increased security risks in IT banking and other commercial transactions.

This aspect could be framed differently: We are more experiencing a metatrend that could be derived by the fusion of scientific disciplines and technologies. The referred to "exponential pace of technological change" has been sustained mainly by ICT. Information technology, social media and virtual reality will imply radical changes to how groups think, perform politics, compete, entertain and educate themselves. This can change the world views of the people.

Increasing atmospheric greenhouse gas concentrations

An analysis of the situation in the EU –and of the impact of the activities of the EU as a global player- is indicated in this context. The question on greenhouse gas concentrations is written in a very one/sided manner. Developing countries include 150 countries and it is logical that their emissions should be more than the 40 or so developed countries. On a per capita basis this is also the case. Why not use the IPCC reports and their long term climate predictions here?

It is not inconceivable that China and India are able to make a breakthrough in renewable energy technology and make large-scale use of this. Carbon capture and storage; The other environmental impacts of coal lead to a closure of coal and fossil fuel mining; On warming non-linearities are important.

Climate Change

Insurance companies will opt out of paying for natural disasters. Richer and poorer countries will be affected. – E.g. current heat wave in Russia may make Russia more positive towards dealing with climate change Better and faster regulatory processes are driven by the natural disasters as the urgency for taking action is demonstrated; Climate change impacts may destabilize certain countries – the risk of governance failure may lead others to take action. Climate change impacts on water supply; Climate change impacts on extreme weather events; The worst impacts of climate change are forestalled.

Footnotes

¹ EC, DG Research and Innovation, Socio-economic Sciences and Humanities (SSH).

² E.g.: The visions and prospects from EU projects, European Technology Platforms and ERA-Nets, from national and international foresight exercises (via the EU EFMN Network and the EFP) and from corporate foresight have been exploited.

³ Studies with a focus on a time frame before 2030 have been omitted. The complete inventory of forward looking studies is portrayed in the Annex document to this paper including the title and reference and an ad hoc summary of the statements or visions made in the respective forward looking exercise.

⁴ Since it was argued that the future is about uncertainty and that uncertainty calls for redundancy, some experts plead for a restructuring of these dimensions.

⁵ EFONET, "Assessment of Energy Foresight in the EU", Foresight Brief No. 163, 2009.

⁶ EFMN database

⁷ For instance: Changing Jobs, skills and labor; Changing Values and Value formation; Trends in governance changes at the UN level but also at supranational, regional and local levels; Trends with respect to changes in education and research potential; Trends with respect to culture; Will technology define society or will society define technology?; Security risks in technology (internet banking; internet communication, etc.).

⁸ Purchasing power parity (PPP) is a theory of long-term equilibrium exchange rates based on relative price levels of two countries. The concept is founded on the law of one price; the idea that in absence of transaction costs, identical goods will have the same price in different markets. An example of one measure of PPP is the Big Mac Index popularized by The Economist, which looks at the prices of a Big Mac burger in McDonald's restaurants in different countries. Although it is not perfect, the index still offers significant insight and an easy example to the understanding of PPP.

⁹ Personal communication of Vasco Cal, May 2010.

¹⁰ PWC, The World in 2050

¹¹ OECD, "Handbook on Economic Globalisation Indicators", 2005.

¹² OECD, "Higher Education to 2030: What Futures for Quality Access in the Era of Globalisation?"; KOF index, measuring three main dimensions of globalization: economic, social, and political

¹³ UK Development, Concepts and Doctrine Centre, DCDC report "Future Character of Conflict" February 2010.

¹⁴ Yale Center for the Study of Globalization

¹⁵ BBC online

¹⁶ José Manuel Barroso President of the European Commission, "A new Atlanticism for the 21st century", Brussels Forum 2010, Brussels, 26 March 2010.

¹⁷ French Ministry of Defence, Délégation aux affaires stratégiques, "Geostrategic perspectives for the next thirty years", 2008.

¹⁸ Development, Concepts and Doctrine Centre, DCDC report "Future Character of Conflict" February 2010.

¹⁹ Leopold Summerer, personal communication, July 2010.

²⁰ Jaap de Zwaan, personal communication, July 2010.

-
- ²¹ Helena Helve, personal communication, July 2010.
- ²² METRIS Report, "Emerging Trends in Socio-economic Sciences and Humanities in Europe".
- ²³ French Ministry of Defence, 2008, op. cit.
- ²⁴ Joyeeta Gupta, personal communication, July 2010.
- ²⁵ OECD, 2008, The Future of the Family to 2030 – A Scoping Report – OECD International Futures Programme.
- ²⁶ OECD, 2008, The Future of the Family to 2030 – A Scoping Report – OECD International Futures Programme.
- ²⁷ " UK Ministry of Defence (2010) Global Strategic Trends - Out to 2040"
- ²⁸ United States Joint Forces Command, Centre for Joint Futures, "The Joint Operating Environment (JOE)", 2008; METRIS Report, "EUR 23741 – Emerging Trends in Socio-economic Sciences and Humanities in Europe", Brussels, 2009.
- ²⁹ Goldman Sachs, "BRICs and Beyond".
- ³⁰ UK Ministry of Defence (2010) Global Strategic Trends - Out to 2040".
- ³¹ The poverty threshold, or poverty line, is the minimum level of income deemed necessary to achieve an adequate standard of living in a given country. In practice, like the definition of poverty, the official or common understanding of the poverty line is significantly higher in developed countries than in developing countries. The common international poverty line has in the past been roughly \$1 a day. In 2008, the World Bank came out with a revised figure of \$1.25 at 2005 purchasing-power parity –PPP (Wikipedia).
- ³² UK Ministry of Defence (2010) Global Strategic Trends - Out to 2040".
- ³³ Leopold Summerer, personal communication, July 2010.
- ³⁴ UK Ministry of Defence (2010) Global Strategic Trends - Out to 2040"
- ³⁵ United States Joint Forces Command, 2008, op. cit.; METRIS Report, "Emerging Trends in Socio-economic Sciences and Humanities in Europe"; OECD, "Higher Education to 2030: What Futures for Quality Access in the Era of Globalisation?", French Ministry of Defence, 2008, op. cit.
- ³⁶ United Nations, World Population Prospects: The 2008 Revision, Population Database, New York: United Nations, 2009.
- ³⁷ Mainly originating in developing countries where, parallel to what was observed in developed countries, fertility rates are assumed to decline as a result of growing prosperity as well as the education and emancipation of women.
- ³⁸ Personal communication of Vasco Cal, May 2010.
- ³⁹ United Nations 2009 World Population Aging.
- ⁴⁰ L'Institut national de recherche alimentaire (INRA), "Agrimonde: Scenarios and Challenges for Feeding the World in 2050"; The 2nd SCAR Foresight Exercise; Government Office for Science, "Tackling Obesities: Future Choices", Project Report, 2007.
- ⁴¹ OECD, "The Future of the Family to 2030", 2008, op. cit.

⁴² METRIS Report, op.cit.

⁴³ Dragana Avramov, personal communication, July 2010.

⁴⁴ Henri Bogaert, personal communication, April 2010 and European Commission, DG ECFIN, "The impact of ageing on public expenditure: projections for the EU-25 Member States on pensions, healthcare, long-term care, education and unemployment transfers (2004-2050)", 2006.

⁴⁵ Helena Helve, personal communication, July 2010.

⁴⁶ Documentation on the European Congress, "Demographic Change as Opportunity: The Economic Potential of the Elderly", Berlin, 17-18 April 2007; Teknologisk Fremsyn, Danish Foresight, "Ageing Society 2030", Sector Futures, "The Health and Social Services Sector", EMCC, 2003.

⁴⁷ Braun Rijkers et al., European Commission, DG RTD, "Special issue on healthcare - Healthy ageing and the future of public healthcare systems", EUR 24044 EN, November 2009.

⁴⁸ Health care, education, long-term care, pensions, unemployment transfers.

⁴⁹ Ingo Rollwagen, "Emerging Issues for the work of the Expert Group of the European Commission on Europe and the World in 2030", April 2010.

⁵⁰ OECD, "OECD infrastructure to 2030: mapping policy for electricity, water and transport", 2007.

⁵¹ E-Inclusion policy, Riga Declaration, June 2006.

⁵² World Economic Forum, "Strategies to address the challenge of financing retirement and healthcare in a rapidly ageing world".

⁵³ OECD, "The Future of the Family to 2030", 2008, op. cit.; World Economic Forum, "Scenarios for the future of pensions and healthcare in a rapidly ageing world".

⁵⁴ European Commission, DG ECFIN, (2009) The 2009 Ageing Report: economic and budgetary projections for the EU-27 Member States (2008-2060).

⁵⁵ European Commission, DG SANCO; World Economic Forum, "The Future of Pensions and Healthcare in a Rapidly Ageing World Scenarios 2030", 2008.

⁵⁶ Danish Research Agency, Ministry of Science, Technology and Innovation, "The-ageing-society-2030".

⁵⁷ Fraunhofer, "EU policy workshop programme".

⁵⁸ Christine Lee, Michael Spisto, "Medical Tourism, the Future of Health Services", 2007.

⁵⁹ OECD, "Higher Education to 2030", op. cit.

⁶⁰ OECD, "The Future of the Family to 2030", 2008, op. cit.

⁶¹ European Commission, DG ECFIN, (2009) , op.cit. p. 24.

European Commission, DG ECFIN, "The impact of ageing on public expenditure: projections for the EU-25 Member States on pensions, healthcare, long-term care, education and unemployment transfers (2004-2050)", 2006.

⁶² EC DG ECFIN, 2009 Ageing Report: Economic and budgetary projections for the EU-27 Member States (2008-2060).

⁶³ Ingo Rollwagen, "Emerging Issues for the work of the Expert Group of the European Commission on Europe and the World in 2030", April 2010.

⁶⁴ Daniele Archibugi, personal communication, April 2010. See also Daniele Archibugi et. al., "Opening to the world: International cooperation in Science and Technology, *New Political Science*", Vol. 32, No. 1, March 2010, and Daniele Archibugi et al., "Report of the ERA Expert Group, Directorate-General for Research", 2008, EUR 23325 EN.

⁶⁵ OECD, "Higher Education to 2030", op. cit.

⁶⁶ METRIS Report 2009, op.cit.

⁶⁷ OECD, "The Future of the Family to 2030", 2008, op. cit.

⁶⁸ Key words: Global power shifts, International terrorism, Emerging Asia, BRIC, E7, terrorism, Attacks on transport systems, Attacks on critical infrastructure, Attacks on crowded places, Attacks with CBRN, Cyber terrorism, Collapse of the Non-proliferation Treaty, Nuclear Iran, Interstate conflict (US/Iran), Transnational crime, Regional conflicts, Israel-Palestine conflict, Arms race in Asia, Fragile states (Iraq Afghanistan Pakistan), State failure, Global governance gaps, Failure to adapt to complexity, Global power shift, European loss of power/Future of EU Regional rivalries, Assertive Russia, Resource competition, Water shortage, Oil shortage, Food shortage.

⁶⁹ Leopold Summerer, personal communication, July 2010.

⁷⁰ UK Development, Concepts and Doctrine Centre, op. cit.

⁷¹ Helena Helve, personal communication, July 2010.

⁷² METRIS Report, 2009, op. cit.

⁷³ UK Development, Concepts and Doctrine Centre, op. cit.

⁷⁴ These quasi-religious movements may turn out to be e.g. technoid, (e.g. using cognitive sciences and applications to come up with "Scientology 2.0") or may also take to combining ecological thinking and spirituality (For an overview of these strands in religion see e.g Bron Taylor, "Dark Green Religion. Nature Spirituality and the Planetary Future", 2009, University of California Press).

⁷⁵ Ingo Rollwagen, "Emerging Issues for the work of the Expert Group of the European Commission on Europe and the World in 2030", April 2010.

⁷⁶ Helena Helve, personal communication, July 2010.

⁷⁷ UK Development, Concepts and Doctrine Centre, op. cit.

⁷⁸ McKinsey Global Institute, "Mapping global capital markets: Fourth annual report", 2008.

⁷⁹ PricewaterhouseCoopers, "The World in 2050: How big will the major emerging market economies get and how can the OECD compete?", March 2006.

⁸⁰ Lionel Fontagné, personal communication, July 2010.

⁸¹ Goldman Sachs, "BRICs and Beyond".

⁸² PricewaterhouseCoopers, op.cit.

⁸³ METRIS Report, 2009, op. cit.

-
- ⁸⁴ Jeffrey Sachs, "Economics for a crowded planet", 2008.
- ⁸⁵ United States Joint Forces Command, *op. cit.*
- ⁸⁶ UK Development, Concepts and Doctrine Centre (2010) Global Strategic Trends out to 2040.
- ⁸⁷ UK Development, Concepts and Doctrine Centre, *op. cit.*; NATO, "Multiple Futures Project: Navigating Towards 2030", Allied Command Transformation, April 2009.
- ⁸⁸ French Ministry of Defence, 2008, *op. cit.*
- ⁸⁹ FORESEC Synthesis Report.
- ⁹⁰ United States Joint Forces Command, *op. cit.*
- ⁹¹ Arjan Lejour, The Hague: CPB Netherlands Bureau for Economic Policy Analysis, "Quantifying four scenarios for Europe", October 2003.
- ⁹² United States Joint Forces Command, *op. cit.*
- ⁹³ UK Development, Concepts and Doctrine Centre, *op. cit.*; French Ministry of Defence, 2008, *op. cit.*
- ⁹⁴ United States Joint Forces Command, *op. cit.*
- ⁹⁵ European Commission, DG RTD, "World Energy Technology Outlook-2050 (WETO-H2)", Luxemburg, 2006.
- ⁹⁶ Jacques J. de Jong, The Hague: Clingendael International Energy Programme (CIEP), "Europe, the EU and its 2050 energy storylines", December 2007.
- ⁹⁷ PWC study 100% renewable electricity, March 2010.
- ⁹⁸ The document is part of a long tradition by Shell of developing scenarios on energy production and use not intended to be forecasts, but rather efforts to understand the different development paths that can be followed.
- ⁹⁹ David E. Minns, "Future Fuel for the APEC Region - APEC 2030 Integrated Fuel Technology Roadmap", Industry Canada, August 2005.
- ¹⁰⁰ The 2nd SCAR Foresight Exercise, *op. cit.*; Goldman Sachs, "BRICs and Beyond"; German Advisory Council on the Environment (SRU), 2010
- ¹⁰¹ Leopold Summerer, personal communication, July 2010. see also:
- The Economist, "Let the sun shine in. Energy: Satellites that beam solar power to earth have often appeared in science fiction. Will they ever become reality?", December, 2008.
 - Peter E. Glaser, "Power from the sun: Its future", Science, 1968.
 - Martin I. Hoffert et al., "Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet", Science, 2002.
 - Leopold Summerer et al., "Prospects for Space Solar Power Work in Europe", Acta Astronautica, 2003.
 - David Cyranoski D., "Japan sets sights on solar power from space", Nature, 2009.
- ¹⁰² EU-Technology Platform on Biofuels.

-
- ¹⁰³ U.S. Department of Energy (DOE), "National Hydrogen Road Map 2040".
- ¹⁰⁴ EU HyWays project.
- ¹⁰⁵ EU HyWays Project.
- ¹⁰⁶ United States Joint Forces Command Joint Futures Group (J59) Joint operating environment 2010.
- ¹⁰⁷ United States Joint Forces Command, op. cit.
- ¹⁰⁸ McKinsey&Company, "Charting our water future".
- ¹⁰⁹ EC (2009) 2nd SCAR Foresight Exercise New Challenges For Agricultural Research: Climate Change, Food Security, Rural Development, Agricultural Knowledge Systems.
- ¹¹⁰ EC (2009) 2nd SCAR Foresight Exercise, op.cit.
- ¹¹¹ Nourrirlemonde.org, 2008
- ¹¹² The 2nd SCAR Foresight Exercise, op. cit.
- ¹¹³ Millennium Ecosystem Assessment Vision 2050.
- ¹¹⁴ UK Development, Concepts and Doctrine Centre, op. cit.; Institut national de recherche alimentaire (INRA), "Agrimonde: Scenarios and Challenges for Feeding the World in 2050".
- ¹¹⁵ United States Joint Forces Command, op. cit.
- ¹¹⁶ OECD, "The Bioeconomy to 2030: Designing a Policy Agenda, Paris - Agricultural and health biotechnologies: Building blocks of the bioeconomy", OECD Journal: General Papers, Paris, 2009.
- ¹¹⁷ OECD International Futures Programme.
- ¹¹⁸ Dragana Avramov, personal communication, July 2010.
- ¹¹⁹ UK Development, Concepts and Doctrine Centre, op. cit.
- ¹²⁰ OECD, "Space 2030 - Exploring the Future of Space Applications", 2004.
- ¹²¹ Leopold Summerer, personal communication, July 2010.
- ¹²² OECD, "The Bioeconomy to 2030", 2009, op. cit.
- ¹²³ Millennium Ecosystem Assessment Vision 2050.
- ¹²⁴ Jeffrey Sachs, "Economics for a crowded planet", 2008.
- ¹²⁵ Thorning, M. (2007) What Can Technology Deliver?, International Council for Capital Formation, London, Annual Conference of APEC Centres Melbourne, Australia, 18-20 April 2007.
- ¹²⁶ Thorning, M. (2007), op.cit.
- ¹²⁷ John Llewellyn, "The Business of Climate Change", 2007.
- ¹²⁸ PWC study "100% renewable electricity", 2010; French Ministry of Defence, 2008, op. cit.; German Advisory Council on the Environment (SRU), 2010.
- ¹²⁹ John Llewellyn (2007) The Business of Climate Change, Challenges and Opportunities.
- ¹³⁰ John Llewellyn (2007) op.cit.

¹³¹ John Llewellyn, 2007, op. cit.; 2nd SCAR Foresight Exercise; UK Development, Concepts and Doctrine Centre, op. cit.

¹³² United States Joint Forces Command, op. cit.; The 2nd SCAR Foresight Exercise, op. cit.

¹³³ UK Development, Concepts and Doctrine Centre, op. cit.

¹³⁴ Stern review on the economics of climate change, 2006.

¹³⁵ Goldman Sachs, "BRICs and Beyond".

¹³⁶ Millennium Ecosystem Assessment Synthesis Report, Draft 9: 1 March 2005.

¹³⁷ Millennium Ecosystem Assessment Vision 2050.

¹³⁸ N. V. Fedoroff et al., "Radically Rethinking Agriculture for the 21st Century".

¹³⁹ This chapter is based on the contributions of Ingo Rollwagen, Joyeeta Gupta, Geoff Mulgan, Leopold Summerer, Jaap de Zwaan, Dragana Avramov, Helena Helve, Heli Koski and Lionel Fontagné.

¹⁴⁰ Apart from the methodological notes, one startling fact revisiting the existing studies was that though labor and jobs are of utmost importance for the prosperity and social cohesion of democratic societies especially these fairly developed industrialized nations in the enlarged and enlarging EU (Turkey), jobs and the changes to labor have not been mirrored in the different studies. The changes to qualificationary requirements, the change of labor as one of the major fields for identity-formation and the self-esteem of individuals in modern, highly differentiated societies are not at all reflected at the moment. Given the dynamic development of knowledge in use and knowledge embedded in technical systems and repositories (also reflecting the increasing codification of knowledge), the nature of work/labor and professions will be changing in quite diverse forms, setting tough challenges for political decision-makers.