European Commission

Global Europe 2050

Research and Innovation

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate B – European Research Area
Unit B.5. – Social Sciences and Humanities

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Directorate-General for Research and Innovation
Socio-economic Sciences and Humanities

2012

EUR 25252

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Luxembourg: Publications Office of the European Union, 2012

ISBN 978-92-79-23357-9
ISSN 1018-5593
DOI:10.2777/79992

Printed in Belgium

Printed on elemental chlorine-free bleached paper (ECF)

Foreword

We can rise to the Europe 2020 challenges of dealing with an ageing population, securing sustainable resources, developing clean energy supplies, improving healthcare and combating climate change – but only if we take effective short, medium and long term action. This is why the European Commission asked twenty five leading analysts to look into the future and work-through a number of scenarios to see where the EU might be in 2050.

Their work, presented in this Global Europe 2050 report, analyses three key scenarios which describe different but nonetheless possible pathways that Europe could choose to follow over the decades to come.

The first scenario is what if *Nobody cares* and Europe just muddles along with no clear vision or direction. In this scenario the analysis shows that economic growth will remain stubbornly lower than in the US and China, and that we will fail to exploit our potential for innovation and will, in consequence, lose our position in terms of global competitiveness to other regions in the world.

At the other extreme, the *EU under threat* scenario paints a bleak picture of global economic decline followed by reactionary protectionist measures. The EU will see its share of world GDP fall by almost a half by 2050. Frequent food and oil crises will occur. EU Member States will become more inward-looking leading to inefficient fragmentation of effort that will touch every sector especially research – so vital for our future prosperity.

Fortunately, the third scenario, which the experts call the *European Renaissance*, describes a much more attractive pathway. The EU continues to enlarge and become stronger. It consolidates its political, fiscal and military integration. Innovation systems become more efficient with an increased role given to users. Investment in technological and services innovations will have a direct impact on economic and social development. Member States will work together to make the European Research Area fully functional with research agendas being decided in common across Europe. EU GDP almost double by 2050.

These scenarios are presented by some of Europe's leading foresight and macro-economic modelling experts. Their work not only demonstrates the power of forward-looking exercises but lights the path to a better future – a path that we can and must follow. The first steps have already been taken. The EU 2020 strategy for smart, sustainable and inclusive growth has paved the way for the creation of the Innovation Union and led to a completely new EU approach for supporting research and innovation – Horizon 2020, which will help put the EU on the pathway towards a *European Renaissance*.

Robert-Jan SMITS
Director-General for Research and Innovation
European Commission

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1.1
Unfolding issues and trends

A number of foresight studies have been reviewed in the context of the Global Europe-2050 preparatory work[1].These studies, along with a variety of other sources[2] on distant future forward looking, point a number of currently unfolding trends at the global level in each of the following six dimensions:

- Global demographic and societal challenges
- Energy and natural resource security and efficiency, environment and climate change
- Economy and technology prospects
- Geopolitics and governance: EU frontiers, integration and role on the global scale
- Territorial and mobility dynamics
- Research, education and innovation.

Such unfolding trends are common to all future scenarios and include:

In the global demographic and societal dimension

A continued imbalance in population growth

Over the next ten years and beyond, improvements in health, education and living standards will continue to drive population growth. In the absence of major pandemics, global natural disasters or multi-regional wars, organizations such as the UN and OECD estimate that the world population will reach around 9 billion people in 2050 and peak at around 9.2 billion in 2075. Taken at this level, an extra 2 billion of us in the next forty years inevitably means a more crowded world with ever more of us competing for the same resources. The life expectancy increase in different areas of the world is somehow more difficult to predict, but globally it will continue to increase. Wherever you are, expect to be here at least ten years longer than your parents. Looking forward, our children can expect to live on average to celebrate 97 years, and from 2030 onwards it will be not surprising if life expectancy reaches 106. The concept of 'old age' will have to be redefined. In many developed economies, 55 is already the new middle age and we can clearly see a future where what used to be the average age of retirement becomes the mid-point of the average adult life. Longer life expectancy will offset the trend towards having fewer children, which means that by 2020 and beyond, up to 2050, there will be more of us and more of us will be older (ageing population). Regional differences in growth rates and life expectancy at the world level will result in a larger proportion of people living in Asia. 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 in China 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. In addition, continued migration from rural areas means that a greater number of people will live in cities than ever before (urbanisation). The questions that matter are not only around general growth but also around balance. Are people in the right places? Do we have the right skills? Can we reduce child mortality in emerging economies? Do we have enough people of working age to support economic growth? As the population ages, are there enough people to support the old? How can we close the gap between the 'haves' and the 'have-nots'? These are all-important questions that we need to address in order to understand a number of global demographic and societal challenges.

Changing reproduction and family lifestyle

The fertility rate represents the number of children an average woman is likely to have during her childbearing years (15-49). Taking typical averages into account, the natural replacement rate by which a population stays level is 2.1 children per woman. Globally that point will be reached by around 2020 for the first time. There are several reasons for the decline in overall fertility. There is, for example, clear evidence to suggest that as people get more affluent they want smaller families. The transition in fertility rate from five children to two, which took place over 130 years in Britain (1800-1930), happened in just twenty years (1965-1985) in South Korea. Some countries are experiencing an even more dramatic change. Such declines in fertility have a lot to do with the movement of people from the countryside to the towns and cities: tilling the land is generally labor intensive and an extra pair of hands to help is welcome but it is a different matter altogether in the restricted space of the city where the cost of feeding and housing a larger family is often prohibitive. Another specific factor which may cause a global decline of fertility is the significantly fewer number of women than men in South and South-East Asia. For instance, China's population rests on an uncommonly uneven foundation. Since 1979 the traditional preference for sons has been exacerbated by the compulsory one-child policy, and this has left China with a shockingly aberrant sex ratio at birth. The normal ratio of boys to girls is 106, but some Chinese provinces are above 115. Given the huge dimension of the China's population, this reality will condemn tens of millions of men to spouseless (shorter, less satisfying) lives. Fertility is also falling, especially in Western societies, because more women are better educated and are therefore more likely to go out to work and demand contraception and less likely to want large families. However, an increased quality of life in Europe may help to partially overcome the present incompatibility between work and parenthood, as well as advances in technologies may help to enhance the probability of late motherhood, leading to a recovery of fertility among richer and higher educated women – a trend presently becoming visible in some parts of Europe. All these changes are combined into a global modernization of the lifestyle as global wealth increases. The nature and role of families is also changing. While there is a trend in OECD countries 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.

1 See: A. Braun – EC Expert Group, *State of the Art of International Forward Looking Activities beyond 2030*, August 2010.

2 This chapter drawns heavily from these studies *'Future Agenda, The World in 2020'* (www.futureagenda.org) and R. Watson *'Future Files. A Brief History of the Next 50 Years'*.

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 continue to 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.[3] Perhaps the focus of the issue on family and care is much too narrow. The social – and the legal – definition of the concept of 'family' are changing ('Family is where children are'). The whole social fabric is changing – from 'relations of blood' to relations of choice ('elective affinities'[4]) – with growing multiple, temporary relations driven by affinities and interests. It is not at all obvious what this implies for the society as a whole. A kind of fragmentation, sure, but... other ways to react, other ways for opinion formation, with impacts on policy making too. It is a change so deep, that we almost do not see it.

Generational shifts

There is much hype surrounding the young generation (sometimes called 'digital natives'), but when it comes to work arrangements, the next generation will change the rules of the game for themselves and everyone else. First, if the economy continues to grow in advanced economies and ageing societies, the young generation will call the shots simply because there will be far more jobs than people. Employers will have therefore to become more flexible about how and where people work and how they are rewarded. Indeed, the young generation will increasingly search for more flexible and attractive works to better fit with life aspirations, flexibility will not only be imposed by the employers. The young generation is also hyper-connected, so virtual and collaborative networks will grow in importance as a way of getting things done. Workforces will also become more balanced. There will be a greater spread of ages, more ethnic diversity and more women in the workforce, the latter significantly contributing to a shift away from the white middle-aged alpha male culture that has dominated for so long.[5] Some facts help to grasp the situation in the European Union: in the EU there are currently 96 million 15-24 year olds. In 2030 this generation will be 35-44 years and in 2050 their cohort from 55 to 64 will still be in working life. The education of EU young people is high: more than half of all students are in upper secondary education attending vocational programs. Gender differences will continue also in the future because girls prepare for higher education while boys prepare for employment (54 % of girls in upper secondary education attend general programs and 57 % of boys attend more employment-oriented vocational programs). More than 1/3 of 15-24 year olds are NEETs (Not in Education, Employment or Training). Every fourth (26 %) of unemployed 15-24 year olds and third (35 %) of unemployed 25-29 year olds have been unemployed for more than 12 months, so they will have difficulties in transition to work in the future. This will be also true for that half of employed 15-24 year olds who is in a low skilled or elementary occupation. When more than half (65 %) of employed 15-24 year olds have used to work on a temporary contracts or in a part-time jobs their work attitudes have already changed.[6]

In the energy and environment dimension

More constraints on key resources

Economic growth is coupled with resource consumption – as people become wealthier they use more energy (e.g. for air conditioning, heating, computing, mobility), eat and waste more food. They also use more water. So far, efficiency gains have been largely offset by the 'rebound effect',

where techological improvements have ultimatey led to greater consumption. The trouble is that it has taken the industrialized world over a century to develop the infrastructure to supply natural resources to the point of use (pipelines, sewage farms, ports, rail and road links, electricity grids) and making significant changes to this infrastructure will take decades. Delays in investment in infrastructure and inability of legacy infrastructure to cope with changing demand will result in supply and demand gaps, market opportunities and price volatility. Countries will no longer be concerned just about energy security but also about resource security – land, food, water and raw materials. This is particularly true because resources tend to be geographically concentrated – often in areas that are difficult in terms of physical accessibility or ease of doing business. The growing economic power of China and India, the world's most populous countries, has brought millions of people increased wealth and an improved quality of life which previous generations could only dream of. Other countries in Latin America (Brazil) and Africa (South Africa) are now following the same path. But this new-found prosperity has knock-on effects on the demand for resources, and especially for the countries that are traditionally the big consumers. Indeed, the catching-up process of China, India, Brazil, South Africa is similar to that experienced in Japan after the Second World War, but this time on a much larger scale, with unavoidable impacts on the availability of global resources. Different evolutions can be envisaged concerning how the growing pressure on natural resources will be solved in the next 40 years, e.g. global privatization of common resources whose access will be regulated by market prices, or the hegemony of larger countries (namely China) that will control strategic resources in other parts of the world (as China is doing now by acquiring land in Africa), or, more optimistically, a global precautionary governance of natural resources which will enable sustainable consumption of resources world-wide. The latter seems the only evolution that will ensure global human security until the 2050 horizon, and – to the extent that this is an unavoidable need for human development – a systemic and precautionary governance of sustainable development can be considered an unfolding trend per se (see below).

Systemic governance of climate change and sustainability challenges

Present solutions to the threat of climate change are often tokenistic, opportunistic and simplistic. Global weather may indeed become more volatile and severe, meaning more bad hurricanes and disastrous flooding in some regions. Extreme heat and shortage of water may make other places almost uninhabitable, while rising sea levels could devastate low-lying cities. But the solution is not only carbon pricing, especially if this is merely symbolic. There is the need of a paradigm shift in the global economy, especially in manufacturing efficiencies and in energy saving solutions for cities. We should also focus on the limited future availability of natural resources. Climate change plus a shortage of resources will also be a catalyst for innovation, but there will be an increasing need of systemic governance of innovation to successfully tackle climate change and sustainability challenges. Combining technologies will require imagination and a systemic approach, to exploit opportunities across sectors. For instance, even the landfill problem will be resolved when someone realizes that there is money to be made by digging up old refuse sites and converting used plastic bags and bottles into fuel. Inclusive strategies will be increasingly needed to allow fair access to increasingly scarce resources, to the knowledge and technologies more appropriate for an efficient use of the resources, and to new employment opportunities connected to increasingly decentralized processes of sustainable production and consumption.

3 OECD (2008), *The Future of the Family to 2030 – A Scoping Report* – OECD International Futures Programme.

4 I. Rollwagen, (2007): *Tracing the Future of Consumption. The Fragmentation of Societies and its Implications for Business Strategies*. Frankfurt 08/03/2007.

5 R. Watson, *Future Files. A Brief History of the Next 50 Years*, NB Publishing, 2010.

6 European Commission: 'EU Youth Report', SEC(2009)549.

Trend-break changes in energy and ecosystems services use

Often the global trends of the energy and environment dimension considered in the scenarios are mainly linear extrapolations of today. If we want to construct different scenarios, however, we should think to different possible developments for all drivers. So e.g. in terms of unsustainable use of ecosystems services a trend-break towards sustainable modes of production and consumption, circular economy, factor 10 reduction etc. can be considered as well amongst future plausible events. Also the idea that eco-innovation and green technologies are at the base of a third Kondratiev wave or Third industrial revolution should be considered. Finally, for what concerns the evolution of the Earth ecosystems, the most positive Millennium Ecosystems scenarios should be taken for inspiration. A shift to new forms of 'blue technologies' may be also considered.[7] ICT technologies will be able to calculate how to use ecosystem services without destroying them. Production ecosystems may be created to meet specific needs. Agricultural productivity is expected to double in this way and waste could be reduced by at least 1/3rd.

In the economy and technology dimension

An accelerating shift of economic power to Asia

It is difficult to make generalizations for a continent of 3 billion people, but it is clear that the world's centre of gravity has gradually been sliding eastwards for a while now. Although, overall, Asia is still a poor continent, with more than 71 % of people living on less than a dollar per day, Asian consumers are clearly growing richer, with average earnings in many countries doubling over the past five years. Asians are now able to use their newly acquired disposable incomes to buy everything from mobile phones (43 % of all sales are now to Asian consumers) to cars (35 % of all car sales in 2009 were in Asia). Over the past ten years, Asia has accounted for half of the world's GDP growth and, from an Asian perspective, things are looking pretty good for the future. At the end of 2008, Asia's GDP was just under US$ 14 trillion – roughly the same as the US – and all indications are that its growth will continue to outpace Europe and the US as we head in the next decade. Some emerging countries barely noticed the recession while developed countries continue to struggle. Many economists expect growth in emerging markets to be four percentage points higher than growth in the rich world for at least the next five years. Although increasing numbers of Asia consumers have developed a taste for shopping, private consumption currently accounts for only about half of Asia's GDP (compared with 72 % in the US), so there is considerable room for growth. Three billion Asians currently spend a little less than US$ 7 trillion on consumer goods; in comparison, 300 million Americans spend up to US$ 10 trillion. It is difficult for many people of the West to comprehend China's size and scale. China is now the world's biggest market for many household products, including TVs, refrigerators and air conditioners. It tops the world car sales charts despite car ownership currently resting at fewer than fourteen vehicles per thousand citizens (compared with more than 400 per thousands in the US). It has 400 million internet users compared with America's 240 million and India's 80 million. In fact, China is already well on the way to becoming the world's biggest market for pretty much anything you can think of. Today China has 55 million middle-class households: by 2025, this is expected to more than quadruple to nearly 280 million. As prosperity spreads and the middle classes become big spenders, there is the expectation that the region's emerging economies could soon grow enough to offset falling consumption in the US and the EU. Given all of the above, it is evident that, as a whole, Asian economic growth will continue to outpace that of the West.

Pressure of ageing population on public spending

In most major economies of the world, the population is getting older. By 2050, UN statistics suggest that pensioners in the 'rich world' will comprise

one-third of the population and one-tenth will be over 80. But emerging economies are not far behind. Many governments now have to contemplate the prospect of slowing growth and low productivity, rising public spending – particularly on healthcare – and labor shortages. From an economic perspective, this mass ageing is already producing a significant pressure and, going forward, many see it as a time bomb for healthcare, pensions, taxation and wider social dynamics. The key measure for this is the dependency ratio – the portion of population, which is inactive in relation to the total labor force. Most pensions currently operate on a pay-as-you-go principle, whereby today's workers pay for today's pensioners. They are based on the understanding that tomorrow's workers will do the same for them when their time comes. However, given the increasing number of pensioners dependent on a decreasing number of workers, the pension pot in many economies is beginning to look rather empty and the possibility of filling it challenging. Pension providers will have to re-evaluate their business model. If the current 65 years threshold for retirement stays in place, our children can expect to live in 'retirement' for an additional 32 years. As they stand now, their pension funds are unlikely to be able to pay for this: most pensions have been designed to accommodate an upper quartile life expectancy where retirement age is 'death minus ten'. It looks there is no alternative – we will have to work longer than our parents. Many agree that getting people to work for a few more years – either full or part time – would solve a lot of the problems associated with ageing populations; a retirement age of 70 in the future is already considered highly likely by many in the EU. 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.[8] Clearly much will depend on whether or not 'healthy ageing' becomes a widespread phenomenon, and if emerging technologies are massively deployed.[9] The question is what strategy should be developed in Europe to cope with these future trends. The Stockholm European summit has defined a 3 pronged strategy: reducing the public debt, increasing the employment rate, especially for older workers, and reforming the pension and health care sector. The amplitude of each prong has to be tailored to the situation of each country. This strategy seemed to be largely endorsed, but: (1) in a number of countries the reforms were insufficient and (2) in most of the EU countries the debt has considerably increased during the crisis. Indeed, the recent financial and economic crisis has aggravated and amplified the impact of the severe trend in demographic ageing. Setbacks in economic growth, public budgets, financial stability and employment have made it more urgent to adjust retirement practices and the way people build up entitlements to pensions. The crisis has revealed that more must be done to improve the efficiency and viability of pension schemes, otherwise the situation may even lead to a collapse of the current European model of social protection and heath care.

Global connectivity

Greater connectivity, brought about by technology, deregulation, globalization, low-cost travel and migration, is changing how people live, how they work and how they think. ICT, the Internet and new mobile devices will continue to play a pervasive and transformational role. Mobile devices are becoming a key technology to access the internet and promise to continue heavily transform our way of living. Ten years ago, there were around 700 million mobile devices, most of which didn't connect to the World Wide Web, 370 million people had access to the internet, and the likes of Google (incorporated 1998) and Facebook (2004) were unknown or barely gathering momentum. There are now around 4.6 billion mobile devices worldwide, many of which do connect to the internet and internet penetration has

7 See the recent Report to the Club of Rome by G. Pauli, *The Blue Economy. 10 Years, 100 Innovations, 100 million jobs*, Paradigm Publications, Taos, New Mexico, 2010.

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

9 OECD (2008) *The Future of the Family to 2030* – op. cit. See also the discussion in the 'EU matters' scenario narrative.

grown to 76 % in the US, 53 % in Europe and many emerging economies are catching up quickly (in China, for example, internet penetration has grown from 2 % in 2000 to 27 % in 2009). All in all, around 1.8 billion people now have access to the internet. There are also 2.5 billion talking to each other on mobile phones and 13 % of the world's population is now living somewhere other than the country of their birth.[10] Mobile devices (smart phones) are becoming a key means to access the internet, and they do not have the same barriers to access as PCs – they are inexpensive and relatively simple to use. These trends are expected to continue, with growth for smart phones projected to increase from 54 million today to 289 million in 2013. Perhaps more significantly, though, it is increasingly likely that the first internet experience for the majority of people who live in an emerging economy will be through a mobile rather than a PC. The majority of the world's population will be connecting to the internet via a mobile device as of 2020, with the major share of new users coming from China and India. This will increasingly enable social networking that has already given us the ability to host global interactive debates on anything with anyone with the simple click of a mouse or touch of a screen. It has made the sharing of ideas easy. It also means that many of us now live in a 24/7/365 world where it is possible to talk, to email or even video call wherever we are, whenever we want with whomever we want. We can create a global discussion for anyone to join it. Not so long ago, this would have been possible for only a few highly technical, well-funded institutions.

Key enabling/general purpose technologies

Machines will be a dominant feature of the future. Computers may eventually become more intelligent than people, at which point humanity will be faced with something of a dilemma. If machines are more intelligent than their makers, what is to stop them taking over? This, of course, requires an element of self-awareness, but impossible is nothing in the future. More concretely, as machines get smarter and artificial intelligence takes over many repetitive jobs that can be reduced to a set of formal rules that an intelligent and emotionally aware machine can learn, displacing entire layers of workers, humans will increasingly face the risk of becoming more stupid and useless. However, machines do not think. And even if they can be said to 'think' they only really think about what they are doing, which leaves the gates wide open for humans to have empathy, imagination, creativity and ideas. Developing smarter tools and infrastructure, embedding intelligent technology, will need to be balanced by greater awareness and people's cognitive and creative abilities to find out intelligent uses of the intelligent technologies. The other intriguing aspect of this issue is the convergence of computing with robotics and nanotechnology, which will give rise to a number of pervasive and disruptive technologies. Nanotech will affect every industry from aerospace and construction to energy, transport and medicine and will create products that we cannot possibly imagine now. This will have important impacts on the people everyday life. Whatever we do will be touched by technology in some way in the future, and in many cases our world will be turned upside down by it. For example, all business will to a greater or lesser extent be e-business.

In the geopolitics and governance dimension

Changing geopolitics[11]

Political developments are inherently unpredictable, given the wide scope for human agency in shaping the course of events. However, drawing from the development of structural trends and from the evolving strategic outlook of key international actors, some insights into the future international political system emerge. First, in the absence of a clear and established international political system, like the one based on the East-West confrontation during the Cold War, globalization itself will be the most influential factor shaping international politics. The ways in which the new economic powers will be willing and able to translate their weight into some form of political influence will be key to the future

political and security system. Second, multipolarity will be a fact of life. The rise of new global and regional players such as China, India, Brazil, South Africa and Indonesia among others will make the international system more heterogeneous. The ability of the West to influence international affairs will be put to the test as its share of world population and GDP is shrinking. The emerging powers bring with them their own vision of the world, which can differ considerably from that of the established ones. Consequently, the West will probably find it much harder to set the international agenda, and new ways of fostering the international cooperation will need to be defined. Third, global governance will be put under serious strain. The relationship between old and new powers will determine the future of global governance. A more interdependent and complex world generates challenges, which demand a coordinated response. At the same time, however, it might become more difficult to focus collectively on systemic issues such as poverty and environmental degradation. This will require, amongst other things, to redefine the meaning of economic success and the capability to measure global progress including also environmental sustainability and social cohesion aspects (see below).

Happiness beyond GDP?

Today and in the decades ahead it will remain crucial to compare the standard of living of the different regions of the world by measuring their GDP per capita, and the convergence (or divergence) of GDP growth paths. However, in Europe and elsewhere – also in the emerging economies when the currently huge investment opportunities (e.g. in new energy, transport, etc. infrastructures) will be saturated and the growth rates reduced – the criteria for success will not be simply the raw GDP growth rates. There will be a world-wide political reframing of growth in terms of its quality rather than simply its quantity. This reframing will be necessary to support 'good global governance', creating the basis for a new social bargain world-wide. It should be underpinned by meaningful measures of sustainable prosperity such as well-being, income stability, environmental quality and social mobility. The need for a different way to measure progress is already evident and is part of the scientific, cultural and (partially) policy debate in the affluent societies of today, and can be coupled with the need to better measure capabilities and freedoms for the population living in less developed countries. Materialism and consumerism are starting to lose their appeal in the more affluent societies, and this will increasingly contribute to transform the focus of policy discourses and strategies, beyond the current 'growth' focused policies. Globally, especially with the growth of emerging economies, people are working harder and longer – and will earn more money as a result – but in affluent societies it is becoming increasingly obvious that money cannot buy happiness and that identity is shaped by how we live rather than what we own or consume. There are signals that increasing material wealth is accompanied by changing values and aspirations also in the emerging economies, with an increasing attention towards less material aspects of quality of life after a certain per capita income threshold is achieved. To some extent, the focus on happiness and work/life balance is really just an aspiration, a search for a meaning in a meaningless world. But it is also a result of the fact that people have on average more time and money on their hands. This is true for retired people in the increasingly ageing old-industrialized societies (US, Europe, Japan), but may be true also for the members of the young generation, that will experience more flexible work careers and may enjoy, in the more affluent portion of the population, supplementary earnings from the assets accumulated by their parents. Similar conditions and changes may hold in the future for the emerging economies, with the consolidation of a wealthier middle class.

10 R. Watson, *Future Files. A Brief History of the Next 50 Years*, NB Publishing, 2010.

11 This paragraph is mostly based on: Institute for Security Studies (2006), *The New Global Puzzle: What World for the EU in 2025?*

e-Action and the future of democracy

People can bank online, bet online, date online and watch television online, so why not vote online once digital access is universal and e-illiteracy eradicated? E-voting will expand in the future to cover a wide set of policy issues, allowing citizens to check policy actions and express their opinion more frequently, although this should be backed by adequate information and awareness raising activities to enable the citizens to provide their judgment on an increasing range of topics. Besides e-voting, global e-action groups and virtual protests are already with us, and will thrive in the future. This would not necessarily changing anything – although at least in the recent wave of popular revolts in the Maghreb and Mashreq countries social networks on Internet played a key role – but it will make politics much more interesting and entertaining. It is possible that representative democracy as we see it today will radically change, with Internet ending up disenfranchising politicians. If voters can connect directly with the issues, do we need politicians in their current form? The answer will be different depending on the future scenarios of democracy. As a form of government, democracy is about the way in which government is appointed, by popular vote, and not the way power is exercised. The constitutional feature of Western democracies is the distinctive set of principles and institutions of liberalism, with an emphasis on check and balances and respect for individual rights. Political regimes can, however, be democratic while not being liberal. Conversely, some non-democratic regimes can guarantee the rule of law, proper services and a degree of respect for human and civil rights, while not permitting electoral competition challenging the ruling elite (hybrid regimes). According to the Economist Intelligence Unit's measure of democracy, one-half of the world's population now lives in a democracy of some sort.[12] However, according to the same Economist's index, the number of 'full democracies' is low, at only 26 countries; 53 countries are rated as 'flawed democracies'. Of the remaining 88 countries considered in the index, 55 are authoritarian and 33 are considered to be 'hybrid regimes'. In addition, the decades-long global trend in democratization had come to a halt and democracy is in retreat since 2008. 'Illiberal' democracies have proliferated over the past years, ranging from the 'managed' or 'sovereign' democracy of Russia to the new populist democracies of South America. Unless they are reinforced by strong constitutional constraints, new democracies are fertile ground for populist leaders, prone to consolidate their power by mobilizing masses with a nationalist, aggressive rhetoric. In perspective, serious challenges confront democratic regimes as well. The control exerted by private interests on policy making (lobbycracy) and the corresponding loss of prestige and influence of traditional political parties, particularly noticeable in the US but significant across Europe too, undermine an open public debate and the definition of collective preferences. Opinion-poll driven politics pose a serious problem of leadership, with political classes increasingly inclined to bend to the demands of the majority as opposed to taking alternative, albeit unpopular, courses of action. In this sense, the growing share of the elderly population in Europe might lead to an increasingly conservative and defensive political discourse. In addition, the European Union project itself is in danger, as this was created with the impulse of strong leaders in the past, and is now weakened by increasingly weak forms of leadership, strongly influenced by an increasingly volatile public opinion. In this context, social media and various forms of e-Action may change the future policy landscape, in Europe and elsewhere, by allowing an increasing share of citizens from all ages and walk of life to participate, exchange new ideas and support – with a sometime surprising speed – new societal initiatives and policy actions outside the traditional parties' pathways.

In the territorial and mobility dynamics dimension

Territorial dynamics

Basic information on the European territory is available in various official EU documents, including among others the Fifth Cohesion Report, the revised Territorial State and Perspectives and the

'Territorial Agenda 2020'. Findings of the EC DG Regio ESPON program are also available, which show the most relevant challenges for the future territorial dynamics of Europe, within its borders – with different possible patterns of competition and cooperation among the different regions of Europe – and in relation to the evolution of neighborhood regions. The basic structural elements of territorial dynamics include: the urban settlement system (hierarchy and networks), the semi-urban areas (suburban, peri-urban, diffuse city patterns), the more rural areas (including also areas with a high natural heritage value), systems of transport and communication networks. These elements are to be analyzed to understand the future evolution in the different territories of specific problems (congestion, depopulation, insufficient accessibility to transport networks and/or other basic services, negative impacts of climate change, etc.) and opportunities (organization of knowledge-based clusters, exploitation of local renewable energy sources, organization of the tourist, culture and leisure economy, natural and cultural heritages, cross-border and transnational territorial strategies). Territorial dynamics are highly complex, as they depend on a number of long-term heavy trends – population ageing, social mobility, globalization, resource shortages, diffusion of ICT in society and economy, growing knowledge-based production, progressing climate change, to name a few – as well as uncertainties – the level of international migrations from outside Europe, the flows of Foreign Direct Investments towards central and eastern Europe, possible departure from nuclear energy production and accelerated promotion of renewable energy sources, also to name a few. Smart growth (fostering knowledge, innovation, education and digital society), sustainable growth (making production more resource-efficient while boosting competitiveness) and inclusive growth (raising participation in the labor market, acquisition of skills and fight against poverty) remain until 2050 the leitmotifs of EU policies, and these will have important territorial impacts. In this context, the Europe 2020 flagship partnerships smart cities and smart mobility will contribute to influence the territorial dynamics, enabling resource-efficient investments in the pilot cities and regions. Inclusive growth will be enhanced through social innovation, and the territorial dyna-mics will be fostered by a close relation between the EU funded research and the innovation managed by the regions to leverage private funds and address externalities of development.

The challenge of sustainable transport

Transport is the most challenging sector as concerns the medium (2020) to long term (2050) targets of CO_2 emission reduction. For this reason, it is also a sector where an important research effort is concentrated, to produce both technological, social and public sector innovation. Climate change, urbanization and resource shortages – most notably oil – will fuel a shift away from large petrol-engine cars to small electric and hybrid vehicles. There will be also a boom in cheap cars and bikes in emerging countries. Tax rates, license charges, road charging and parking fees will increasingly be linked to vehicle type and we will see even more anti-car and anti-driver sentiment and regulation. This will be a catalyst for car-sharing schemes, green car loans, green car insurance and bicycles. It would seem logical that, as urban roads and parking spaces fill up, there will be a growth in public transport. However, the car is so linked to ideas of individualism, freedom, private space and personal identity that people will be unlikely to give up private car ownership in the short term. In theory high oil prices should discourage people from driving private cars, but private car use has shown to be fairly inelastic during the past oil crises. From a sustainability point of view the future must see the reinvention of mass public transport, but people would not embrace the idea until the governments start thinking long term and build safe, clean, convenient and affordable networks. This means services that link supply and cost to real-time demand. This will be enabled by

12 Economist Intelligence Unit, *Democracy index 2010. Democracy in retreat*, November 2010.

the capability to constantly monitor in real-time traffic conditions, freight deliveries, etc. Embedded intelligence and remote monitoring will allow to support travelling and to combine the travelling experience with a number of other services, increasing the efficiency of our journeys. Cars can already be opened or started using fingerprint and iris recognition, so we will see more technologies linking vehicle security to user identification. Cars will also become mobile technology platforms linking data to other services, such as healthcare. Obviously privacy issues abound, but cars could become useful data-collection and delivery points. Indeed, in the future all cars will be automatically tracked from space, making no journey entirely private. The good news in all this is that real-time data on where a car is and what it is doing will revolutionize the auto theft recovery and insurance industries and will foster various location-based services such as pay-as-you-go insurance. Embedded intelligence may evolve creating driverless cars. We cannot expect this any time soon, but by about 2040 we will see around cars capable of driving themselves with minimal interference from the driver. Cars will also be able to travel automatically in platoons and correspond with other vehicles and the infrastructure about conditions ahead or alternative routes. Speed regularity – a feature of automated driving – will help to relief congestion on busy highways. If drivers do not need to drive, this will open up a whole host of entertainment and information possibilities.

In the research, education and innovation dimension

Filling the EU innovation gap

The 'EU innovation gap' is not an unfolding trend common to all scenarios, but a past and present trend that has created a state of affairs that needs to be changed. Several arguments have been put forward to explain different aspects of the relative under-performance of the EU research and innovation system as whole and the related productivity gaps, including: the under-financing of various activities across research and innovations systems; weaknesses in the operation of specific components of these systems at EU, national and regional levels; the failure of many system components to function or link effectively together; and weak research and innovation governance systems and resulting policy portfolios. As recognized in the Europe 2020 strategy,[13] enhanced capacity to innovate will determine whether we can deliver solutions to the complex and entangled problems that the world and Europe will face. At the same time, the innovative solutions need to be safe, accepted by society and sustainable. According to the latest Innovation Union scoreboard, indicators of innovation in Japan and the United States continue to grow faster than in Europe while emerging economies like India and China are moving from competition based on imitation and low cost to competition based on new and innovative products, catching up rapidly; their young populations are well disposed to novelty – both as producers and consumers of innovation. It is in this context that, on 6 October 2010, the Commission presented its proposal for a flagship initiative to turn Europe into an 'Innovation Union' by 2020. The EU intends to lead by example and spend on research, education and innovation programs in a smart way that enhances growth. Simplifying the administration of the framework program is a top priority, but it is also necessary to simplify the interrelated effects/relationship between instruments and to deploy them more skillfully (also by training the partners/beneficiaries). To start this process, the Commission has developed the idea of European innovation partnerships that would pool expertise and resources to accelerate research, development and market deployment of innovations to address selected major challenges. The intent is to cover the whole R&I value chain, ensuring that the conditions are conducive to bringing the results of R&I successfully to market and that the numerous existing instruments at EU, national and regional levels are deployed effectively to a common purpose.[14]

1.2 Scenario building approach

Confronted with highly complex and dynamic landscapes, states of crises and short-term reactions of governments and decisions-makers of all kinds, most readers will probably think that looking forward 30 or 40 years resembles writing science fiction. And yes, indeed, the time horizon (2050) of this study and its all-encompassing scope (Europe and the world) call for a balanced combination of daring ambition and down-to-earth realism.

Forward-looking exercises are not set out to forecast or predict the future, especially with such a long-term perspective as adopted here, but rather to provide images of possible futures that can stimulate and inspire policy and decision makers, and society at large. Such visions of the future should not be constrained by mainstream, conventional thinking, hence the above reference to the daring dimension of the study.

On the other hand, to effectively serve the objective of influencing policy and decision making, the proposed visions of the future should be credible, and build upon past and present knowledge, hence the reference to realism.

This report is the result of a highly participatory approach to scenario building that seeks to optimally combine visionary thinking with plausibility: it was generated by an iterative process of interaction and debate among a group of ca. 25 experts representing a considerable variety of disciplinary expertise/specialisms. To make the most of the individual and collective expertise of the group, a full bottom-up process was adopted, with the experts contributing freely to both the overall selection, framing and shaping of the scenarios, and to their detailed representation. While such a 'free-mode' approach led to an unconstrained and unconventional representation of possible long term futures, the complementarities within the group and the extensive debate that took place ensured that the basic requirements associated with scenario building (like plausibility, internal consistency) were ultimately met.

The methodology adopted for building scenarios combines and integrates a qualitative and a quantitative component.

13 European Commission, *Europe 2020: a strategy for smart, sustainable and inclusive growth*, COM(2010) 2020.

14 European Commission, European forward-looking activities: Building the future of 'Innovation Union' and ERA, Studies and reports, 2011.

1.2.1 Qualitative analysis

After a state-of-the-art review of the most relevant foresight studies[15] and the description of unfolding trends presented above, an extensive narrative has been produced with the contribution of the group of experts for each of the scenarios, along a common format that deals in sequence with 6 main dimensions of the future:

- Global demographic and societal challenges
- Energy and natural resource security and efficiency, environment and climate change
- Economy and technology prospects
- Geopolitics and governance: EU frontiers, integration and role on the global scale
- Territorial and mobility dynamics
- Research, education and innovation.

The six dimensions are illustrated, for each scenario, in increasing order of sensitivity to policy decisions, starting with demographic trends – already largely in the cards, and therefore considered as exogenous – and concluding with the future of research and innovation, which remains to be shaped by appropriately inspired policies. The detailed scenario description – the scenarios' narratives – are illustrated in Chapter 2. Hereby we provide a summary of the approach and synoptic overviews of the main traits of the different scenarios.

The Global Europe-2050 scenarios have been shaped with a view to combine the global perspective (notably including future dynamics and trends that are mainly out of the reach of EU policies) with a specific focus on the future of European integration. In the focus of these scenarios the potential impacts of EU policies in such diverse areas as governance and geopolitics, economic and technological growth stimulation, the use of land and of other increasingly scarce natural resources and, most importantly, research, innovation and education are devised and assessed.

The perspective followed to build the scenarios is deliberately Euro-centric, and in fact 'EU-centric'. Of course, Europe and the EU will evolve in the wider international context, and depending on the evolution of the rest of the world, we may have a wider set of scenarios to consider. For the sake of simplicity, the group of experts decided to focus on three different future trajectories by building three contrasted scenarios for Europe and the EU in the global context. The rest of the world in these scenarios is in the background although it obviously evolves and is accordingly modelled in the quantitative part of the exercise. It could logically follow different trajectories, that could be again identified with three basic alternatives, depending on whether they are better, worse or similar to that of Europe, producing a potential set of 9 scenarios.

Out of this potential set of 9 scenarios dealing with changes within the EU and in other parts of the world, the following three highly contrasted scenarios have been built:

'Nobody cares: standstill in European integration'

In this scenario (NC in the following), Europe is seen in a process of prolonged 'muddling through' in the absence of guiding and visionary actors and the lack of a redesigned policy framework. Thus, economic growth remains low in Europe. The divergence between the EU and the leading world economies – USA in the short-medium term, but also China in the longer term – widens, as the latter keep a strong developmental pace (the implicit assumption is therefore a better future trajectory for the rest of the world). The challenges posed by the ageing phenomenon in Europe are not decisively addressed, leading to economic instability. The completion of the European market remains unachieved. There is limited public support to address climate change and other global challenges, leading among others to an increased dependence on the foreign supply of energy.

'EU Under threat: a fragmented Europe'

This scenario Under threat envisages a global economic decline, with protectionist reactions, the subsequent increase in transaction costs and increasingly congested infrastructures. A range of serious geopolitical risks emerge including possible low-intensity conflicts – civil wars, nuclear conflicts and the radicalization of governments in advanced democracies. The EU heads towards disintegration, triggered by the possible withdrawal of one or more leading Member States and the emergence of two or more speeds of development and integration within the Union. Climate change and its implications are not addressed. Food and oil shocks materialize. Major energy supply disruptions and failures of the different European grid(s) system(s) are becoming more probable due to heavy underinvestment in the renovation of these. The failure of Europe to implement sound research policies leads to a reduction in the pace of innovation. Productivity gains diminish progressively until 2050 within the EU, also compared to the Nobody cares scenario. Unlike Europe, the rest of the world and especially the emerging markets reap their potentials to economic growth, so that the rest of the world continue to keep a relatively strong developmental pace.

'EU Renaissance: further European integration'

In this EU Renaissance scenario global security is achieved, with the generalized enforcement of human rights and the rule of law. The world undergoes a global democratization of power also as a consequence of increasingly active non-state actors, global public policy networks and the media. The EU is enlarged both east- and southwards, and political, fiscal and military integration is consolidated. There is strong public support toward challenging targets in e.g. climate change and energy efficiency. The all-continental integration of energy systems (with renovation and heavy re-investments) boosts the share of renewable energy. Innovation systems undergo major reforms to become increasingly systemic, with more user-integration, more easy-to-use technological systems and services, and more encompassing smart growth oriented technology and innovation policies. Importantly, the EU manages to optimally design its technological and research policies, to target the right domains and methods, and this leads to an acceleration in the pace of innovation and the productivity gains increase progressively until 2050 within the EU, compared to the Nobody cares scenario, the rest of the world keeping its own pace.

Summary overviews of the main traits are presented on pages 22 to 36 for each scenario. Clearly, given the very large number of dimensions and variables, variants of all kinds could be devised and generated by playing with individual variables one at the time. This would have led to an unmanageable set of scenarios, and it was therefore decided that a selection of extreme variants would be briefly illustrated with dedicated narrative 'boxes' without however undergoing a quantitative assessment. Such 'shocks', or 'wild cards', could serve as variants to one or the other of the scenarios, as most of the events and variables on which they are based could prove at least partly independent from the background context of the scenarios.

15 A. Braun A. – EC Expert Group, *State of the Art of International Forward Looking Activities beyond 2030*, August 2010.

Dimensions	Scenario 'Nobody cares: standstill in European integration'
Demographic and social	**Population ageing:** this will continue in Europe being the result of three phenomena: persistent 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. **Immigration:** to sustain competitive growth in the face of declining fertility and ageing, Europe will support increased migration – and this will largely come from North Africa and the Near East. Europe's Muslim population will easily double by 2020 and that, by 2050, one in five European will probably be Muslim.
Energy and environment	**Increased energy constraints:** over the next twenty years, global energy demand will increase by around 40 % – so an average of 1.5 % a year – with the vast majority of the growth coming from non-OECD countries such as China, India, etc. (IEA reference scenario). Oil will remain the largest single fuel, providing 30 % of the total energy mix. Global gas supply will also increase by 2030 to provide just over a fifth of the world's energy needs. World electricity demand will grow at an average of 2.5 % a year. In 2010, 13 % of the world's electricity came from nuclear power. Its overall share of electricity is expected to fall. In absolute terms, the biggest increases in demand will be met by coal-based power generation. The growing use of renewable energies – wind, wave, solar, hydro and geothermal – will start to make an impact but, in comparison to the other energy sources, their individual shares of the mix will still be in single digit percentage figures by 2020. **Rising consumption of raw materials:** alongside energy, the growth in consumption of many of the world's main metals is also on the rise. According to BHP Billiton projections, between now and 2030 we will consume more copper, more aluminium and more steel than we have in history. A number of rare metals increasingly matter in the global economy, not only because they are vital to the production of advanced electronics equipment – cell phones, batteries, plasma screens – but also because they are part of the 'green technology revolution', being essentials in the construction of hybrid cars and wind turbines. **Rising pressure on water:** as GDP per capita rises, so does water demand and by 2025 two-thirds of the world's population are expected to be living in water-stressed regions. a significant part of the problem is the huge and often deeply inefficient use of water. In addition, throughout many parts of the world, rainfall and river flows are strongly seasonal, with too much water arriving during monsoon periods followed by maybe seven or eight months of water scarcity. Climate change will exacerbate this and we will increasingly get the wrong water in the wrong places at the wrong times of the year. **Rising pressure on land, food production and biodiversity loss:** another key natural resource is land and the global food supplies. An immediate challenge concerns bio-fuels and associated regulations that have been passed in recent years. Bio-fuels support programs have contributed already to raise global food prices and consequently increased malnutrition among the world's poorest. The consumption of ecosystem services,

	which is unsustainable in many cases, will continue to grow as a consequence of a likely three to sixfold increase in global GDP by 2050 even while global population growth is expected to slow and level off in mid-century.
Economy and technology	**Accelerating globalisation:** globalisation will continue at an unabated pace and will even keep accelerating. Due to increasing pressure from global challenges international institutions will acquire greater influence, and the emergent economies are expected to increase their influence the context of the international trade and financial agreements. However, globalisation will also tend to marginalize some parts of the developing world. Another important consequence of globalization may be the increasing plausibility of internal social revolutions – those in Tunisia and Egypt are indeed a recent example – caused by social inequalities and large cohorts of young adults in poorest regions of the world. These tensions are exacerbated by the media revolution, which has made the inequalities of wealth and well-being globally transparent. **Asia-led global growth and trade:** led by the sheer scale of growth in India and China, but also influenced heavily by the likes of Japan, South Korea, Indonesia and Vietnam, the centre of wealth generation is clearly shifting eastwards. So far Asia's growth has been built primarily on Western consumption – or, more accurately, over-consumption. So, because the once profligate Western consumer is now saving – or, at least, not spending as much – Asia needs a new market. This might well be Asia's own population. **Economic consequences of ageing:** in Europe, a key factor will be the economic consequences of population aging. Many of them are self-evident and glooming. Older populations reduce the tax base, and hence they lower average per capita state revenues and increase the average tax burden. Falling numbers of employed people push up the average dependence ratio. As most countries finance the current retirement costs of their workers by current contributions from the existing labor force (pay-as-you-go arrangement), increasing retiree/worker ratios will bankrupt the entire system unless current contributions are sharply raised, pensions substantially cut, or both. Most new companies are started by individuals 25-44 years of age, and the shrinking share of this cohort will also mean less entrepreneurship and reduced innovation. **European youth NOT on the move:** another key factor for Europe's prosperity is indeed its young people. There are close to 100 million in the EU, representing a fifth of its total population. Youth unemployment is unacceptably high at almost 21%. Too many young people today leave school early, increasing their risk of becoming unemployed or inactive, living in poverty and causing high economic and social costs. What is worst, however, is that unemployment is currently high also among young graduates from different levels of education and training. European systems have been slow to respond to the requirements of the knowledge society, failing to adapt curricula and programs to the changing needs of the labor market. Indicators for youth labor market performance do not fully capture that an astonishing 15% of European 20-24 year olds are disengaged from both work and education (NEET youth: neither in employment, education or training) and risk being permanently excluded from the labor market and dependent on benefits.

	A still vital European industry: manufacturing remains vitally important for the EU economy, and manufacturing productivity is still the motor driving EU wealth creation. The industrial base in Europe stretches far beyond the industrial core of manufacturing and represents a great share of the economy. When the wider productive sector is factored in (power generation, construction) along with associated business services the share of GDP is about 37 %. Indeed, the statistical dichotomy between industry and services does not reflect the reality of the modern business world. EU industry will continue to generate economic growth, but it will largely contribute indirectly to employment creation through generation of increased demand for business related services. **A challenging transition to digital Europe:** nowadays, in Europe, the ICT sector is directly responsible for 5 % of European GDP, but it contributes far more to overall productivity growth (20 % directly from the ICT sector and 30 % from ICT investments). Indeed, faced with demographic ageing and global competition, Europe has three options: work harder, work longer or work smarter. We will probably have to do all three, but the third option is the only way to guarantee increasing standards of life for Europeans. The social impact of ICT has already become significant – for example, the fact that there are more than 250 million daily internet users in Europe and virtually all Europeans own mobile phones has changed lifestyle. It will be challenging for business and other organizations to find new ways of work-life integration. The increasingly free production and access to information content will challenge the traditional business model in many sectors.
Geopolitics and governance	**Redistribution of global power:** out to 2040, the locus of global power will move away from the United States (US) and Europe, as the global system will have shifted from a uni-polar towards a multi-polar distribution of power. a multipolar system is likely to emerge, but the question is what type of multipolar system that will be. As new countries acquire power status, they may prove willing to mutually accommodate their interests so as to ensure the stability of the system and preserve their new prerogatives, creating a multipolar system of a relatively benign nature. The potential gridlock of international institutions, widening disparities and the emergence of a nationalist/protectionist discourse might, however, lead to a more conflicting form of multipolarism, with great powers competing for scarce resources, markets and spheres of influence. **Change of military power balance:** 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. However, the change of military power balance towards the Asian countries is unlikely, as the overall stream of public military expenditures of the West will be much greater than that Asian over the next 30-50 years.

	Challenged role of EU on the global stage: in 1900, Europe (excluding Russia) accounted for roughly 40 % of global economic product; 100 years later it produced less than 25 % of global output, and by 2050, depending above all on growth in the GDP of China and India, its share of global economic product might be as low as 15 %. By 2050, Europe's share of global economic product may be lower than it was before the onset of industrialization, hardly a trend leading toward global economic dominance. In addition, the continent has no coherent foreign policy or effective military capability. Although in all probability the European Union will remain intact as an organization and will continue to play a role in the global governance, its position will be relatively weak, challenged as it will be by the need to find a compromise between the different Member States on foreign and global policy issues.
Territorial and mobility dynamics	**Global urbanization:** a key future development is the growing urbanization and the related change of the standard of living, as the city will increasingly become the standard human habitat across the world. 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.
Research, education and innovation	**A failing European Innovation Union:** in the 'Nobody cares' scenario, the innovation system thinking and coordination capabilities at EU level fail to emerge, leaving the whole Europe in an unfavorable competitive position as compared to other regions of the world, and especially to emergent economies. **Public Sector Information:** the public sector agencies of different EU countries collect and diffuse data in a fragmented manner, and pricing practices for PSI sectors vary among countries. In many cases, data is difficult to access and expensive. Some public sector agencies use IPR protection for restricting the re-use of data. **Research governance:** although some improvement has been made there is still duplication of research and fragmentation across regions and countries with significant resources being wasted. At the national level the situation remains that the research world is separate from businesses and that the businesses still do their major projects in house although using largely approaches like open-innovation. **Research institutions:** the ERA has not fully been realised although significant improvements are evident. While the fifth freedom (free circulation of knowledge) is possible there are still institutions, legislations and rules which are MS-specific and not harmonised thus hindering circulation of research, cross-border funding of research.

Dimensions	Scenario 'EU Under threat: a fragmented Europe'
Demographic and social	**A shrinking population in Europe:** recent studies suggest that for each decade from now on if fertility remains at its present low level, there will be a further fall in the EU population of some 30-40 million people. By 2050, over ten per cent of Europeans will be over 80 years old. While the EU is ageing rapidly, the number of young people in prime migration age continues to increase in the EU's greater neighbourhood, but migratory flows are hindered by restricting EU Member States immigration policies, aimed to protect national workforce (especially young Europeans that continue to have low opportunities to find jobs in their stagnating countries). However, Europe can over the medium term benefit from 'reversed Malthusian effect' caused by the inheritance of large amounts of capital from the past. Europe will continue to invest in capital, and this will compensate for depreciation: capital stock will not decrease. More importantly labour force will stabilize, but not shrink. All in all K/L ratio will be kept stable to its 2010 level. **A declining social capital:** the changing role of families has an impact on social capital and consequently on the capacity of family life to develop values and moral for the next generation. The gap between older and younger generation will be widened, also due to the difficulties that a continued state of global crisis and instability will create for the new generations to find or maintain decent jobs and create their own adult life. Moreover, the scale of the situations individuals are called to cope with is going beyond what they have control over. With the increased awareness about global issues, we are called to deal with more generic risks, e.g. climate changes, which are outside our individual control level. This is a new sort of uncertainty we have to cope with today and increasingly tomorrow. If the behavior of the society becomes too complex for the individual to comprehend than society becomes more risk averse, an attitude that will prevail in a world increasingly 'Under threat'.
Energy and environment	**Global energy insecurity:** 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 worst global warming scenario:** with the transition from 'easy oil' (easily recoverable and therefore cheap) to 'tough oil' (cost expensive in recovery, non-traditional kinds of oil), reserves are considerably growing. Therefore, current global fossil-fuels based energy trends continue and are expected to increase atmospheric greenhouse gas concentrations. 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. 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.

	Unabated degradation of water: 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 %. Extensive spreading of industrial fertilizers has upset the chemistry of the planet. **Global food crisis and degradation of biodiversity:** the enormous transformation and degradation of land by human activities will continue (in Asia largely unabated, in Africa much accelerated) during the first half of the twenty-first century, with the tropical deforestation and conversion of wetlands causing the greatest losses of biodiversity. Even if quantifying this demise is difficult, the trend is clear. Climate change could become a major cause of extinction in addition to excessive exploitation and extensive habitat loss (to which climate change directly contributes).
Economy and technology	**A declining labour input:** 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, the trends towards a decline in European working-age population will continue, but altogether EU27 labour force will not shrink but rather stabilise and become older, notably owing to migrants entering the labour force. 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. However, the labour input, measured by total hours of work in the EU is expected to fall by 12.9 % between 2020 and 2060. 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). **Human capital circulation:** human capital will continue to accumulate despite the negative prospects of this scenario. Individual talent will continue to be a crucial resource and companies as well as universities and other knowledge-intensive institutions will compete for talents. Schemes of brain-circulation will proliferate. Education in international top institutions will continue to be a growing business. But the role of institutions outside Europe will increase and the brain flows will be also increasingly directed outside the EU. **A declining infrastructure investment:** in OECD countries, traditional sources of public finance alone will not suffice to meet future infrastructure needs, which are huge and growing. Indeed, in the aftermath of the financial crisis and bearing the burden of indebtedness of former years, most EU countries and other international counterparts are restricted in their capability to invest and to mobilize resources for long overdue development and improvements of existing infrastructures and for investing in new innovations in sectors like healthcare, living, mobility, energy and the like, which are important for the well-being of citizens.

Geopolitics and governance	**EU fortress:** this scenario envisages an increasing inward-looking view of the EU characterised by a European shield against the winds of global change. a 'fortress Europe' with internal liberalisation but closed external borders to face crises and negative impacts from rising new markets and economies. Things may evolve even worst, with the break up and the end of the EU itself. **Global insecurity:** 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. One or more new countries, especially in the Muslim world, will become nuclear powers. Pakistan, which has acceded nuclear capabilities in 1998, may leave the 'western alliance' and become an Islamist Sunni regime. Iran will be a nuclear Shiite power, while other countries, like Turkey, Syria and Egypt will follow or try to follow the same path of nuclear proliferation. The risk of clandestine proliferation to terrorist groups will increase. The terrorist threat becomes increasingly decentralised and 'spontaneous'. The ultimate fear is of terrorists acquiring biological agents or nuclear material to move terrorism onto a new phase. Potential commercial breakthroughs resulting from military investments may be an attractive additional reason to increase military power. Furthermore, extreme weather events resulting from climate change may call for ensuring a military strong enough also for civil defense activities. Lack of water and potential water conflict in the South Asian region may also reinforce the need for military investment. By 2020, China's continuing high economic growth rate will allow it to spend on its military as much as the United States today, and this will make it a real superpower impervious to any threat or pressure. **A widening governance gap:** as it concerns global governance, due to the progressive marginalization of the UN, different frameworks of governance will come to play a larger role. However, networks, whether at the political or technical level, lack the inclusiveness and the unique legitimacy of the UN, and this will pose an accountability problem and entail the risk of competing networks running conflicting agendas. Overall, there will be a widening gap between governments and citizens. a great share of decisions will also be devolved to non-political (and therefore non-elected) actors, with technical expertise on specific domains (telecommunications, networks, regulations) but with no knowledge of the implications that their decisions may have on the society at large.
Territorial and mobility dynamics	**Increasingly vulnerable and unsustainable cities:** urban growth is being fuelled by new levels of mobility and the migration of diverse populations within nations, especially in China, India and Brazil. These rural-to-urban migrants are attracted to live in cities by a number of factors – more opportunities, better jobs, better education and better healthcare. However, while a better quality of life is the aspiration, often the reality is very different. Larger European cities are affected by this urban poverty problem too, but on a smaller scales, and often this is linked to the incoming of poor migrants and their concentration in the most deprived zones of the city. Alongside urban poverty, another challenge for the cities is to ensure the quality of the urban environment.

	Another big concern raised by some about major future cities is that many of them are continuing to be built on the coast where better trade and communication with other countries has been a traditional rationale. With highly probable rises in sea levels caused by climate change over the next century, there is an emerging issue that most of the coastal cities in the world are not designed to float, or deal with floods.
Research, education and innovation	**Public Sector Information:** the public sector agencies of EU countries protect IPRs of their data by various means (e.g. copyright, database protection) and sell it with market prices, often competing with private sector parties. The public sector information concerning the actions of governments is increasingly stored for internal information systems only. **Research governance:** most of research governance is fragmented within national borders even more than in the 2010s. Earlier steps taken towards research governance and coordination at the supra-national level have been withdrawn due to overall crisis (e.g. financial but may also be public outcry with various S&T risks materialising from new advancements). This crisis towards science not only downsized research to a large extent but it has also put it behind national borders. Grand challenges are not a theme of common interest anymore but a topic addressed by individual nations as they see fit for their own interests and stakes. **Research institutions:** the ERA concept is long forgotten as it has not materialised and the lack of trust in science has grown considerably. Trans-national research agendas exist in some cases where nations share the same interests but they are mainly driven by industry with profit-making motives.

Dimensions	Scenario 'EU Renaissance: further European integration'
Demographic and social	**Preserving the standard of living:** the predictions made do show that Europe, to maintain its standard of living also in the future, will need to 'import' a substantial number of citizens from other regions of the world. Some countries, e.g. the UK, have managed to do it rather well. Other countries, like Italy, are much less successfully. However, good practices will eventually prevail. The advanced countries will face a shortage of qualified labour force (scientists, engineers, medical doctors, software programmers). This will lead them to plan immigration and ne more selective in terms of immigration policy. Population growth in the rest of the world may be accompanied by modern technologies that reduce the rate of growth of resources needed to meet basic needs. Already today mobile 'all-in one iPod telephones' help to replace many needs, and they promise to continue to support in the future lifestyle changes across the world. **Active ageing:** active ageing may impact positively on society, through the increased communication of values and expertise – when three, or four rather than two generations are involved. Life-long education, informal and non-formal learning will play a pivotal role. Already by 2020 there will be a greater proportion of older workers in the workforce than today: both experience and work place performance will be valued. The regulatory system (retirement schemes, labor regulation...) will be adapted to population ageing. By 2020, several countries in Europe will substantially revise their pension system by allowing their citizens to adopt flexible retirement schemes in which, after a certain age, they can progressively decrease the number of working hours. 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, is expected to become an integrated part of the health system of the future. 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. The diffusion of Internet and changing lifestyles may also help to improve the elderly life. Intellectual stimulation of the elderly via Internet facilities will reduce brain deterioration. Emotional stimulation of the elderly will take place via social network applications. **An open European society:** fueled by innovations in the field of electronic media and Information and Communication Technologies people in different contexts are beginning to be more active in communities. Some citizens/customers are more actively contributing to certain forms of issue-based discourse and sometimes activities (campaigning) on the basis of shared interest or the identification with a certain group of people or certain attitudes/values. The birth of 'new' social movements reflect the emergence of novel problems and commitments such as 'post-material' values about personal and collective freedom, self-expression and quality of life. The increasing openness, availability of and access to information will contribute therefore in this scenario to increasing public awareness and sensibility against any type of unfairness and injustice around the globe.

Energy and environment	**Better energy and CO_2 reduction prospects:** as economies grow, the demand for energy, food, protein, water and metals all pretty well scale linearly: increasing GDP per capita is largely directly linked to per capita resource consumption. The big challenge going forward is to decouple resource use from economic growth by essentially using less and yet continuing to allow economies to grow. Technological developments may drastically cut down energy consumption in production, distribution and waste processes. Other factors include: (1) focus on dematerialization and de-carbonization of society; (2) consumption behavior changes to more modest and environment conscious life styles; (3) spatial planning which improves local consumption patterns. 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 could 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. **A sustainable roadmap to low carbon Europe:** in Europe, the flagship initiative 'resource-efficient Europe' under the Europe 2020 Strategy will tackle successfully with the energy and resource security problems, and it will continue to provide benefits after the 2020 horizon, towards 2030/2050. According to the Roadmap, the transition towards a competitive low carbon economy means that the EU will achieve emissions in its domestic emissions by 80 % by 2050 compared to 2050 – domestic meaning real internal reductions of EU emissions and not offsetting through the carbon market.
Economy and technology	**A new global financial stability:** in the 'EU Renaissance' scenario, we assume a movement towards a multi-polar world, which will be characterized by a much broader consultative process that extends to a large number of jurisdictions. Greater coordination amongst major economies on financial sector regulation will be needed. In this multi-polar context, the perspective on the future of global currencies at the 2050 horizon is not that of substituting the US dollar – the unique dominant currency in the Bretton Woods system – with another currency, let say the Euro or the China's renminbi. There are basically two options for the future of the global currency. The first is to shift towards the adoption of one truly international currency, i.e. for all countries to adopt what are termed 'special drawing rights (SDR)' as a parallel reserve currency for international trade. SDRs are currently the international reserve assets managed by the IMF. A second option – which is assumed to be the successful one in this scenario – is the emergence of a third 'Asian-based' global currency, which will be used together with the US dollar and the euro to regulate international trade and financial transactions. Perhaps the most realistic option for the third global reserve currency is the creation of what has been termed the Asian Currency Unit or the ACU. This is a basket of Asian currencies that are used not as the primary currency in each country but as a secondary parallel currency for trade. Given the similarities to what happened in Europe in the late 1990s, many see that the ACU could be a precursor to a common future currency, just as the ECU was for the euro.

New opportunities for the EU industry and employment trends: globalization and the integration of the emerging countries of Asia and Latin America into the world economy, falling transport and communication costs, and on-going trade and investment liberalization in the emerging economies offer new markets and opportunities for the European industry. The process of globalization has increasingly resulted in tightly interlinked international value chains. Emergence of global value chains not only led to efficiency gains and a geographical fragmentation of production processes by fabrication of components in different locations around the globe but also moved some of the relevant know-how and services into these locations. In this context, the employment trends by level of qualification show that the 'skill intensity' of jobs in Europe has been increasing in recent years and is expected to continue to do so in the coming years.[16] As a result, the proportion of high qualified jobs is expected to increase to over a third by 2020, whereas the proportion of jobs employing low qualified people is expected to decrease to 15%.

Tackling the challenges of the knowledge economy: scrutinizing the emergence of the knowledge economy, we may want to consider different types of knowledge-based economic value-creation activities with different ways of acquiring/accreditating/ sharing or even defining knowledge (everyday creativity vs. formalized knowledge). What is for sure in some way is that, indeed, production patterns are rapidly changing.

First and foremost, the loci of production: the geographical patterns of production are changing in the wake of a more knowledge-intensive economy. Secondly, the production patterns are changing due to the change of customer needs. More informed customers often exert a pressure on companies and providers of services to deliver more and more personalized products for more diverse niches in the global market landscape. Solutions integrating products and services are requested.

New forms of value creation activities: the approach of one company and legal entity producing the lion's share of innovative industrial and service production is being altered by new and more flexible forms of value creation and organization of knowledge activities, for instance by means of projects (also instituted as own legal entities), with groups of workers and self-employed innovators working together loosely knit on a temporary basis to come up with new products and solutions. This is going to radically change the industry structure. A key pervasive feature of the transformation in the way added-value is produced in the service sectors – to support any kind of business, including industry, agriculture, environment, urban services etc. – is the dynamic development of knowledge bases and the use of knowledge. We will assist in this scenario to a shift in the social logic of production, whereby the old logic (division of labor, functional organizations, hierarchy and standardization) is replaced by the new logic of sharing knowledge in networks and teams, with a focus on core competencies, continuous learning, absorptive capacities, and innovation. While these trends may lead to new opportunities for innovative, highly skilled and entrepreneurial minded people, these changes to the system of production and new forms of collaboration like crowdsourcing, – which make it difficult to see who delivered what – may bring about total new challenges as to the reform

of social security systems. A fundamental issue embedded in this topic is the 'end of intellectual property (IP)'. With the growth of the creative commons and open source movements, core components of corporate and institutional knowledge will increasingly be shared without restriction and, in the eyes of some, result in further decline of copyright and weaker patents.

The continuing ICT revolution: perhaps the most important trend in the area of science and technology is the continuing information and communications revolution and its implications. The fastest computers perform trillions of operations per second at time of writing with strong signs that Moore's law will uphold up to 2020+. If continued in the future, the computers will have reached the computational power equivalent to one and possibly all human brains before 2050. In parallel to the computational power, new algorithms and general ways of using this power will be developed. Decisions and their consequences will increasingly be simulated before being taken, identifying options and providing decision support systems to start with. Moreover, 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 worldviews of the people. Established education systems that emerged in the industrialization period will increasingly struggle to cope with the 'learning economy'. By 2030 severe changes may have occurred in the way knowledge is defined, stored, accessed, acquired and accredited. Today's schools and universities may have disappeared.

New developments in energy technologies: energy efficient technologies will become available, and even breakthroughs in alternative forms of energy that reduces dependency on hydrocarbons may be likely by 2050, though their effect on the overall energy system might be only gradual. One of the much discussed, but yet to be realized, dreams of architects, engineers and progressive developers is the idea of the zero-waste, zero-energy building – one which, when in use, has zero net energy consumption and zero carbon emissions. As operation accounts for 85 % of the total whole-life energy consumption of a building and buildings account for the majority of global CO_2 emissions, this would be an enormous step forward. With the major technological advances taking places, increased integration of control systems and, in some markets, regulation for the rollout of smart meter systems, all the ingredients for the high-tech option are falling into place. With several countries such as South Korea taking the lead, smart homes that control energy, ventilation, communication services and so on are starting to be built. A critical element in all this is the role of smart meters and grids.

Smart investment in global and local infrastructure: the nature of transport and energy infrastructure will change with the increasing use of smart technologies. For instance, instead of an increasing grid for transport, less roads and rail infrastructure will become necessary with higher precision transport systems and automatic breaking systems. Infrastructure will be accompanied by pay-as-you-use systems and pressure on government for new transport infrastructure building will decrease. Smart grids will reduce the need to build new centralized power plants. Local infrastructure upgrading (energy distribution grids, urban transport, other urban infrastructure) is another key issue especially

16 CEDEFOP, *'Future skill needs in Europe'*, 2010.

	in developing countries. The prevailing approach to finance infrastructure needs is to devolve to the business sector the provision of public services and infrastructures. But this is also generating great controversies. An alternative option might be a growing demand for the socialization and nationalization of public goods, services and infrastructures. **Key enabling technologies:** while technologies such as air travel and telecommunications transformed economies in the 20th century, growth is also now being driven increasingly by other key enabling technologies, such as eco, nano, bio and info-technologies. Alongside the latter info-technologies – and often convergent and integrated with those – there are nano-technologies and bio-technologies that will help Europe to address a number of societal challenges such as an ageing population, the effects of climate change, and reduced availability of resources. Indeed, there is no reason to single out nano or biotechnology, and they are often discussed under the same label of 'converging technologies'. New developments in technology are dramatically redefining the way we see and conceptualise the human body, and even life itself. This is already raising a number of ethical problems and fears about the social impacts of such technology advancements.
Geopolitics and governance	**Towards the European Political Union:** in the global strategic architecture for 2040, the most important breakthrough could be a further step of European integration, creating a powerful political union, not only in the economic and monetary dimension, but also in the political and defense dimensions. A real European Political union may be created, based on a new EU constitutional treaty which introduces reinforced versions of the present institutions. **Global security:** global security is achieved by enforcing human rights and rule of law, and enabling sustainable development and cohesion across the whole European territory. Traditional security issues outside European boundaries are tackled thanks to a better integration with larger geo-political areas (Latin America, Middle and Far East Asia, African States, etc.), with an increased international regulation and mutual acknowledgement of risks and security problems. **EU leadership on the global stage:** the new EU will be able to speak with one voice, but many votes, in all international forums, and to promote multilateralism by means of the support given to international agreements on key global issues (climate change, water, public health, global security and fight against crime, combating poverty). It will continue the enlargement process including countries beyond the 27 members achieved in 2004, geographical widening the EU boundaries to neighbors, east and south. The EU will increasingly become therefore a world actor/model/ leader on the global stage, increasing the power of Europe in defining global rules and being actively engaged in dealing with global challenges. A balance is also envisaged for EU enlargement so as to avoid continual distraction of enlarging the Union and potentially weakening its ability to be a valid global partner.

	Filling the governance gap: the governance gap – a feature initially shared with the other two scenarios – will increase in the EU Renaissance scenario the pressure to create a form of global governance that will be accountable, transparent, bounded by shared rules and ultimately democratic. The number of countries run according to democratic rules has substantially increased over the last twenty years. Although recently there has been an halt to this favourable trend, and democracy is in retreat since 2008, it is likely in this scenario that the number of democracies will return to increase in the next decades. It is very likely that by 2040 all countries of the world will have a form of democratic government according to the standards of democracy accepted in 2010. An important trend supporting democratization is better information for citizens: in 2004 90 % of the OECD countries enshrined information rights for citizens into law.
Territorial and mobility dynamics	**A polycentric Europe:** the urban-rural picture in Europe is partially different from the rest of the World. While the global mega-city is one extreme interpretation of a dense urban environment valid for Asia and elsewhere, others see that groups of midi-cities are in many ways a better solution, especially for some regions in Europe. A network of interlinked cities, with efficient transport systems operating between them can create a highly effective urban area without the challenge of growing in one place. **Sustainable cities:** in the positive scenario, future cities will succeed in becoming more sustainable, especially in Europe: ideally, they will produce more energy than they need, become net carbon absorbers, collect and process waste within city limits and collect and clean recycled water, thanks to the pervasive diffusion of clean urban technologies and processes in the different sectors. Eco-cities and eco-communities will develop to respond to oil shortage (resilient cities). **Smart and sustainable mobility:** concerning the future of mobility, this scenario recognizes that the mobility patterns of people and goods are changing, as well as the mobility infrastructure and vehicle systems, due to the effects of climate change, more strict regimes and rules as regards to CO_2-emissions, a growing scarcity of fuel, a growing scarcity of clean air and space for new mobility infrastructures. The changes are also enabled by tremendous progress in location-based services, information processing & satellite technology (`Galileo`). People will change their behavior and their attitudes towards existing forms of transport and traffic. The mobility of goods and people will be more intermodal than today. Another important development is electric mobility.
Research, education and innovation	**Public Sector Information:** the government data is opened up for public use in all EU countries – subject to security, privacy and privilege limitations – and it is made easily accessible in the Internet. The public sector agencies encourage citizen participation by developing online systems gathering together also free and timely information concerning the work of government and politicians.

Research governance: national interests are tackled within national programmes focusing on specific strengths and weaknesses but taking into account the overall international strategies which are primarily devoted to tackling global problems like hunger, poverty, regional inequalities, energy shortages, etc. All countries have the international dimension in their national research policies to facilitate participation in trans-national and international activities.

Research institutions: the ERA has accelerated to more than what it aspired to be in 2015. It's fully realised and even more, there are uniform rules and regulations in setting research agendas taking into account societies concerns and interests with societal organisations fully engaged in research policy-making alongside the research community and businesses. A lot of research is also done in the virtual world not requiring large amounts of money and also based on concepts like the peer production, the shared economy, etc.

1.2.2 Quantitative analysis

Since numbers also increasingly count for socio-political decision-makers, the group of experts decided to use quantitative measures to depict probable changes, thus bringing additional clarity to the scenarios. Following that line, the scenarios are then translated in numerical terms through the combined use of a growth model and of a computable general equilibrium (CGE) model. The quantitative scenarios are first built using the growth model of Fouré, Bénassy-Quéré and Fontagné (2010) adapted to a new set of assumptions.[17] These assumptions, as well as the results of the growth model, are then run in the new dynamic baseline of the MIRAGE model using the approach of Fontagné, Fouré and Ramos (2011).[18]

Growth in the first model results from the combined effects of demography, capital accumulation, efficient energy use and technological progress measured by total factor productivity (TFP). Technological progress is a function of the distance to the technological frontier and of human capital accumulation (according to a catch up function). Let us remind here that growth is not development, as development is embodying many more dimensions than income, ranging from health, education, participation to the social life. However, there is a fairly good correlation between the two, with well known counter-examples indeed. In projecting economic growth, the next clarification to be done is how to best tackle income at the country level. The sum of value added is the right benchmark and must be preferred to the value of production, in order to take stock of the content of production in services, intermediate products or raw materials used. This is the concept we use in the growth model, namely the GDP, and we compute it clearing out inflation, i.e. in volume. GDP is not individual income: it represents the economic size of a given economy. The mean individual income is the GDP (corrected for international movements of factor incomes, like multinational firms profits) divided by the population. Last, GDP per capita must be considered as a poor proxy of personal income in emerging economies given the large income inequalities among individuals. Income per capita is only a mean.

In order to derive production patterns from the macro-economic projections referred to above, a Computable General Equlibrium (CGE) model was also used (MIRAGE, developed by the CEPII). The world economy is split into sectors and regions. Regional aggregations leads to considering 20 regions (see **Table 1**), corresponding to the main regions of interest at the horizon considered. Asian countries (China, India, etc.) and other large developing countries (Russia, Brazil) will post high rates of economic growth, in some cases due to a particular development of some key sector (e.g. new energy sectors). The oil price trend is another key aspect for a prospective analysis, not only for its importance in the development of every economy but especially for those countries that are well endowed with this natural resource. Accordingly, Middle Eastern countries whose economies are very dependent on the petroleum sector are presented as a group. Developed countries are also part of this disaggregation, particularly to follow the prospective situation for those countries that have strongly suffered from the last financial crisis.

As for sectoral aggregation, 17 sectors are considered (see **Table 2**) with a particular focus on manufacturing (7) and services sectors (4 including the Transport sector). Agriculture and food are represented by 4 sectors grouped according to their origin: animal, vegetal, prepared food and others. Energy includes all kinds of natural resources, derived products as well as distribution of energy, while primary sectors corresponds to mineral products only. Most of these sectors are assumed to work under perfect competition conditions with a simple demand tree (i.e. no quality differentiation is considered according to geographical origins), except for manufactured and the Food markets for which imperfect competition is assumed.

The model basically uses the GTAP database version 7 for calibration, describing the world economy in 2004. Most of behavioural elasticities, which describe how agents react to a change in prices of goods and factors, are drawn from econometric studies (GTAP, USDA). The model is imposed to reproducing the trajectory of the world economy from 2004 to 2010 and relies on projections afterwards. Accordingly the evolution of the following exogenous variables is considered: population growth, labour force, GDP growth, saving rate growth, agricultural factor productivity, availability of natural resources, oil price evolution, energy efficiency, current account changes. For most of these parameters the values originate from CEPII estimations (Fouré et. al, 2010), complemented by data provided by reference institutional sources (IIASA, ILO, WEO).

The bridge between the qualitative and the quantitative analysis is a set of macro-variables that are explicitly represented in the modeling tools and that can be used to characterize and contrast each of the scenarios, notably including: energy price and energy efficiency, CO_2 emissions, global and sectoral productivity, migratory flows, education levels, mobility of capital, trade costs, tariff rates, and others.

Table 3 summarizes the assumptions adopted for the macro-variables, where projections of the current observed trends are used to characterize the first scenario ('Nobody cares'), while the other two scenarios depart at times significantly from such trends.

Specifically, while EU policies are the main focus of the three scenarios, many more dimensions are considered.

First, as **institutions** have been proved to be a determinant driver of economic growth, it is important to assess whether they will converge or not at world level.

17 J. Fouré, A. Bénassy-Quéré, L. Fontagné L. (2010), *The world economy in 2050: a tentative picture*, CEPII Working paper, 2010-27.

18 L. Fontagné, J. Fouré, M.P. Ramos (2011), *A new dynamic baseline for Mirage*, CEPII Working paper, forthcoming. However, the ´translation` has to be seen as some form of (crude) approximation due to the fact that some dynamics, developments and aspects in the process of European integration simply cannot be `translated`numerically due to the lack of sound data.

Table 1 – Regional aggregations		
	Regions	**Composition**
1	EU27	
2	USA	
3	Canada	
4	Japan	
5	Oceania	
6	EFTA	
7	Korea and Taiwan	
8	China (and Hong Kong)	
9	India	
10	ASEAN	
11	Rest of World	Rest of East Asia
		Bangladesh
		Pakistan
		Sri Lanka
		Rest of South Asia
12	Russia	
13	Rest of Europe	Albania
		Belarus
		Croatia
		Ukraine
		Rest of Eastern Europe
		Rest of Europe
14	Brazil	
15	Rest of Latin America	
16	Turkey	
17	Oil rich Western & Central Asia	Kazakhstan
		Azerbaijan
		Islamic Republic of Iran
		Rest of Western Asia
18	Other Western & Central Asia	Kyrgyzstan
		Rest of Former Soviet Union
		Armenia
		Georgia
19	Northen Afrincan Countries	Egypt
		Morocco
		Tunisia
		Rest of North Africa
20	Rest of Africa	

Table 2 – List of sectors used for the exercise		
	Sectors	**Composition**
1	Vegetal Agriculture	Paddy rice
		Wheat
		Cereal grains nec
		Vegetables, fruit, nuts
		Oil seeds
		Sugar cane, sugar beet
		Plant-based fibers
		Crops nec
2	Animal Agriculture	Cattle, sheep, goats, horses
		Animal products nec
		Raw milk
		Wool, silk-worm cocoons
3	Other Agricultural products	Forestry
		Fishing
4	Food, Beverages and Tobacco	Meat: cattle, sheep, goats, horse
		Meat products nec
		Vegetable oils and fats
		Dairy products
		Processed rice
		Sugar
		Food products nec
		Beverages and tobacco products
5	Energy	Coal
		Oil
		Gas
		Petroleum, coal products
		Electricity
		Gas manufacture, distribution
6	Primary products	Minerals nec
7	Textile	Textiles
		Wearing apparel
		Leather products
8	Metals	Ferrous metals
		Metals nec
		Metal products
9	Cars & Trucks	
10	Planes, Ships, Bikes and Trains	
11	Electronic equipment	
12	Machinery	
13	Other Manufactured products	Wood products
		Paper products, publishing
		Chemical, rubber, plastic prods
		Mineral products nec
		Manufactures nec

Table 2 – List of sectors used for the exercise		
	Sectors	**Composition**
14	Transport	Transport nec
		Sea transport
		Air transport
15	Other Services	Water
		Construction
		Trade
		Communication Dwellings Recreation and other services
16	Ins. Fin. and Buss. sector	Financial services nec
		Insurance
		Business services nec
17	Public Adm. Health and Educ.	Pub Admin/Defence/Health/Educat

Table 3 – Main variables in the scenario modelling			
Variable	**Nobody cares**	**EU Under threat**	**EU Renaissance**
Institutions	constant	half-divergence	half-convergence
Financial globalisation	projected	reduced*	perfect mobility
Energy efficiency	projected	+20 % in 2050	+40 % in 2050
Education	projected	conv / 2	conv x 2
TFP EU	proj. & sim.	-25 % in 2050	+25 % in 2050
Energy price	proj. & sim.	+50 % in 2050	Current proj.
Obsolescence	constant	depr. rate + 2pp	depr. rate – 2pp
Migration into EU	As in UN projections	2 000 000/year, unskilled	1 000 000/year
Migration out of South Med countries	As in UN projections	- 800 000/year	-800 000/year
Migration out of Sub Saharan Africa (SSA)	As in UN projections	-1 200 000/year	-200 000/year
Emissions	simulated	+25 % in 2050	-75 % in 2050
Trade cost	constant	+25 % in 2050	-25 % in 2050
Agr. TFP	projected	change by region (+/-)	+25 % in 2050
Current acc.	Fixed % world GDP	Fixed % world GDP	All balanced in 2050
Tariff rates	2007 level	all double	all zero

*aligned on lowest regional value in the sample

In the Renaissance scenario, there is a convergence, and conversely divergence increases in the Under threat scenario. One should keep in mind however that any convergence reduces the relative advantage carried out by countries or regions endowed with the best institutional framework initially, while laggards manage to catch up.

Another important factor that will shape the global economy surrounding EU economic policies in the next decade is the degree of **financial integration** at world level. The recent crises may lead to different outcomes in terms of regulation, integration and governance of the whole financial system. Depending on the capacity of governments to shape a more secured environment, countries will decide to further pursue their integration or not, in particular developing economies. For instance, openness of capital accounts may be reconsidered, with heavy consequences on the evolution of world macroeconomic imbalances. In the Renaissance scenario, the assumption is made that the G20 manages to fix the current systemic problems, which authorizes a further financial integration, up to a perfect international mobility of capital. This means that savings and investments can be better allocated at world level depending on returns, existing imbalances and demographic or technological underlying forces. As a result of this assumption, global imbalances are fixed by 2050 in the Renaissance scenario, and current accounts deficits are driven back to zero.

Given that our collective future is characterized by scarcity, brains and more generally **education** of the average citizen are key to better growth, governance, institutions and adjustments to external shock. The three scenarios also take this dimension into account and consider that the speed of convergence on the educational frontier can be halved or doubled depending of the scenario.

A more stable (or insecure) world will be economically characterized by less (or more) **capital destruction**, including infrastructures, intellectual/human/educational capital (schools and more life-long learning provisions) and new production capacities, as illustrated by recent conflicts in the periphery of the EU. This is tackeld by changing the rate of depreciation of capital accordingly.

Another challenge for Europe is that of **migrations**. Demographic trends in Europe suggest that these are inevitable in the medium term, notwithstanding the growing social discontent explicable – if not justifiable – by the crisis. Also, the geopolitical and economic environment of a rather stable and prosperous Europe is a pull factor. In the Renaissance scenario, the EU is receiving one more million recruited worker immigrants per year, out of which 80 % come from the Mediterranean world and the remaining share from Sub-Saharan Africa. These immigrants have the same patterns as the native population in terms of skills and occupation rates, except that they are in their working age. The assumption is further made that these migrants are endowed with the same human capital pattern than European natives. In the 'Under threat' scenario, civil wars, droughts and other societal disasters push one more million emigrants from Sub-Saharan Africa to seek asylum in the EU, over and above the figures of the Renaissance scenario. These additional migrants are modeled as most likely unskilled, in their working age but here again exhibit the same occupation rate than natives, which is a rather optimistic assumption.

Feeding the world population is another issue that must be tackled in any medium term prospective scenario. Many dimensions of the problem are intrinsically addressed by the model used in our quantitative exercise, including: competition for land use between various activities, allocation of arable land to different categories of crops, **food** prices and the related adjustments of consumers and agro-food industries, impact of energy price on the food prices, changing patterns of consumptions as per capita income increases over time. Still, one more issue needed to be introduced: the **productivity**, or efficiency, or the production factors mobilized (land, tractors, and animals) which *inter alia* depends on the climate change and its impacts on returns.

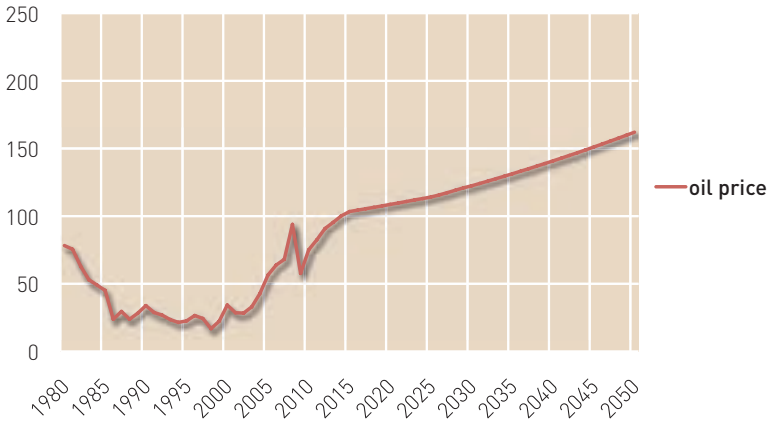
In the Renaissance scenario, the circulation of new green technologies worldwide leads to a linear 25 % increase in production in 2050. In the Under threat scenario, there is a negative or slightly positive feedback of global warming on productivity in agriculture depending of the region of the world economy.

Lastly, how the world economy will be confronted to the scarcity of energy is a key ingredient of the scenarios. **Figure 1** plots the evolution in constant dollars of the price of **energy**. In the Under threat scenario, the price of energy is more than doubling in real terms compared to the current situation. This will be a huge toll on purchasing power and will impose drastic investments to spare energy.

In the Renaissance scenario, the assumption was made that the dynamism of the world economy, compared to the Nobody cares situation, will authorize to realize the adjustments avoiding any further impact on the price of oil of this dynamism.

Indeed, societies will adapt to the increasing scarcity and price of energy and produce more wealth with a given amount of energy, labour and capital. Energy efficiency will increase as a result of the increasing price of energy as well as the result of general technical progress. This is illustrated in **Figure 2** for three major economies with very characteristic patterns in terms of efficiency in energy use: Japan, USA and China.

Figure 1
Energy price (2005 USD per barrels of oil)
Nobody cares and Renaissance
Source: CEPII



Energy price (2005 USD per barrels of oil)
Under threat
Source: CEPII

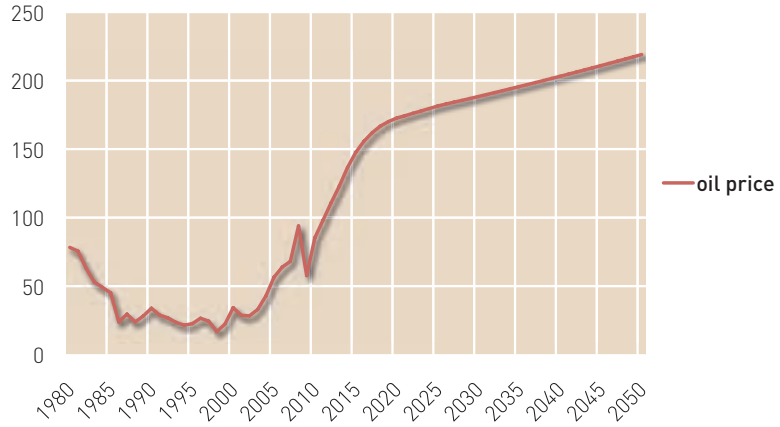


Figure 2
Energy efficiency in the three scenarios: Japan, USA, China
Source: CEPII

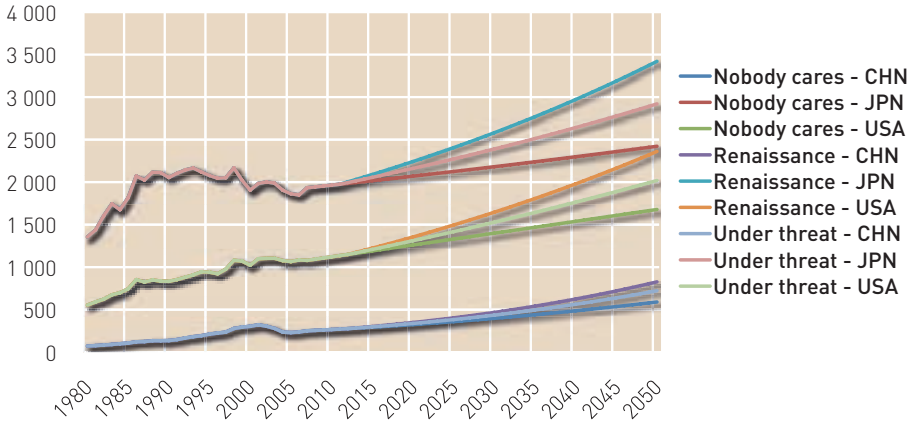
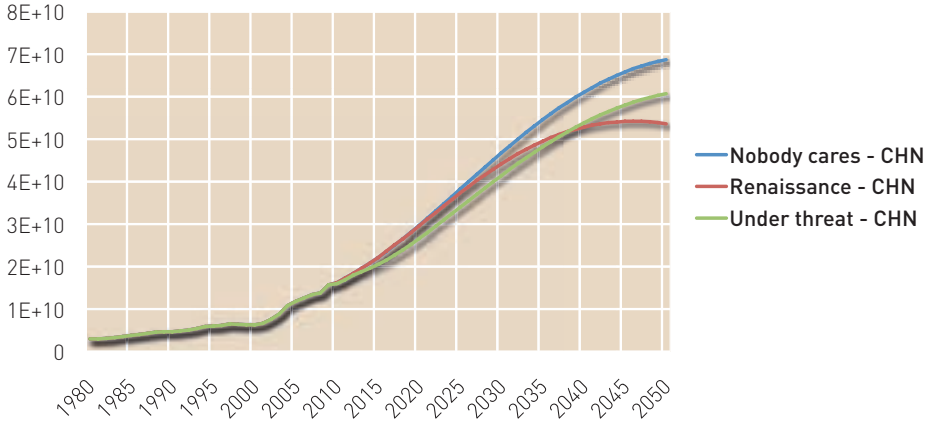


Figure 3
Energy consumption in the three scenarios: China
Source: CEPII



In all three countries, energy efficiency is the lowest in the 'Nobody cares' scenario, although it increases significantly. In the 'Under threat' scenario, the increasing price of energy leads to a general increase in energy efficiency, new and more efficient equipments being adoped, and less energy intensive activities gaining on more intensive ones. In the 'Renaissance' scenario, something different takes place as no additional increase in the price of energy is assumed, compared to the Nobody cares scenario: the way our societies are organized becomes more efficient (e.g. organisation of cities) and the gain in energy efficiency is much larger. As the assumption is made that these gains are proportional to the initial level of efficiency, they are ultimately much larger in societies already engaged in a more efficient use of energy, as Japan, compared to China. Such a pessimistic assumption is justified on the grounds of a very slow adaptation of habits and values in human societies: a generation or two will not lead to a convergence at the international level.

Combined with the expected growth of the economy, changes in energy efficiency will lead to visible differences in energy consumption in the long term. **Figure 3** shows that energy consumption in China will be the largest at any date under the 'Nobody cares' scenario. The 'Under threat' scenario and the associated increase in the price of energy

combined with modest gains in terms of energy efficiency leads to the lowest energy consumption until 2035. At the very end of the period, on the contrary, the 'Renaissance scenario' and the associated reorganization of our societies becomes worth the investment: with energy consumption being deci-dedly curbed in China despite the fact that the price of energy is kept at the level of the 'Nobody cares' scenario.

Further highlights of quantitative results are presented below as comparisons between the three scenarios. Each scenario with its traits has its effects on growth potentials/dynamics in selected countries. The different hypotheses of the scenarios interact with each other. It is thus the result of these interactions that is considered here rather than the result of individual hypotheses and variables computed separately. This is also why some variables for which no explicit assumption was made, like capital accumulation, are nevertheless subject to impacts caused by traits in the different scenarios. That is to say: assumptions on other variables such as savings (and hence investment) have their effect on (net) capital accumulation in the different scenarios in a much different way.

Demography and human capital

Figure 4 shows the expected dynamics of population in the 'Nobody cares' scenario. For the sake of readability, this graph only shows the developing world. A first immediate observation concerns the slow down of Chinese population, contrasting with the demographic dividend to be expected by India. Sub-Saharan Africa is less advanced in the demographic transition and this has important consequences in terms of population size. It will be the second most populated region of the world economy after India in 2050. As a result, the need for economic growth to achieve a given improvement of individual people economic situation will be much larger in Africa than in China. The situation is somehow comparable in the rest of Asia, with a buoyant demography. This is not observed in Brazil, and the demographic growth is much more limited in the rest of Latin America. Lastly, the Mediterranean countries also exhibit a rather dynamic demography that will become an issue if economic development is not sustained. It should be noted that these figures do not take into account the migration flows (over and above UN projections) to be expected in the scenarios out of SSA and MENA countries.

Concerning the advanced economies, the contrast is striking between dynamic USA and stagnant Europe, as shown in **Figure 5**. Russia demographic decline and ageing Japan are also clearly visible.

Such difference between the two sides of the Atlantic is even more striking when the age structure of the population is taken into account, as the labour force will shrink much faster than the population in Europe. **Figure 6** plots the total population and the labour force of the EU and the US: the difference between Europe and the US has clear-cut economic consequences, whereby with equal performances in terms of education and innovation (which is an optimistic assumption) and equal capital accumulation, Europe will grow less than the USA.

Figure 7 then deals with education. Accumulation of human capital is key to economic growth and social achievement and will continue in advanced economies, with a marked convergence towards the levels of the United States.[19] The same trend to convergence may also be observed in major emerging economies: in 1980, the average was 4 years in China and 12 years in the United States. In 2050 it will be respectively 10 and 14 years approximatively. In other words, the education level in China in 2050 will be equivalent to the French one today. This projection has two consequences. The first one is that the average level of education in the world will increase dramatically at the horizon considered here, which is good news in terms of functioning of

19 Following the approach of L. Barro (2010), the US is taken as the reference for convergence although this means to probably not incorporate future changes to the education levels in the US and other countries being brought about by intensified continuous vocational education and training.

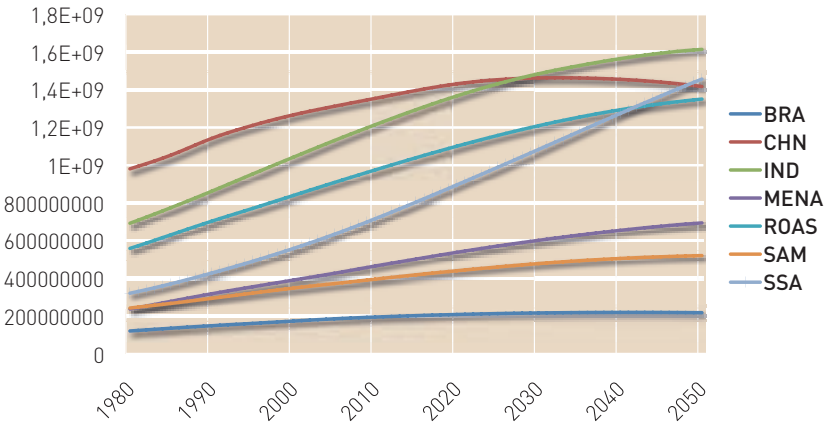


Figure 4 Population in the main regions of the developed world: Nobody cares

Source: CEPII

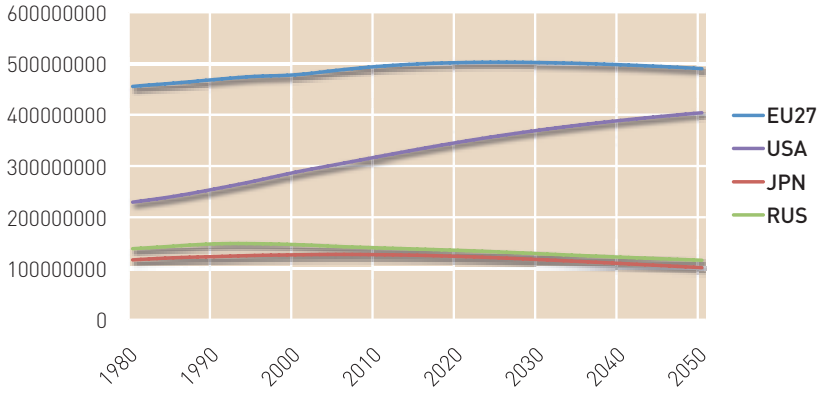


Figure 5 Population in the main regions of the developed world: Nobody cares

Source: CEPII

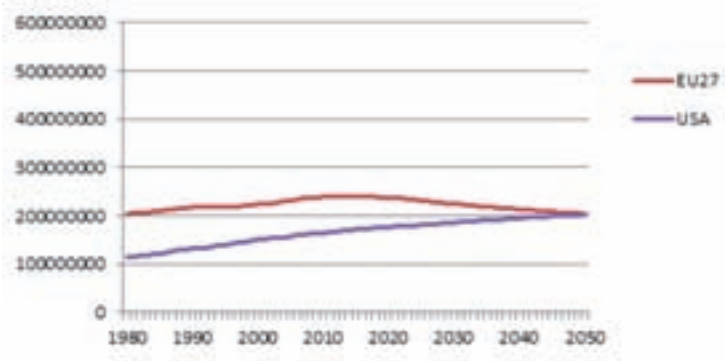
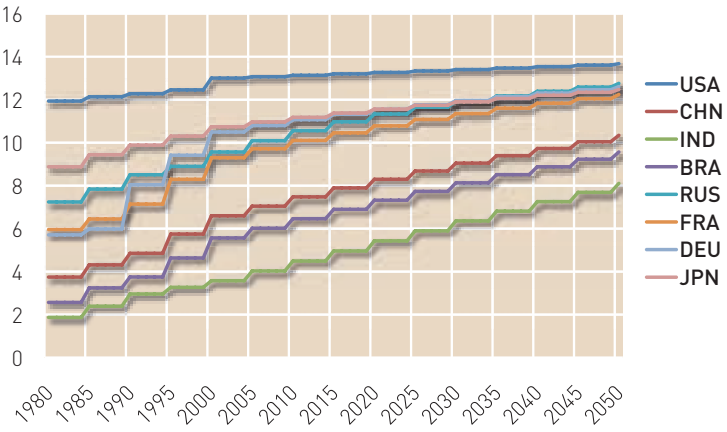


Figure 6 Labour force – USA and EU: Nobody cares

Source: CEPII

Figure 7
Average number of years of schooling: Nobody cares
Source: CEPII



the institutions, in terms of innovation, or simply in terms of well being of our societies. At the same time, the advance of industrialised countries will be eroded with obvious implications in terms of sharing of the knowledge at the world level.

In the 'Under threat' scenario (**Figure 8**) the reduced convergence in terms of education is affecting both emerging and European countries. For instance, instead of reaching a level of education comparable to that of the current USA, a country like Germany will hardly reach what was the USA level in 1980. Similarly, India will only achieve 6 years of education instead of the 8 years in the 'Nobody cares' scenario. Two major consequences can be derived: first an increasingly conflictual world with exasperated differences between North and South and tensions on access to the technology; second a laggard Europe in terms of innovation.

In the 'Renaissance' scenario (**Figure 9**), on the other hand, the speed of convergence is doubled compared to the 'Nobody cares' scenario in terms of education. China attains in 2050 a level of education comparable to that of the US in 1980, and India achieves a level of education in this scenario that is above that of China in the 'Nobody cares' scenario. Europe is doing also very well and more or less catches up with the US level.

Capital accumulation and technical progress

To come up, with an encompassing projection up to 2050, capital is the second production factor to be combined with the labour force, augmented by the value of human capital (resulting from education). In the 'Nobody cares' scenario the accumulation of capital in China is impressive (**Figure 10**). The pace of investment is such that China overcomes Japan in terms of capital stock within the next five years, the US by 2025 and the EU a decade later, while India overcomes Japan by 2050. But as the size of the labour force in China is so large, the capital/labour ratio (the amount of capital per worker) is expected to remain much below that of advanced countries. This difference is important in terms of comparative advantage towards labour intensive activities and hence international specialization. **Figure 11** plots the amount of capital per worker under the 'Nobody cares' scenario. Japan is tentatively compensating its rapidly declining labour force by huge capital accumulation (robotisation). This is somehow observable also in Europe, where the stock of capital increases enough to overcome that of the US, while the size of the US economy becomes greater than that of the EU over the same period. The Chinese stock of capital per worker will converge in 2050 to the value of Europe and the USA today.

Figure 8
Average number of years of schooling: Under threat
Source: CEPII

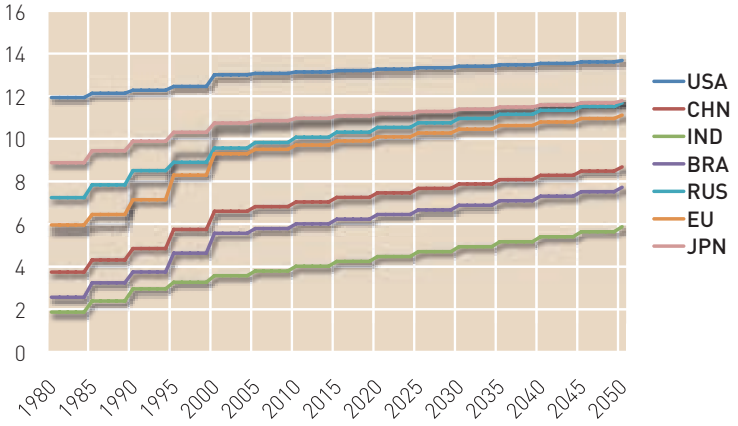


Figure 9
Average number of years of schooling: Renaissance
Source: CEPII

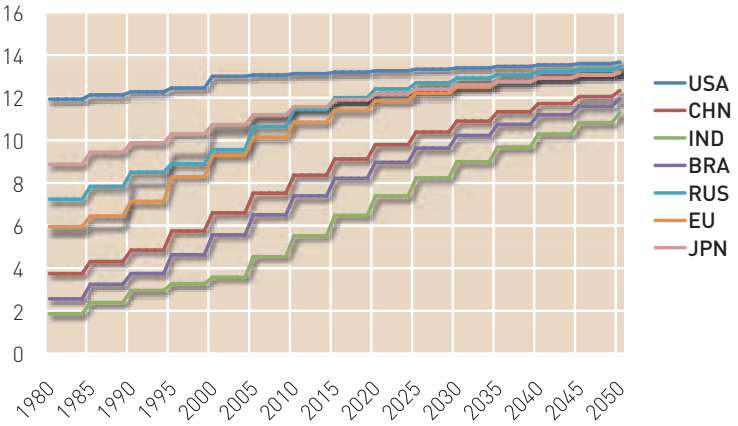


Figure 10
Accumulation of capital: Nobody cares
Source: CEPII

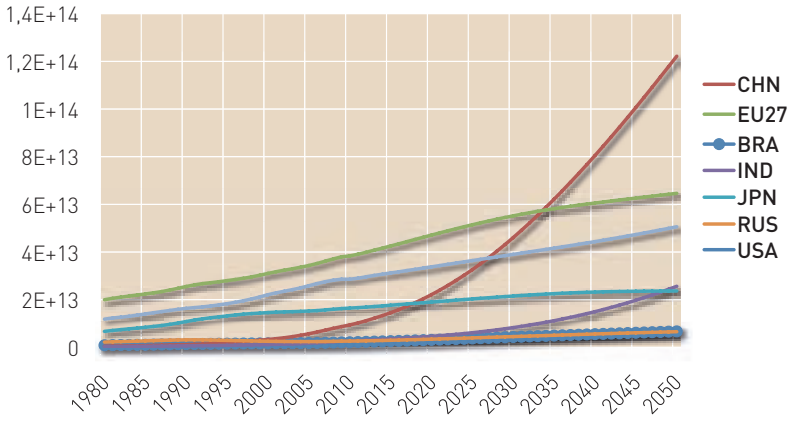
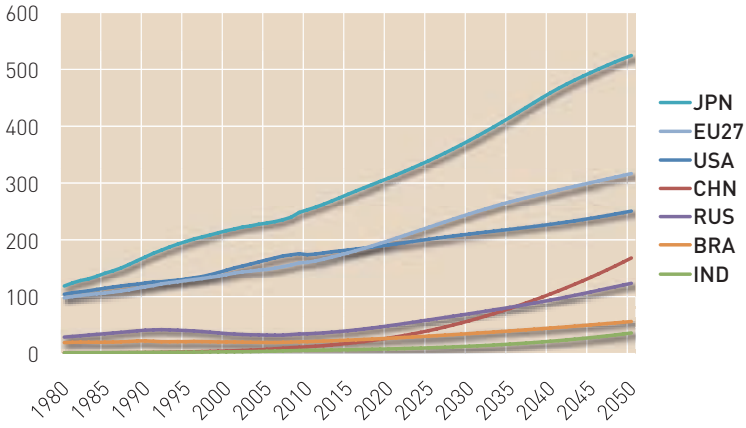


Figure 11
Capital intensity of the production: Nobody cares
Source: CEPII



Technical progress, as measured by total factor productivity (TFP), is more rapid in emerging economies than in the OECD. China, Russia, India or Brazil will be converging progressively towards the leading group. As shown in **Figure 12**, the outcome in the 'Nobody cares' scenario is a generalized technical progress at the world level, with a reduction in the technological distance between the largest economies (USA, China or India). Interestingly, the speed of convergence of China is quite impressive compared to Russia or Brazil. But competition between advanced and emerging economies is not the only important factor for the EU. Technological competition among advanced economies, USA, Japan and the EU, is in fact decisive in terms of future growth. In the 'Nobody cares' scenario, Europe does not manage to converge towards the US. Also, while the EU managed to converge toward the technological level of Japan until the 2000s, it does not recover as fast after the crisis.

A focus on the developing world in **Figure 13** points to highly uneven performances. China is outperforming the rest of the developing world, followed by India. While the situation of India compares on average nowadays with Sub-Saharan Africa in terms of Total Factor Productivity, India manages to catch up with Brazil at the 2050 horizon, SSA reaching only todays' Chinese level by then. India also outperforms the rest of Asia. MENA countries do much better than the rest of Latin America.

The EU on the other hand shows internal heterogeneities in terms of technological attainment, as can be seen by the positioning of individual member States in terms of total factor productivity: in **Figure 14** the two (currently) largest economies of the Eurozone – France and Germany – are considered, showing that the difference with Japan vanishes.

Figure 12
Total Factor Productivity: Nobody cares, EU27 as a whole
Source: CEPII

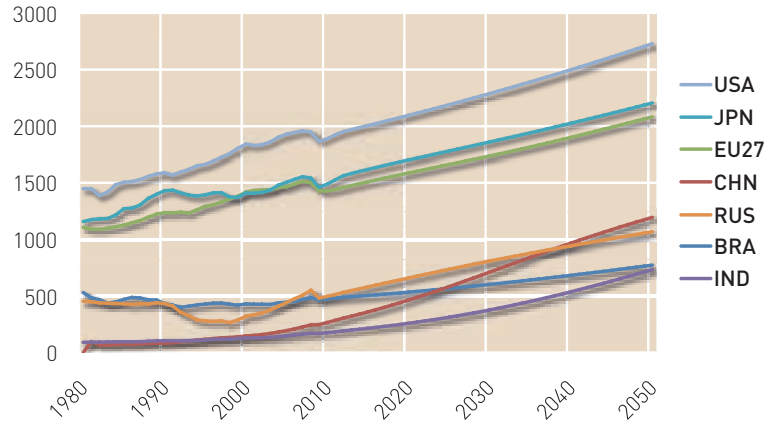


Figure 13
Total Factor Productivity: Nobody cares, focus on the developing world
Source: CEPII

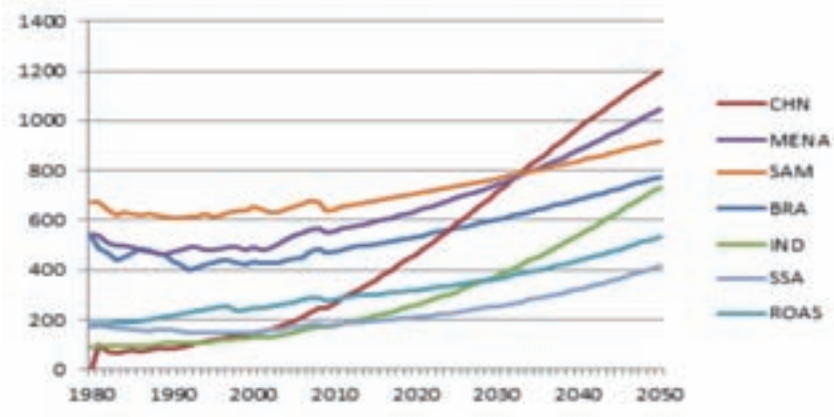


Figure 14
Total Factor Productivity: Nobody cares, euro-zone largest economies
Source: CEPII

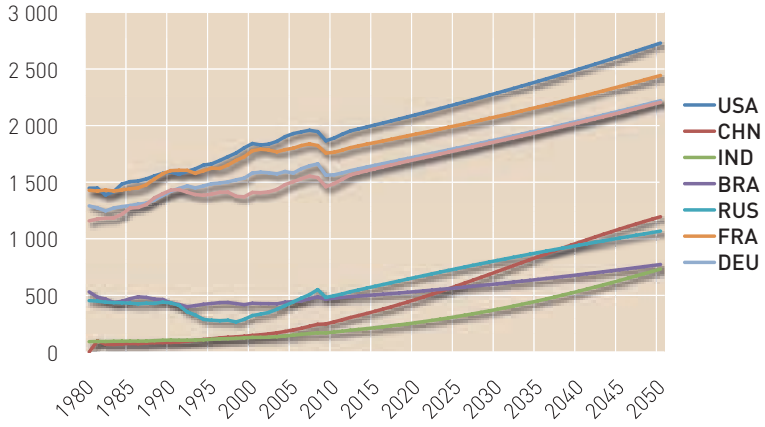
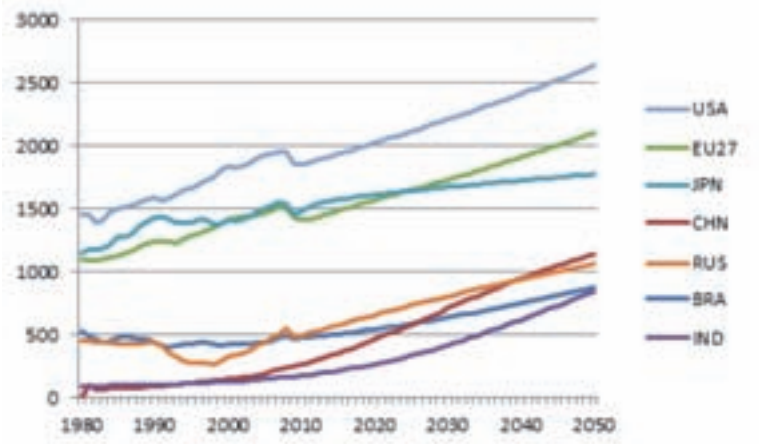


Figure 15
Total Factor Productivity: Renaissance
Source: CEPII



Total Factor Productivity: Under threat
Source: CEPII

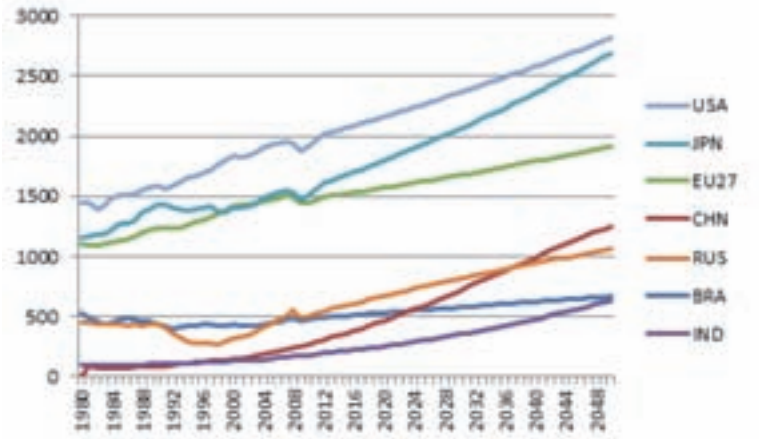


Figure 16
EU27 GDP under the three scenarios (constant 2005 USD)
Source: CEPII

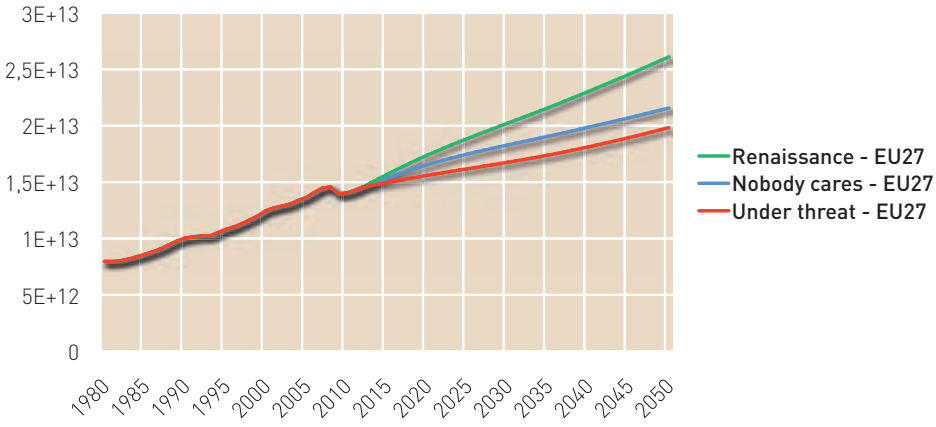
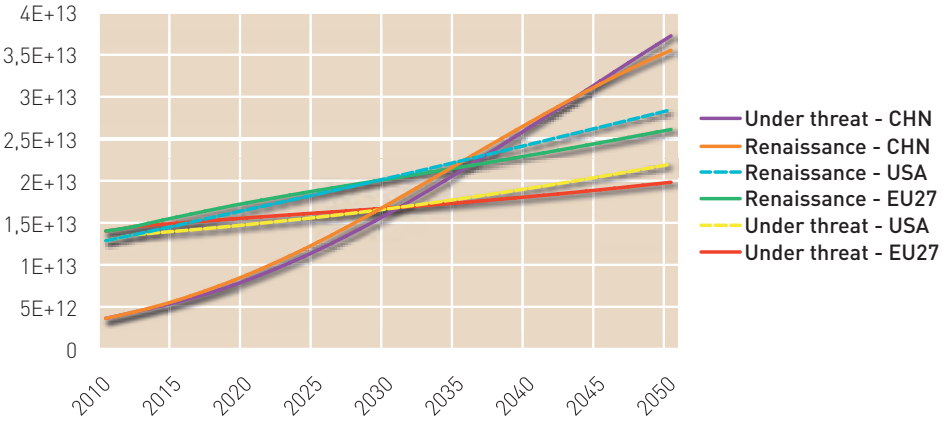


Figure 17 GDP 'Under threat' and 'Renaissance' scenarios: EU27, USA, China (constant 2005 USD)

Source: CEPII



In the 'Renaissance' scenario, the assumption is made that improved EU policies in terms of research and innovation boost TFP in Europe. The opposite assumption is made in the 'Under threat scenario'. The outcome is shown in **Figure 15**, pointing at the strategic importance of a good orientation of the European research effort in the next decades.

Economic growth

Under the adopted assumptions, the differences in the future dynamics of GDP values are considerable in both absolute and relative terms. **Figure 16** shows the impact of each scenario on the GDP of the EU27.[20] GDP of each country or region is expressed in constant 2005 dollars (inflation is not accounted for). The difference between a favourable economic environment combined with sound and pro-growth policies in Europe, and a more adverse environment combined with less action at the European leval is immediately visible. When the effects of these assumptions cumulate over time, the difference becomes considerable: EU GDP is 30 % larger in the best option, compared to the worst. In other words, our future is not in the cards: it is to a large extent to be shaped by the policies that Europe will be able, or not, to put in place, and by our international environment. But EU policies or postures in the international arena are able to somehow shape our international environment: in the Renaissance scenario, free trade is preserved, international mobility of capital is preserved (meaning that financial regulations making it sustainable have been enforced at the international level), global imbalances are fixed. All these elements will contribute to EU future prosperity, beyond EU capacity in terms of innovation.

As illustrated in **Figure 17**, EU27 GDP remains consistently below that of the USA after 2030, even in the 'Renaissance' scenario. This is mainly the outcome of the demographic dynamism of the US compared to Europe, that cannot be compensated by capital accumulation or even by more rapid technical progress in Europe. For demographic reasons, and even taking into account migrations, the relative decline of Europe compared to the US is already in the cards. More importantly, the relative GDP of economic super powers will be totally different at the 2050 horizon under the more extreme scenarios. In the 'Under threat scenario', the US and the EU account for only 59 % and 53 % of China respectively, against 80 % and 73 % respectively.

20 GDP growth convergence/divergence between EU Member States is not addressed, as the model is global and does not break up data within EU27.

Figure 18
GDP of India, SSA, MENA (constant 2005 USD)
Source: CEPII

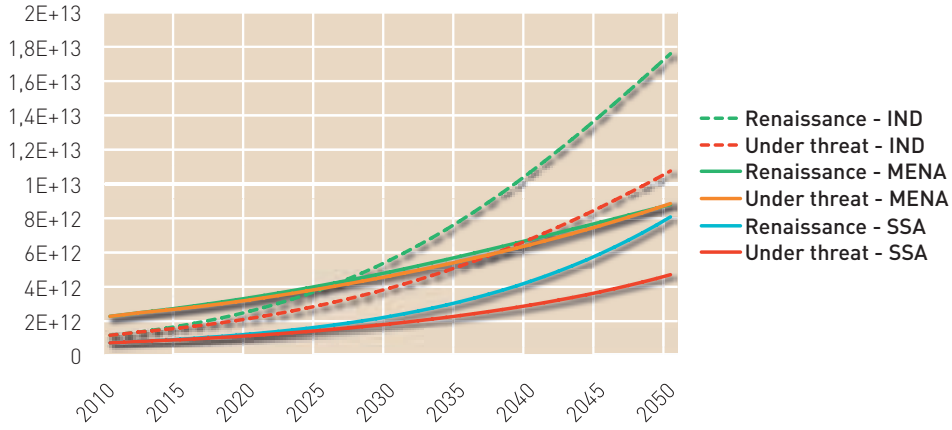


Figure 19
GDP per capita (constant 2005 PPP) relative to the US (USA = 100 at each date)
Source: CEPII

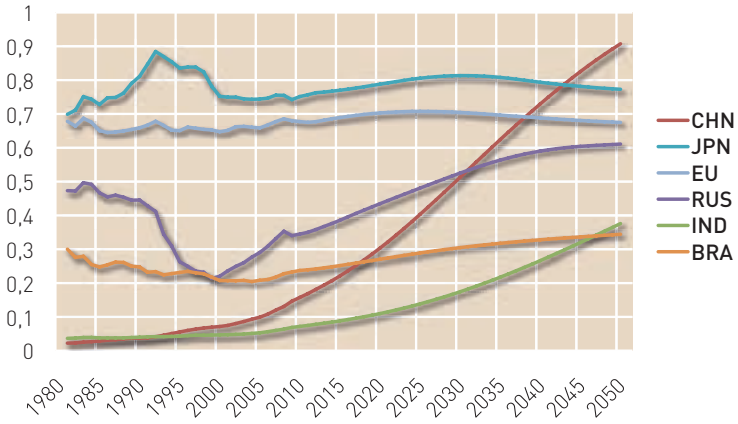


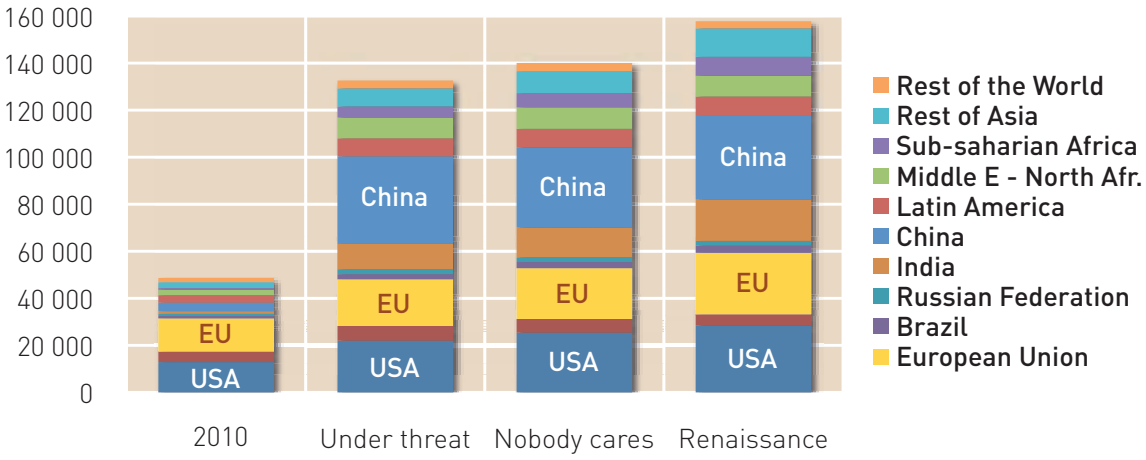
Figure 18 shows that the difference between scenarios is striking for India and even more for SSA countries. Hence, in terms of poverty reduction, the 'Renaissance' scenario is really needed. In the Mediteranean region, this is hardly the case however: the future growth of this region is really embedded in internal determinants, such as demography or technical progress, and will hardly be affected by other assumptions regarding macroeconomic imbalances. A complementary explanation is that the two extreme scenarios entail hypotheses that are favourable and detrimental to the region, as for instance a higher oil price in the Under threat scenario that may be favourable to several countries in the regions) combined with emigration (reducing the labour force).

The combination of GDP growth and demography determines the changes in the average income per capita in each country or region (**Figure 19**). Before commenting such outcome, it is worth stressing that internal economic conditions within each country will very much depend from the internal distribution of income, which is clearly not reflected

in average values. The situation will improve dramatically in China, with an expected catch up of purchasing power towards European level within the next 25 years and towards Japan a decade later. The improvement of living standards is also striking in India, while Europe is characterized by stagnation, in contrast with Russia where GDP per capita increases despite the overall stagnation of the GDP driven by adverse demographic conditions.

Ultimately, the impact of the three scenarios on the world economy is summarized in **Figure 20**. Each bar is proportional to the size of the world economy in 2050, measured in GDP at constant 2005 USD. Each bar is then split among regions to reflect the share of their contribution to the world GDP. The impact of the scenario assumptions on policies at the European and international levels is clearly visible in this graph.

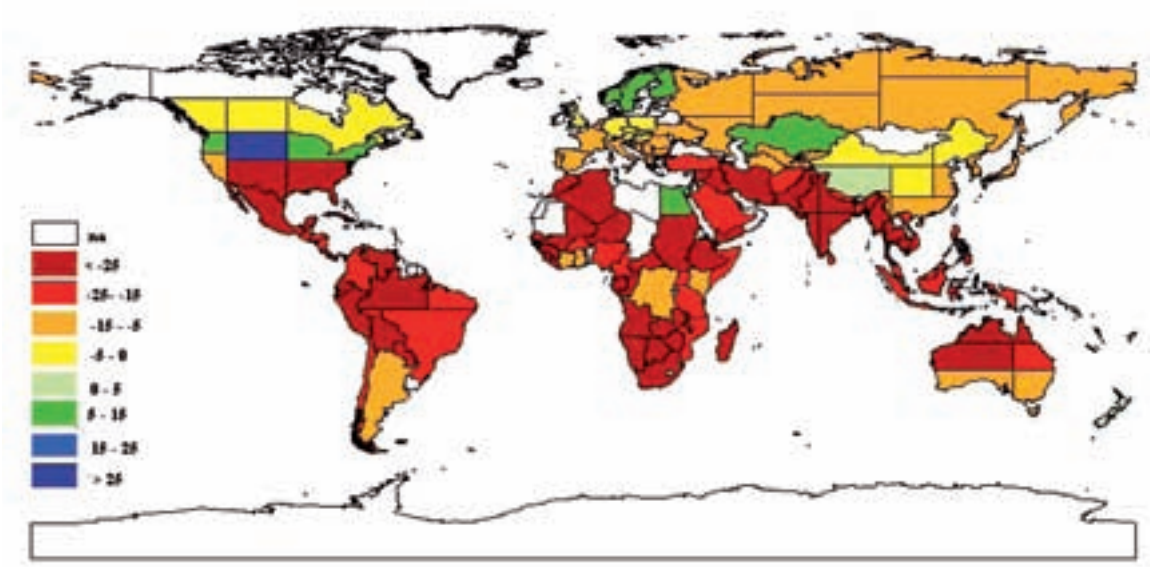
Figure 20
World GDP in 2050 (bn 2005 USD) for each scenario
Source: CEPII



Production and trade patterns: agriculture

Technical progress in the agricultural sectors is critical for several long term issues and has accordingly been analysed separately from other sectors. Agricultural productivity for all GTAP countries/regions is estimated by following the methodology of Ludena et. al (2007). A feedback of global warming on productivity is explicitly considered, which differs across regions as illustrated in **Figure 21**. On the other hand, for industry and services, the model determines endogenously the technical progress matching GDP trajectories with the projected resources endowments.

Figure 21
Changes in agricultural productivity associated with climate change: Under threat
Source: Cline



The improvements in agricultural total factor productivity are illustrated in **Figure 22** for the EU. For all scenarios, the EU27 trends are strikingly at odds with the expected trends in Sub-Saharan Africa (**Figure 23**) where the global warming and other pessimistic assumptions of the 'Under threat' scenario would worsen an already very adverse evolution. On the other hand, one must consider that Sub-Saharan Africa has an expanding agricultural population, and production increases despite the decrease in efficiency.

The results of theses changes in agriculture in the Nobody cares scenario are illustrated in **Figure 24**. The EU share of vegetal production is declining fast,

Figure 22
TFP gains in agriculture (2010-2050) EU27
Source: MIRAGE, CEPII

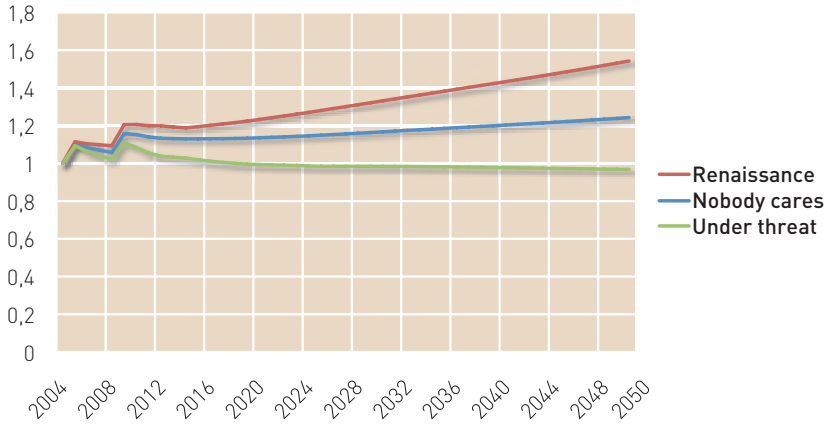


Figure 23
TFP gains in agriculture (2010-2050) Sub-Saharan Africa
Source: MIRAGE, CEPII

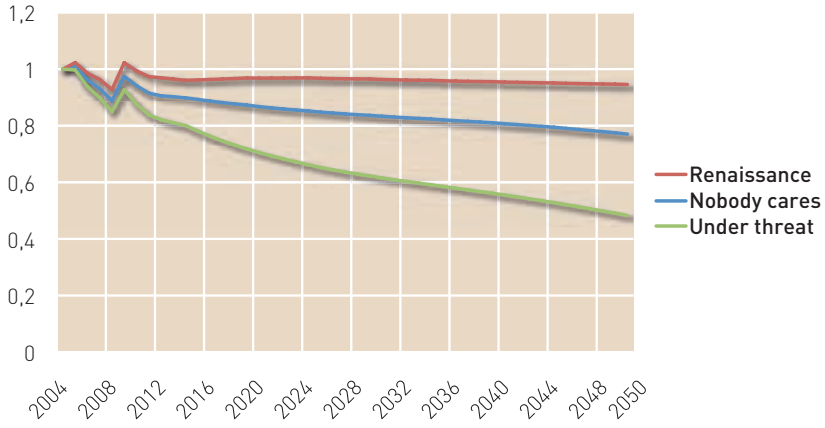


Figure 24
Regional shares in world vegetal production: 'Nobody cares'
Source: CEPII, MIRAGE

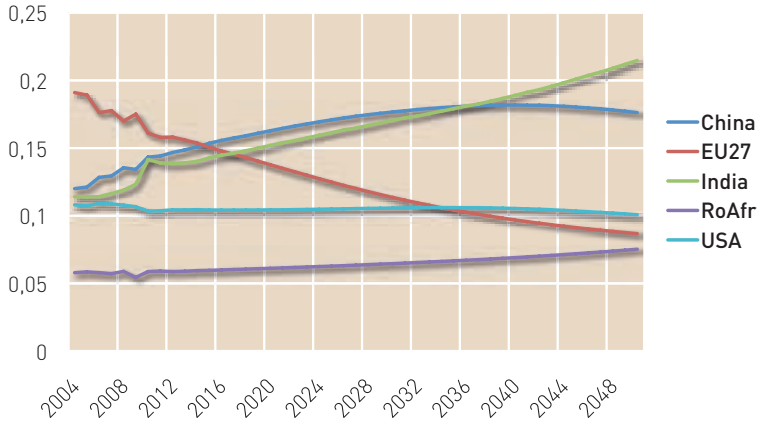


Figure 25
Regional shares in world animal production: 'Nobody cares'
Source: CEPII, MIRAGE

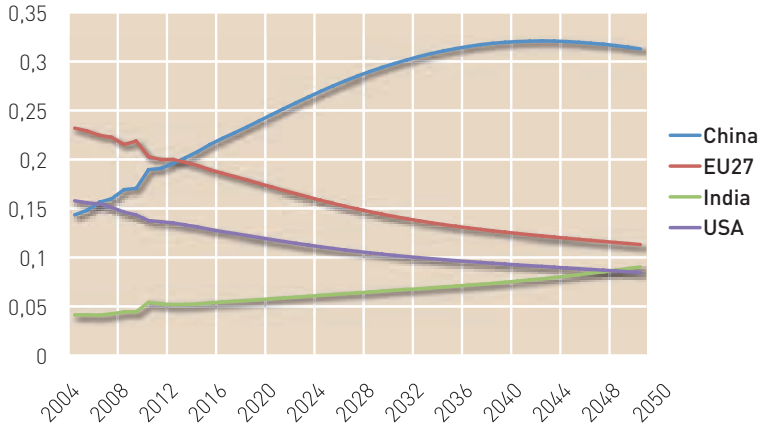


Figure 26
Regional shares in world vegetal production: 'Under threat'
Source: CEPII, MIRAGE

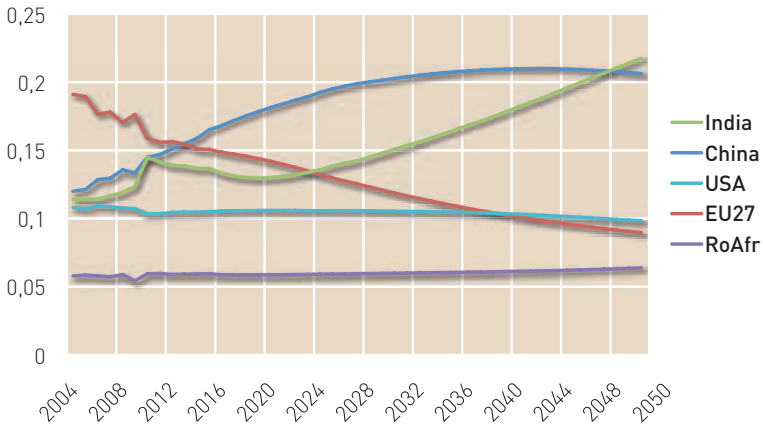
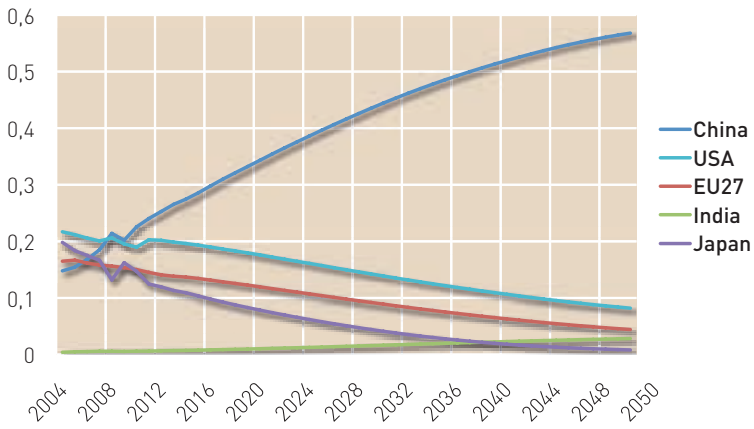


Figure 27
Regional shares in the world production of electronic products
Source: CEPII, MIRAGE



to be overcome by India at the 2050 horizon, and in contrast with the resilient share of the USA. India becomes the leading actor, while the Chinese share declines due to the reorientation of this economy towards other sectors as economic development proceeds. As expected, the Sub-Saharan share ('Rest of Africa') increases, primarily as the consequence of an extensive growth.

The projected evolution is totally different for animal productions. As shown in **Figure 25**, the share of China is booming, as a result of the changes in consumption habits as this country catches up with the standard of living of today's rich countries. Interestingly, the share of Latin America (not represented here) remains constant. The EU and US shares decline while India catches up progressively.

The 'Under threat' scenario (**Figure 26**) is highly detrimental to the Indian's share of vegetal production that catches up only much later, and, although to a lesser extent, is also detrimental to Sub-Saharan Africa. Climate change is indeed favoring some European and American regions (Scandinavia, center of the United States, North of China), compared to Africa, or the rest of Asia. But such outcome also results from increased trade costs and tariffs making it necessary for large economies to rely on their own resources to back their population food needs, instead of deepening their specialization towards services or industry.

Production and trade patterns: industry

Turning to industry, how 'Manufacturing Asia' will specialize is a concern for most policy makers.

Figure 27 shows the changes in the shares of selected countries in the world production of Electronic products, a sector chosen as a representative example. The generalized outsourcing of production of electronic devices to China is expected to last. The share of China should double at the 2050 horizon compared to today. This can be the result of the specialization of China in industrial sectors where it enjoys advantages, and/or the result of its increasing absolute size. In this scenario, India does not become an important actor in this sector, as its advantage lies rather in the software production sector.

The mirroring outcome in terms of Chinese specialization is shown in **Figure 28**: the share of electronics' exports does not actually increase over

Figure 28
Sectoral shares in Chinese exports
Source: CEPII, MIRAGE

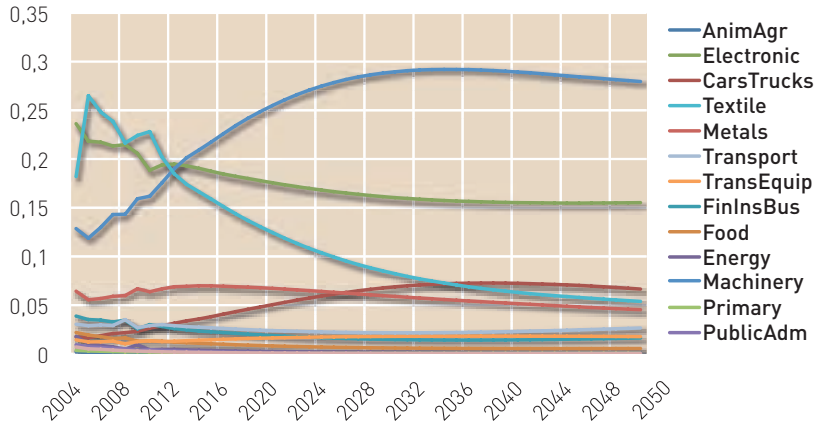


Figure 29
Sectoral shares of EU27 exports
Source: CEPII, MIRAGE

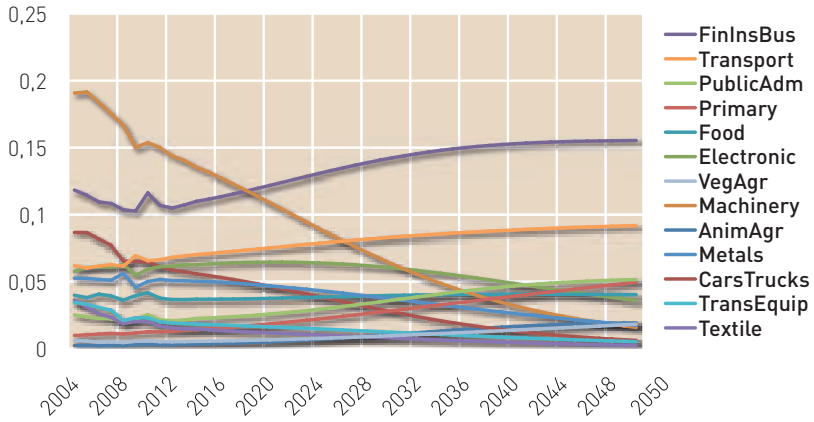


Figure 30
Global CO_2 emissions (Million tons of CO_2)
Source: CEPII, MIRAGE

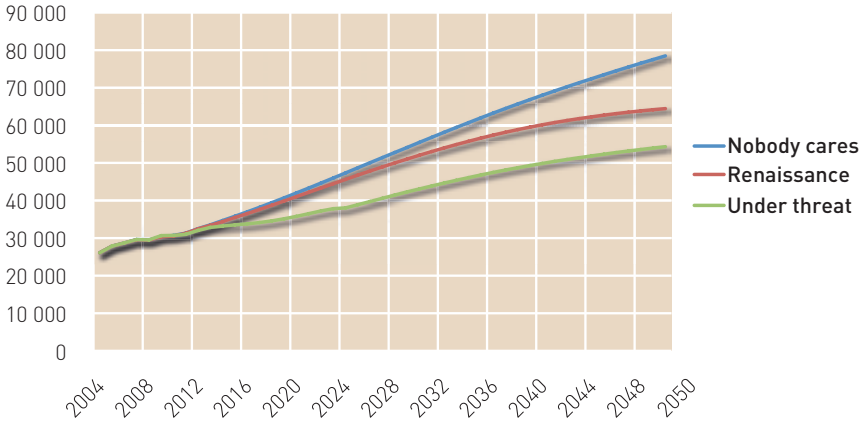
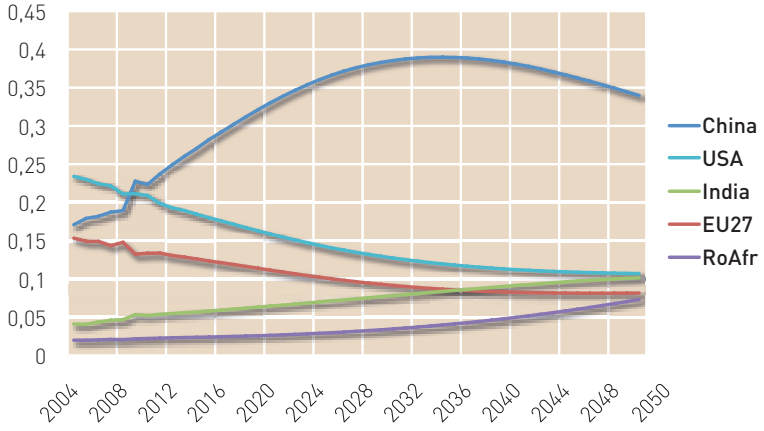


Figure 31
Regional share of CO_2 emissions – EU Renaissance scenario
Source: CEPII, MIRAGE



time, leading to interpret the boost in production volumes as the outcome of the sheer size of China. China is seen to specialize in a different sector, Machinery, which will rapidly represent as much as 25% to 30% of its exports, threatening the traditional leadership of Europe in this sector. The only EU strategic response is to climb up the quality ladder to escape from price competition. On the contrary, Chinese specialization will move away from textile and clothing, a sector increasingly reclaimed by newcomers with lower wages than China. Lastly, Chinese specialization in the car industry will culminate around 2035, as this industry is somehow protected by its 'regional' nature: it is necessary to produce in the proximity of the customers.

On the other hand, Europe is expected to further desindustrialise, at least in terms of export specialization, as shown in **Figure 29**. The buoyant export sector will be financial, insurance and business services. Transport is also expected to play an increasing role. Specialisation in Machinery will decline sharply, as well as that in Electronics and Cars. Lastly, vegetal production should also increase their share. The 'Renaissance' scenario would only cushion such fundamental trends, the only notable difference being the increasing share of transformed food products in EU27 exports in this case.

More generally the effect of tariff and trade cost reduction associated to the 'Renaissance' scenario is to significantly boost world trade in this scenario (+24.6%), which further witnesses a (limited) change in trade composition, whereby the share of services trade decreases while agri-food and manufactured products increase their share.

Emissions

Changes in CO_2 emissions shown in **Figure 30** should be analysed in the light of the underlying mechanisms. In the 'Under threat' scenario the assumption is made that the price of energy considerably increases, and that energy efficiency also increases as a technical response to such constraint. In the 'Renaissance' scenario, the price of energy does not increase, as the boost in energetic efficiency helps to better match world demand and supply in a context of dynamic growth. Accordingly, in the 'Under threat' scenario two forces combine to curb the demand for energy (and emissions): technical progress, and energy price with the induced reduction in its consumption. At world level, CO_2 emissions increase more under the 'Nobody cares' scenario. The 'Under threat' scenario, combining a moderate technical progress with a large increase in the price of energy leads to the lowest level of emissions at world level. The 'Renaissance' scenario, in contrast, can only rely on a sharp increase in energy efficiency. The conclusion is that prices will be a decisive instrument in the management of energy in the future, as technical progress will not sufficiently alleviate the constraint.

Such evolution also bears implications at the regional level (**Figure 31**). Considering for instance the 'Renaissance' scenario, most of the action takes place in China until 2035. The USA and the EU mana-ge to maintain their emissions at today's level, despite the growth of their economy, but China is exhibiting a very bad record. After 2035 China mana-ges to seriously curb its emissions, but the problem then shifts to India, and even to Sub-Saharan Africa at the 2050 horizon.

2
Global Europe-2050 scenarios

This chapter illustrates and compares the three scenarios in detail. It also presents a series of possible shocks, or 'wild cards', that might affect each of the scenarios. The table below shows the main traits of the scenarios narratives and of the wild cards.

Table 4 – Scenario structure and wild cards

	Scenarios		
	'Nobody cares'		'EU Under threat'
Dimensions	**Europe**	**Rest of the World**	**Europe**
Demographic and social	• An ageing population in Europe • Immigration • Slow integration of immigrants and culture-based social segmentation		• A shrinking population in Europe • A declining social capital
Energy, environment and climate changes	• Increased energy constraints	• Rising consumption of raw materials • Rising pressure on water • Rising pressure on land, food production and biodiversity loss	
Economy and technology prospects	• Challenging economic prospects for Europe • European youth on the move? Not enough • A still vital European industry • A challenging transition to digital Europe	• Accelerating globalization • Asia-led global growth and trade	• A declining labour input • Human capital circulation • A declining infrastructure investment
Geopolitics and governance	• Challenged role of EU on the global stage	• Redistribution of global power • Change of military power balance • Struggling against global instability	• EU fortress
Territorial and mobility dynamics		• Global urbanization	• Increasingly vulnerable and unsustainable cities
Research, education and innovation	• A failing European Innovation Union		• A fragmented European Research Area

	'EU Renaissance'		
Rest of the World	**Europe**	**Rest of the World**	**Wild Cards**
	• Preserving the standard of living • Active ageing • An open and attractive European society		• No immigration into European Union • Changing values of future young generations
• Global energy insecurity • The worst global warming scenario • Unabated degradation of water • Global food crisis and degradation of biodiversity	• A successful roadmap to low carbon Europe	• More positive global energy and CO_2 reduction prospects	• Global dismissing of nuclear power after the accident in Japan
	• New opportunities for the EU industry and employment • Tackling the challenges of the knowledge economy • New forms of value creation activities • Smart investment in global and local infrastructure	• A new global financial stability • Continuing ICT revolution • Key enabling technologies • New developments in energy technologies	• New techno-economic paradigm from Asia and technological breakthroughs • EU disruption
• Global insecurity • A widening governance gap	• Towards the European Political Union • EU leadership on the global stage	• Global security • Filling the governance gap: global democratization and citizens empowerment	• The end of the West • Russia member of the EU and NATO • Conflict between Russia and Europe • Extensive democratization of Arab Countries • Civil war in China • Chinese democratic revolution
	• A polycentric Europe • Sustainable cities • Smart and sustainable mobility		
	• An integrated European Research Area		• 'Let thousand people learn, think and apply knowledge in their local context'

2.1
Standstill in European Integration 'Nobody cares'

Quantitative spotlight

In the 'Nobody cares' scenario, the redistribution of economic power at the world level is impressive. While in 2010 the EU accounts for 29 % of the world GDP, with the USA at 26 %, Japan at 9 % and China at 8 % (**Figure 32**), by 2030 the US overcome the EU (23 % and 22 % respectively), with China having more than doubled its share (18 %), Japan still representing 7 % of the world economy and the share of India more than double its 2010 value (5 % in 2030, 2 % in 2010). In 2050 (**Figure 33**) the relative size of the EU in the world economy is halved (15 % against the current 29 %), with the USA still representing 18 % of the world economy, China almost as much and India's economy more than twice that of Japan. While the size of the world economy is multiplied by 2.7 compared to 2010, Europe's GDP only exhibits a 50 % increase, while the US GDP doubles.

Figure 32
Regional shares of world GDP in 2010 (constant 2005 USD)
Source: CEPII

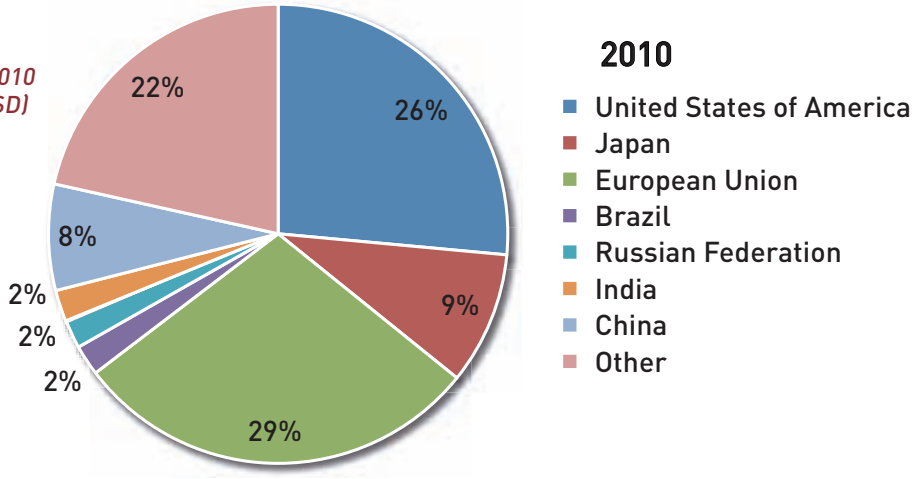


Figure 33
Regional shares of world GDP (constant 2005 USD) in 2050: Nobody cares
Source: CEPII

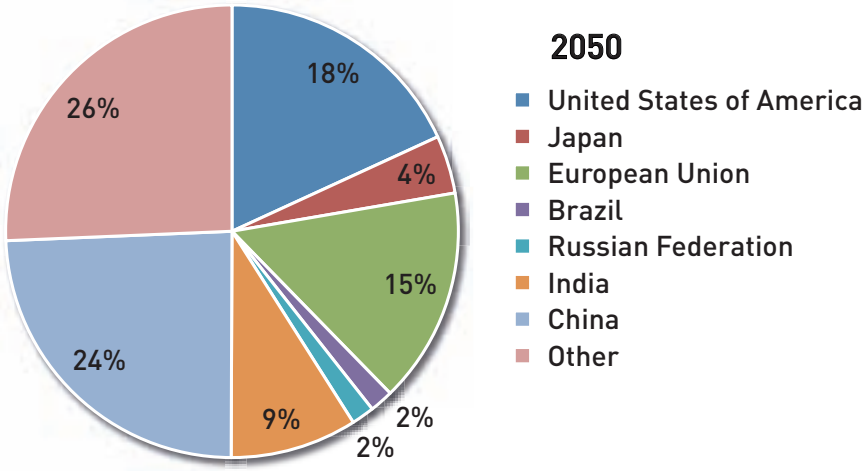


Table 5 provides additional information on the world economy until 2050 under the 'Nobody cares' scenario

Table 5 – GDP for selected regions, 2010-2050, constant 2005 USD bn: 'Nobody cares'

	2010	2020	2030	2040	2050
United Stades of America	12 873	15 748	18 589	21 849	25 412
Japan	4 541	5 206	5 634	5 749	5 805
European Union	14 024	16 538	18 295	19 865	21 567
Brazil	1 047	1 432	1 852	2 259	2 635
Russian Federation	882	1 205	1 530	1 822	2 007
India	1 176	2 270	4 323	7 785	12 682
China	3 637	8 301	15 837	25 072	33 998
Latin America	3 149	4 314	5 482	6 697	7 935
Middle east and North Africa	2 280	3 338	4 822	6 766	9 144
Sub-saharian Africa	730	1 192	2 023	3 499	6 048
Rest of Asia	2 508	3 625	4 995	6 857	9 352
Rest of the World	1 794	2 133	2 524	2 956	3 463
Total World	48 640	65 303	85 904	111 175	140 047

Source: CEPII

2.1.1 Global demographic and societal challenges

An ageing population in Europe

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). The differences in life expectancy among the EU Member States are likely to become much smaller than today if not altogether eliminated.

Population ageing in Europe will continue being the result of three phenomena: persistent low fertility rate, the steady extension of the life expectancy and the transition of the large cohort of the baby-boomers to the age of retirement. These demographic trends are almost certain in the future, up to 2050, and will induce several consequences or pressures on the European societies:

- Growth will be limited by a shrinking population of active age (unless age at retirement is increased, women's employment is facilitated, and immigration increases)
- 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, notably imposing an adaptation of jobs and an internal re-organisation of firms
- Pressures will be exercised by some sectors of the economy for more immigration and will lead to further increases in the multi-culturality of European societies, with a number of problems of integration to be addressed.

Immigration

Migration is the more volatile aspect. However, the impact of migrant workers on the labor force is beginning to be apparent to all. International immigration in the developed world is the highest it has ever been, whereby the immigrants – in the absence of sufficient local workers – have been filling the gaps in numerous countries. What is to be recognized here is the divergence of population growth between areas of the world: some areas will see a reduction in population. Others a stagnating population and some others a rising population. Almost everywhere population will be ageing, but in some areas the average age will move towards 40 or more and in other towards 25. This will have a likely impact on the consistency and direction of international migratory flows.

A question immediately connected to the growing population is how to feed 9 billion people? What kind of organization of the agriculture? In the 'Nobody cares' scenario, with the continuing trends of global agribusiness, should we expect industrial agriculture around the world with less and less people being involved and a continuous immigration towards the towns and the industrial towns close to the coasts? Indeed, taken as a whole, when compared with natural rising populations, internal migration is the major driver of population growth in cities: 2006 was notably the year when, on average, more of us lived in cities than in rural areas. Over the past decade, the shift of people into China's cities has been cited as the largest peacetime movement of population in history. By 2050, 75 % of us will be living in cities.

In any event, many see that, to sustain competitive growth in the face of declining fertility and ageing, Europe will support increased migration – and this will largely come from North Africa and the Near East. Some trends are becoming clear: according to recent EU reports, since 2002 net migration into the EU has roughly tripled to around 2 million people a year, and migratory pressure at the EU's borders could increase in the future. Eurostat data from 2008 suggests that, within the EU, from 2015, deaths will outnumber births and so natural growth will cease. From that point on, positive net migration will be the source of population growth. Although raw data about migratory flows is highly sensitive and hard to come by, the demographic logic seems straightforward here. By 2050, EU-25 is projected to have

449 million people (after losing some 10 million from the present level and an assumed net immigration of more than 35 million in the period 2005-2050 – about 780.000 units per year), half of them older than 50 years. In the same scenario the population of the Europe's southern neighborhood countries is projected to reach about 1.25 billion by 2050.[21]

Migratory flows are relevant 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 by means of remittances) and as a liability (problems with integration, public concern). Key issues in this area include control of flows, legal and illegal immigration, and the impact on human capital in general (strongly related to innovation/education).[22] Also, selective migration aiming at attracting the best trained people from the south (engineers, medical professions etc.) will lead to a brain drain detrimental to origin countries. Indeed, 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 literate immigrants because of new translation software. There will be an increase in multi-lingual education in public schools and universities. The local language will be supplemented by English and often by languages spoken by the communities of the immigrants, especially when these are concentrated in segregated neighborhoods with low or no exogamy.

Multi-cultural society

Europe will become increasingly multi-cultural, due to consistent immigration flows, mostly from Southern Mediterranean countries and Africa. The European society will become increasingly Muslim as, if current trends continue, over 10 % of European nationals will be Muslim by 2020. Several commentators expect that, excluding Russia, Europe's Muslim population will easily double by 2020 and that, by 2050, one in five European will probably be Muslim. Even without Turkey (which alone includes a Muslim population of around 70 million) in the EU in the next decade, with a Muslim population equal to that of Germany, this will have a significant impact on not just Europe's culture and societal make-up but also on how the region operates on the international stage. This migration to Europe will have some important characteristics: first, migrants are much younger than the recipient population. Second, the migrants' birth rate is appreciably (approximately three times) higher than the continent's mean. Third, the immigrants are disproportionately concentrated in segregated neighborhoods in large cities. Fourth, significant share of these immigrants show little or no sign of second-generation assimilation into their host societies.

21 United Nations (2011). *World Population Prospects: The 2010 Revision*. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.

22 METRIS Report – Emerging Trends in Socio-economic Sciences and Humanities in Europe.

2.1.2 Energy and natural resources security and efficiency, environment and climate change

Increased energy constraints

Overall oil and gas demand is growing faster than new reserves are being found, and, in addition, most of the oil is in the Middle East and most of the gas is in the Middle East, Europe and Russia. Today, US energy demand is well outpacing its domestic supply and so it is hugely dependent on imports. Add in increasing demand from China, never mind other growing economies, and the geopolitics of oil and gas are all too evident. Globally, oil and gas supplies are both physically and politically constrained resources. Or, to put it another way, in the language of the energy sector, the 'days of easy oil are over' and from now on it gets more difficult. In terms of other energy sources, the next big one on the list is coal. Here US faces less of a supply problem, as it has around 30 % of the world reserves compared with Russia's 19 %, China's 14 % and Australia's 9 %. In 2008, China produced and consumed over 42 % of the world's coal (compared with 17 % in the US). You can see the important role of coal in China when you look at electricity consumption: at the moment most of China's power is coming from coal. There are clearly alternatives – renewable energy from hydro, geothermal, wind, wave and solar generation, and also nuclear power.

The International Energy Agency (IEA) reference scenario proposes that, over the next twenty years, global energy demand will increase by around 40 % – so an average of 1.5 % a year – with the vast majority of the growth coming from non-OECD countries such as China, India, etc. Oil will remain the largest single fuel, providing 30 % of the total energy mix, with more and more transport accounting for 97 % of the increase in its use. Global gas supply will also increase by around 45 % by 2030 to provide just over a fifth of the world's energy needs. World electricity demand will grow at an average of 2.5 % a year. In 2009, 13-14 % of the world's electricity came from nuclear power and its use is expected to grow in most regions except Europe. However, its overall share of electricity is expected to fall. In absolute terms, the biggest increases in demand will be met by coal-based power generation. The growing use of renewable energies – wind, wave, solar, hydro and geothermal – will start to make an impact but, in comparison to the other energy sources, their individual shares of the mix will still be in single figures by 2020. Associated to this type of energy prospect, there is a continued rise in carbon emissions. By 2020, an additional 5 000 million tonnes will be being emitted annually, and double that by 2030. So, without a massive and fundamental global shift in energy consumption behavior, any chance of slowing CO_2 emissions is years away.

Rising consumption of raw materials

Alongside energy, the growth in consumption of many of the world's main metals is also on the rise. According to BHP Billiton projections, between now and 2030 we will consume more copper, more aluminium and more steel than we have in history. With all the construction under way and planned, as well as increased production of vehicles and domestic appliances, China's demand for steel is expected to double by the 2020s, while in India the government's target for steel production in 2020 is four times the levels of 2010. Driven by demand from the construction industry, global cement supply is also on the up, continuing to rise at just over 4 % a year despite the recession. Although industry experts estimate that there is another 1 000 years' worth of aluminium available around the world, for nickel we are talking about 90 years and for copper the projection is down to only 60 years.[23] The difference between metals and hydrocarbons, however, is that metals can be recycled and reused.[24] But, historically, wealthy economies are not very good at recycling.

A number of rare metals increasingly matter in the global economy, not only because they are vital to the production of advanced electronics equipment – cell phones, batteries, plasma screens – but also because they are part of the 'green technology revolution',

being essential in the construction of hybrid cars and wind turbines. For instance, the majority (88%) of the world's platinum is produced by just two mines in South Africa and most of the rest comes from a single mine in Russia. Platinum is recovered at a rate of about 200 tonnes per year. If used to increase the number of cars powered by fuel cells, this quantity is only enough to produce 2 million such vehicles by 2030, which is only around 5% of the world's current car fleet.

Rising pressure on water

Water is clearly a key resource, without substitutes of any sort. As GDP per capita rises, so does water demand and by 2025 two-thirds of the world's population are expected to be living in water-stressed regions. The problem is not new, as over one billion people currently experience water scarcity, having less than the minimum 50 liters a day recommended by the UN. In Europe, we use around 300 liters per day and the average US citizen consumes twice that. With 20% of the population but only 7% of global water supplies, China is particularly vulnerable. The World Bank reports that half of China's 660 cities suffer from water shortages, affecting 160 million people. Worse, it seems that about 90% of cities' groundwater and 75% of the rivers and lakes are also polluted. Despite all the bad news, water is still however a renewable resource: we are not running out of it. A significant part of the problem is the huge and often deeply inefficient use of water. In addition, throughout many parts of the world, rainfall and river flows are strongly seasonal, with too much water arriving during monsoon periods followed by maybe seven or eight months of water scarcity. Climate change will exacerbate this and we will increasingly get the wrong water in the wrong places at the wrong times of the year.

Rising pressure on land, food production and biodiversity loss

Another key natural resource is land and the global food supplies. While growing and supplying food to feed ever more people is in itself a major challenge that has already led to riots and government changes, namely in Africa, the bigger immediate challenge concerns bio-fuels and associated regulations that have been passed in recent years. Bio-fuels support programs have contributed already to raise global food prices and consequently increased malnutrition among the world's poorest. Subsistence farmers in countries such as Bangladesh can barely support a household and have little if any extra production to sell, which means they do not benefit from higher prices for corn or wheat. In addition, poor slum-dwellers in Delhi and Nairobi, for instance, produce no food at all and need to spend as much as 90% of their meager household income just to eat.

Loss of biodiversity takes places mostly because of the destruction or substantial alteration of natural habitats. Agricultural land is now the largest category of completely transformed, much less biodiverse land. In 2005 its extent, including permanent tree crops, was about 15 million km^2, and the three largest grain crops – cultivars of wheat, rice and corn – are now grown on every continent and occupy a combined area of about 5 million km^2, more than all remaining tropical forests in Africa. Land under settlement and bearing industrial and transportation infrastructures adds up to 5 million km^2 – and this figure is destined to increase with the growing urbanization – whereas water reservoirs occupy about 500.000 km^2. Human activities have thus entirely erased natural plant cover on at least 20 million km^2, or 15% of all ice-free land surface. Areas that still resemble natural ecosystems to some degree but have been significantly modified by

23 When considering the large amounts of copper required in each wind turbine as well as in connections between wind farms, this starts to place growth constraints on some renewable energy options.

24 Compared with primary production, recycling aluminium requires only 5% of the energy and produces only 5% of the CO_2 emissions as well as reducing the waste going to landfill. Similarly, every tone of steel packaging recycled makes the following environmental savings: 1.5 tonnes of iron ore; 0.5 tonnes of coal; 40% of the water required in production; 75% of the energy needed to make steel from virgin materials; 1.28 tonnes of solid waste; reduction of air emissions by 86% and reduction of water pollutions by 76%. (cf. *Future Agenda*, The World in 2020).

human actions are much larger. Permanent pastures total about 34 million km^2, and at least one-quarter of this area is burned annually in order to prevent the growth of trees and shrubs. A very conservative estimate of the global extent of degraded forests is at least 5 million km^2, and the real extent may be twice as large. The consumption of ecosystem services, which is unsustainable in many cases, will continue to grow as a consequence of a likely three- to sixfold increase in global GDP by 2050 even while global population growth is expected to slow and level off in mid-century.[25]

2.1.3 Economy and technology prospects

Accelerating globalisation

Globalisation is about the spread of humans, capital, trade, intellectual property, economic activity, wealth and resources.[26] It also encompasses the guaranteed access to and exploitation of these resources in developing states. The most reasonable and likely forecast is that globalisation will continue at an unabated pace and will even keep accelerating. Key indicators of economic globalization are International trade and Foreign Direct Investment. Both indicators show that there has been a steady increase, and that major external shocks (such as the Gulf wars of 1990 and 2003 and the financial crisis of 2008) have slowed down the pace but not reversed the overall trend.

USA's economic influence and innovative strength is expected to still be the global benchmark in 2020. However, growing strength of the emerging markets will increase pressure to integrate them more neatly into international coordination processes (such as UN, WTO, IMF and the World Intellectual Property Organisation). Due to increasing pressure from global challenges international institutions will acquire greater influence, and the emergent economies are expected to increase their influence the context of the international trade and financial agreements.

Indeed, 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. The following trends may be envisaged as linked to globalisation: (1) global leveling of incomes between rich and poor countries; (2) focus on the development of products that can be traded via cyberspace rather than physically via trade; (3) economic instability in many of the rapidly developing economies leads to fluctuations in who grows and who cannot.

Another important consequence of globalization may be the increasing plausibility of internal social revolutions – those in Tunisia and Egypt are indeed a recent example – caused by social inequalities and large cohorts of young adults in poorest regions of the world. These tensions are exacerbated by the media revolution, which has made the inequalities of wealth and well-being globally transparent.

The global network, which supports globalisation is enabled by shared international communication paths comprising road and rail; sea and air routes; space; cyberspace; and the electromagnetic spectrum, and is referred to as the global commons. For globalisation to work there must not be significant interruptions to flows along these transmission routes; yet all of these paths have chokepoints and vulnerabilities.

Asia-led global growth and trade

Led by the sheer scale of growth in India and China, but also influenced heavily by the likes of Japan, South Korea, Indonesia and Vietnam, the centre of wealth generation is clearly shifting eastwards.[27] As previously shown, China's economy will eclipse that of the US in absolute terms by 2030. However, China's growth is not without problems. The Chinese government faces numerous development challenges, including reducing its high domestic saving rate and correspondingly low domestic demand; creating jobs for approximately 200 million rural laborers and their families as they relocate from the

25 Millennium Ecosystem Assessment (2005), Vision 2050.

26 UK Development, Concepts and Doctrine Centre, DCDC report *'Future Character of Conflict'* February 2010.

27 Two caveats must be taken into account in relation to the narrative of the global economy presented in this scenario. The first is from Steinmuller: 'As it concerns the narrative of global growth and trade prospects, one should be quite skeptical about long-term economic projections. There is a long history of calculated alarmism about being economically overtaken by other regions (e.g. in about 1960: Soviet Union, China, Japan...)'. The second is from Warnke: 'The description of growth prospects follows a very classical notion of growth as a measure for wellbeing. It has long been discussed that other measures for success are needed. We may be missing out a change of paradigm if we think only in the established terms here.'

countryside to the towns; and containing the environmental damage resulting from the economy's rapid transformation. It also sits on a demographic time bomb as a consequence of the 'one child' policy, which means that China is now one of the most rapidly ageing countries in the world.

So far Asia's growth has been built primarily on Western consumption – or, more accurately, overconsumption. Export-led development has lifted significant markets out of poverty; in fact, the per capita income of people of the 'Tiger' economies of Hong Kong, Singapore, South Korea and Taiwan now rival, or in some cases exceed, that of many European countries. The export model has helped Asian countries improve their living standards quickly. Evidence suggests that China has benefited most from this arrangement, with a quadrupling of GDP and an increase in exports by a factor of five over the past decade, not to mention the ability to attract Western technology and expertise and the creation of millions of manufacturing jobs for the poor. The global markets are clearly interconnected. The Asian Development Bank estimates that, because of the amount exported to the West, a decline of one percentage point in America's growth rate knocks 0.3 of a percentage point off Asia's. So, because the once profligate Western consumer is now saving – or, at least, not spending as much – Asia needs a new market. This might well be Asia's own population. Trade within Asia is already growing at roughly twice the pace of trade with the outside world. From almost nothing twenty years ago, China is now India's biggest trading partner. Central Asia's trade with China jumped from $160 million in 1990 to $7 billion in 2006. And China is now the biggest merchandise exporter to the Middle East. The complementarities (and thus less direct competition) that the EU now enjoys with China are fading away and future trading conditions for European companies will be more demanding.

Alongside China, India is another main driver of Asian wealth, being second only to China as a fast-growing large economy. Unlike many of its Asian counterparts, India has a limited reliance on exports, which account for less than 20% of gross domestic product. In fact, the resilience of the economy rests on a huge domestic market, and, even better, India's domestic demand was largely uninterrupted by the financial crisis. India's fast-growing economy also has global ambition. India is increasingly a leading source of process and low cost business model innovations, as for instance the Tata Nano, the world's cheapest car. The industrial sector is also on the rise, currently expanding at a double-digit rate, and the services sector is now at 55% of GDP. Only agriculture, accounting for 20% of GDP, is under-performing, curtailed as it is by poor harvests and low rainfall. Education and knowledge have played a key part in India's growth: India produces 3 million graduates a year and about twice as many engineering and computing graduates as America, counting those with bachelor's or master degrees. A young (70% of the 1.2 billion population is under 35), educated workforce has attracted the hi-tech companies, such as HP, IBM, Microsoft and Accenture. Global drug giants, such as Novartis, GSK, Pfizer, have all begun turning to India as a base for R&D and Indian-born companies are increasingly carrying out original research themselves – at much lower cost than elsewhere. However, although India's growth rate has been among the highest in the world, it remains so far a low-income country, with inadequate infrastructure being a significant barrier to development, particularly in rural areas, home to 70% of India's population and 52% if the workforce that is primarily engaged in agriculture and related activities.

In the most popular narratives of the global growth and trade prospects, too much attention is usually devoted to BRICs, sub-Saharan Africa and Middle East. However, growing economies within the EU (NMS) and its neighborhood (Turkey, Ukraine, North Africa) should not be neglected.

Challenging economic prospects for Europe

In Europe, a key factor will be the economic consequences of population aging. Many of them are

self-evident and glooming. Older populations reduce the tax base, and hence they lower average per capita state revenues and increase the average tax burden. Falling numbers of employed people push up the average dependence ratio. Europe's already high pensioner/worker ratios mean that old-age dependence ratios will typically double by 2050.[28] And in some countries most of this rise will happen during the next generation, with dependency ratios jumping up already by 2030. As most countries finance the current retirement costs of their workers by current contributions from the existing labor force (pay-as-you-go arrangement), increasing retiree/worker ratios will bankrupt the entire system unless current contributions are sharply raised, pensions substantially cut, or both. Older workers may be more knowledgeable, but they still tend to be less productive because of physical or cognitive deterioration, higher disease mobility, and a greater tendency toward workplace injuries and hence more frequent absenteeism. Higher dependence ratios and a higher share of very old people (over 80 years old) will put unprecedented stresses on the cost and delivery of health care.[29] But as health care and pension expenditure rise, the average saving rates of the aging population will fall. This will affect capital formation, change the nature of the real estate market, and shift retail preferences for commodities ranging from food to cars. Despite the tightening labor market, many younger people may find their choice of jobs limited as some companies prefer to relocate their principal operations to areas with plentiful and cheap labor. Most new companies are started by individuals 25-44 years of age, and the shrinking share of this cohort will also mean less entrepreneurship and reduced innovation. Eurostat estimates that the EU working age population (15-64 years) will peak in 2012 and then start shrinking as the 'baby-boom' cohorts retire. As the participation rate of women and of older workers will continue to increase until 2020 the effective labor force should continue to grow slowly. Thereafter the ageing effect will outstrip the increase in participation rates, resulting in a slight but continuous decline of total EU labor supply.

European youth on the move? Not enough

Another key factor for Europe's prosperity is indeed its young people. There are close to 100 million in the EU, representing a fifth of its total population.[30] Youth unemployment is unacceptably high at almost 21 %.[31] By 2020, it is estimated that 35 % of all jobs will require high-level qualifications, combined with a capacity to adapt and innovate, compared to 29 % of today. This means 15 million more jobs requiring high-level qualification.[32] But currently the EU economy is hampered by a shortage of highly qualified ICT practitioners, and fewer than one person in three in the EU has a higher education degree compared to over 40 % in the US and over 50 % in Japan.[33] Too many young people today leave school early, increasing their risk of becoming unemployed or inactive, living in poverty and causing high economic and social costs. Currently, 14.4 % of 18-24 years old in the EU have less than upper secondary education and are not in further education and training.[34] Europe also has to do better on literacy, as 24.1 % of 15-year olds are low performers in reading literacy and this share has increased in recent years.[35] What is worst, however, is that unemployment is currently high also among young graduates from different levels of education and training. European systems have been slow to respond to the requirements of the knowledge society, failing to adapt curricula and programs to the changing needs of the labor market.

28 According to J. Bongaarts (2004), Population aging and the rising cost of public pensions. *Population and Development* Review 30; 1-23.

29 Ageing – or more precisely the combination of ageing societies, scientific and technological progress in the treatment of diseases will lead to higher health-related expenditure.However, new technologies have a great potential to control costs, insofar they allow a reduction of hospital stays (through e-health services) and a rationalization of data management systems.

30 Eurostat, 2009, 15-30 year old.

31 Eurostat, June 2010, < 25 years.

32 European Commission, 'Youth on the Move. An initiative to unleash the potential of young people to achieve smart, sustainable and inclusive growth in the European Union', COM(2010) 477.

33 Eurostat, 2008, 30-34 years olds.

34 Eurostat, 2009.

35 OECD, PISA, 2006.

'Shocking' changes of values of the future young generations

Shock 1: a new underclass of the unemployed is growing especially among ethnic minorities and migrated people. This is why facilitating youth employment and ensuring that young people have access to decent work is among the most important ways to foster their participation in the society and becoming independent citizens of EU countries. Unfortunately youth unemployment is more than double the overall unemployment rate. These circumstances have deepened younger generations' social exclusion. This will undoubtedly facilitate social exclusion, vulnerability and poverty among younger generation leading to certain types of risky behavior.

Shock 2: changing work values. Younger generation is ready to short term, interesting project works and even precarious jobs. For them it is important independence in the work and be engaged on interesting tasks. The commitment towards more traditional and hierarchical forms of work is weak.

Shock 3: shift from materialistic to post-materialistic value worlds. Many of the younger generation show critics against the economic growth and they will follow post materialistic values (c.f. Inglehart 1997, Inglehart & Weltzel 2005). The social media/Internet creates beliefs, attitudes and values through which young people interpret the world – rapid changes in society and people's attitudes, and values are also evident.

Shock 4: freedom of choices and different lifestyles will pose negative aspects like impermanence in living, difficulties to commit to partnership, insecurity, ambivalence and social vulnerability. Living experience has moved from work to leisure time centricity. Work has more instrumental function to express oneself (cf. Maslow´s self-actualization). Value on interesting work has significance for different life styles.

Shock 5: the narrow identity horizon and horizon of hope (cf. Côté, Erikson) will be seen in novelty and experience seeking, emphasizing self-actualization and quality of life (cf. Inglehart. 1997; Helve 2002). The younger generations have individual identities and new potentials to construct their self-identity. Identity work might be in crisis because there are not any more permanent structures for life (cf. Ziehe 1991). This causes narrow identity horizon (cf. Erikson; Côté & Bynner 2008).

Shock 6: more of the adult-age population (30+) will remain in a state of 'youthhood' in which the youthful lifestyle is maintained until later and later ages (i.e., not taking on responsibilities associated with financial independence and career formation or family formation – stable partners and having children). This is part of a reaction chain caused by reduced job opportunities (economic conditions) and cultural pressures (normative conditions).

Shock 7: the attractiveness of Europe is declining as the global economy is recovering but European labour market cannot ensure employment and economic growth for younger generation. This raises the question how to work on problems and issues relevant to young people themselves on a local, regional, EU and international level? This has an impact on the future 2030/50 intergenerational solidarity and social capital of different generations.

Shock 8: informal social learning will be effective and visible in communities of interest and practices in future. Technology and social media have a greater impact on daily life and life-styles of people. Europe's future labor force is mostly in the knowledge economy sectors (c.f. Castells, 1996). ICT & Information Society will coordinate labor globally across time and space. The life paths and social roles of people will be fluid and unpredictable between traditional professional careers and new labor market demands. There will be new jobs (e.g. virtual) replacing those lost in the economic crisis.

Shock 9: the European education and employment will be based more on global networks and global competitiveness. In the global knowledge-based economy national borders have decreasing relevance, leading to an increasing number of immigrant young people in Europe with different cultural, social and religious backgrounds.

Youth workers are very often hired via temporary contracts, which may allow firms to test skills and productivity of workers before offering them an open-ended job. However, too often, temporary contracts are just a cheaper alternative to permanent ones, particularly in countries where the gap in dismissal regulations between these contracts is high: then the result is a segmented labor market, where many young workers experience a sequence of temporary jobs alternating with unemployment, with little chance to move to a more stable, open-ended contract and incomplete contributions to pension provisions. Young women are particularly at risk of falling into this segmentation trap. Finally, indicators for youth labor market performance do not fully capture that an astonishing 15% of European 20-24 year olds are disengaged from both work and education (NEET youth: neither in employment, education or training) and risk being permanently excluded from the labor market and dependent on benefits.

A still vital European industry

As it concerns the structure of the EU economy, it is unquestionable that manufacturing remains vitally important for the EU economy. Before the present economic crisis, it contributed some 17.1% of GDP and accounted for some 22 million jobs (2007). However, the industrial base in Europe stretches far beyond the industrial core of manufacturing and represents a far greater share of the economy than these basic statistics imply. When the wider productive sector is factored in (power generation, construction) along with associated business services the share of GDP is about 37%. Indeed, the statistical dichotomy between industry and services does not reflect the reality of the modern business world. Many industrial companies also derive substantial shares of their revenues from service provision, but there is little quantitative information in this field. Overall, services (including business services and many others) now account for 55.5% of value added and 60.8% of employment in the non-financial business economy.[36] Manufacturing productivity is the motor driving EU wealth creation. There has been a massive increase in manufacturing labor productivity by some 46% over 1995-2007 compared with economy-wide productivity of less than 20% over the same period. This productivity performance has been achieved through process and product innovation, and outsourcing of non-core manufacturing business activities (e.g. logistics, facility management, ICT) and an increasing use of a better qualified industrial workforce. In the same period 1995-2007 employment in manufacturing has declined by 0.5% per year compared with an annual growth rate of 4.5% in business services (including renting and real estate). As there is no indication that this trend is

36 Eurostat: European Business 2009 (Figures for 2006).

likely to go into reverse, EU industry will continue to generate economic growth, but it will largely contribute indirectly to employment creation through generation of increased demand for business related services.

A challenging transition to digital Europe

Nowadays, in Europe, the ICT sector is directly responsible for 5 % of European GDP, with a market value of € 660 billion annually, but it contributes far more to overall productivity growth (20 % directly from the ICT sector and 30 % from ICT investments). This is because of the high levels of dynamism and innovation inherent to the sector, and the enabling role the sector plays in changing how other sectors do business. Indeed, faced with demographic ageing and global competition, Europe has three options: work harder, work longer or work smarter. We will probably have to do all three, but the third option is the only way to guarantee increasing standards of life for Europeans. The social impact of ICT has already become significant – for example, the fact that there are more than 250 million daily internet users in Europe and virtually all Europeans own mobile phones has changed lifestyle. However, today Europe is still lagging behind its industrial partners in the use of internet, as well as in markets such as media services, both in terms of what consumers can access, and in terms of business models that can create jobs in Europe. Most of the recent successful internet businesses (such as Google, eBay, Amazon and Facebook) originate outside of Europe.[37]

However, the flurry of opinion, websites, blogs and personal pages does not necessarily mean that amongst the clamor it is any easier to sort fact from fiction. Increasingly, information no longer has value per se, but understanding information and analyzing what it means still does. Those who are able to gain this understanding and connect with others across borders (be they national, professional or social) will be able to build on their knowledge and create their own networks. This will present interesting challenges as business come to terms with a world in which collaboration, open innovation and crowd sourcing may make the traditional corporate structure seem very outdated. Over the next decades, we should expect that fast, efficient connectivity will facilitate the growing trend towards virtual companies as knowledge workers increasingly become free agents.

It will be challenging for business and other organizations to find new ways of work-life integration. The increasingly free production and access to information content will challenge the traditional business model in many sectors too. Journalism, the movie business and the music industry have been wrestling with ways in which to retain their value, derived as it is from the sharing of information. Journalism is particularly vulnerable as You Tube, Twitter and any wealth of blogs make reporters of us all and undermine the traditional business model. Already, many publications feel obliged to provide online content free of charge. In the short term the media may well continue to make profit both through sales and advertising spend as far as it is still more convenient to read a traditional paper – on the train for example – rather than look at the news through a computer screen. But as new devices, such as the iPad, continue to improve their functionality and become more widely available, this may well change and business models will have to change too. The commercial challenge is not faced just by journalists.[38]

2.1.4 Geopolitics and governance

Redistribution of global power

Out to 2040, the locus of global power will move away from the United States (US) and Europe, as the global system will have shifted 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. A multipolar system is likely to emerge, but the question is what type of multipolar system that will be. The hegemonic domi-nance of the US will fade. It is likely to remain the pre-eminent military power, although, in political, economic and military terms, it is likely to be increa-singly constrained as others grow in influence and confidence. This is probably true at least in relative terms, i.e. the relative strength of the West will likely decrease whereas the relative strength of the East and other emergent economies (Brazil, South Africa) will likely grow. However, especially if key challenges like ageing and shrinking population will be dealt with successfully, the West may be balanced by the East but not dominated.

As new countries acquire power status, they may prove willing to mutually accommodate their interests so as to ensure the stability of the system and preserve their new prerogatives, creating a multipolar system of a relatively benign nature. The potential gridlock of international institutions, widening disparities and the emergence of a nationalist/protectionist discourse might, however, lead to a more conflicting form of multipolarism, with great powers competing for scarce resources, markets and spheres of influence. Concerning global security, the main question will be whether a collective and inclusive system of governance will prevail on the basis of multilateral norms, or whether a new kind of ideological bipolarity will emerge, opposing an alliance of democracies to the rest of the world. The first option would amount to reconciling a multipolar world and an effective multipolar system. The other alternative would be driven by the primacy given to Western interests and a more confrontational or defensive approach to the international system.[39] Still another alternative to the multipolar world could be a more pragmatic, less confrontational bipolar system: perhaps one confronting the US and China as the two leaders of the world, without any ideology nor political objectives underlying their competition. They might be simply the two most important actors, sometimes acting in cooperation (because of their economic interdependence), sometimes in strong competition (Taiwan, North Korea, energy, lands). Other powers will try to defend their interest together with one or the other leader, according to the issue and the moment (a nuclear India will be a military allied of the US but economically a partner of China).

Change of military power balance

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. However, the change of military power balance towards the Asian countries is unlikely, as the overall stream of public military expenditures of the West will be much greater than that Asian over the next 30-50 years. The gap will be much smaller than today, however the dominance of US military technology will be preserved unless the USA abandon their current policy of spending 6-8 percent of GDP on military equipment including development of new technologies. Again – the claim on the shift of military power towards Asia should be rather written in relative than absolute terms.

37 Only four of the top 54 websites visited across Europe are of European origin.

38 For instance, although internet shopping may well be more convenient for some over the next decades, it will also have a huge impact on our high streets as the demand for a physical space in which to buy books, clothes and food declines, with unfavorable employment and social consequences for local communities.

39 Institute for Security Studies, *The New Global Puzzle: What World for the EU in 2025?*, 2006.

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 across borders, influence and resources are probable. Such disagreements may lead to confrontation, including limited wars.

Challenged role of EU on the global stage

The millennia reconstruction of Western Europe GDP's and population shares, illustrated by Maddison's (2001), shows an unmistakable post-1500 ascent that culminates during the nineteenth century and is followed by a gradual descent that is likely to accelerate during the coming decades. In 1900, Europe (excluding Russia) accounted for roughly 40 % of global economic product; 100 years later it produced less than 25 % of global output, and by 2050, depending above all on growth in the GDP of China and India, its share of global economic product might be as low as 15 %. By 2050, Europe's share of global economic product may be lower than it was before the onset of industrialization, hardly a trend leading toward global economic dominance. In addition, the continent has no coherent foreign policy or effective military capability.

Europe cannot act as a cohesive force on the global stage as long as its internal divisions and disagreements remain as acute as they have been for the past three decades despite the continent's advances toward economic and political unification. A multitude of national problems with European integration within the current EU27 frontiers will not go away. The presence of a supranational entity like the EU may have the effect of weakening ancient national entities. On some matters where strong and rapid action is needed, the intergovernmental approaches to coordinate policy implementation across Member States may be less than effective.

But problems within the EU27 can become even secondary matters compared with the eventual course of a further EU enlargement, with the challenge of dealing with the Balkans, Ukraine and Turkey. The EU's conflicting attitudes toward Turkey – among some leaders an eager or welcoming, economics-based embrace, among others a fearful, largely culture-based rejection – capture the complexity of the challenge of further enlarging the EU to the Southern neighborhood countries. This is for instance described in the box (below).

No matter how far EU expands, what is clear is that the current EU, an entity so preoccupied with its own makeup, so unclear about its eventual mission, and so imperiled in terms of its population foundations cannot be a candidate for global political leadership. This does not mean, however, that the European culture and lifestyle cannot influence significantly the rest of the world. As a matter of fact, Europe is already the planet's foremost destination of tens of millions of tourists, and the European population lifestyle and institutions can represent a model for other regions of the world. This is concretely the case already today for thousands of political and 'economic' refugees, coming by boat from Northern Africa – most recently from Tunisia and Lybia – and giving rise to tensions between countries like Italy and Malta on the one hand and the other EU Member States on the other. Even if the EU, in this scenario, does not develop into a strong global power, the impressive results achieved with the formation of the European Union in the past, such as the ever growing zone of peace and stability covering almost all the continent, will continue to have a lasting impact. The key test for the EU will be whether it will play an important role in fostering a collective and inclusive system of global

The EU enlargement to the Southern neighbourhood countries?

'Turkey's exclusion would signal an unwillingness to come to terms with the realities of the southern hinterland. And, as the Turkish Prime Minister said, Turkey's achieving membership in the EU 'will demonstrate to the world at large that a civilization fault-line exists not among religions or cultures but between democracy, modernity, and reformism on the one side and totalitarianism, radicalism, and lethargy on the other' (Erdogan 2005). Admirable sentiments, but only if one forgets a number of realities. The wearing of hijab has become a common act in Turkey, overtly demonstrating the rejection of Turkey's European destiny (...). The Turkish police and courts habitually persecute writers and intellectuals who raise the taboo topic of Armenian genocide and question the unassailability of 'Turkishness'. The Kurds, some 15% of Turkey's population, are still second-class citizens. So much for 'democracy, modernity, and reformism'. And how could one posit a rapid cultural harmonization (integration would be the wrong word here) of what would be the EU's largest nation with the rest of the Union when Turkish immigrants have remained segregated within Islamic islands in all of Europe's major cities? (...). But if the EU admits Turkey, why not then the neighboring ancient Christian kingdoms of Georgia and Armenia? And if EU, as Erdogan says, is not a Christian club, why not admit Iraq, one of the three largest successor states of the Ottoman Empire, ancient Mesopotamia, a province of the Imperium Romanum? And, to codify the inevitable, why not make the EU's southern borders coincidental with those of the Roman Empire? Why not embrace all the countries of the Arab maghrib and mashriq, that is, North Africa from the Atlantic Morocco (Roman Mauretania Tingitana) to the easternmost Libya (Cyrenaica), and the Middle east from Egytp (Aegyptus) to Iraq? Their populations will be providing tens of millions of new immigrants in any case.

Vaclav Smil, *Global Catastrophes and Trends*, The MIT Press, 2008.

governance, thereby promoting its own distinctive values, and averting the danger of renewed ideological confrontations on the global arena.

Struggling against global instability

Although in all probability the European Union will remain intact as an organization and will continue to play a role in the global governance, its position will be relatively weak, challenged as it will be by the need to find a compromise between the different Member States on foreign and global policy issues. The era out to 2050 will be indeed a time of embracing change; 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, 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. Collective responses are highly needed, but could be hardly found in reality. In the real world, there is no proof that future changes will lead to an effective global system of governance, nor to a more democratic world. In 2040, the opposite, i.e. less and less stable democracies,

including in the West, more and more authoritarian regimes to deal with all the new and difficult challenges, could be our future. As there are very few concrete or quantitative indicators in this domain, we need certainly be cautious. This being said, the EU will also in this 'neutral' scenario remain a factor of stability at least at the European level.

Global governance is a major challenge in some aspects of our future but not all. At the opposite a movement towards increasing devolution of power at local levels will also be a challenge. Seen from a European angle, the levels to be considered are: global, EU, EA, MS, Regions, and municipalities. It is a true challenge to know how these different levels will be organized, their specific competencies, their interrelations, etc. For the time being, depending on the countries, depending on the type of challenge, there are pressures and expectations in many directions, from more regionalism or nationalism towards a more powerful federal state at the EU level.

2.1.5
Territorial and mobility dynamics

Global urbanization

A key future development is the growing urbanization and the related change of the standard of living, as the city will increasingly become the standard human habitat across the world. 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.[40] Urbanisation brings about environmental issues including water and air pollution, waste disposal and traffic congestion. The worst affected cities may fail, with significant humanitarian and security implications. As the global population will be increasingly urban, with a majority living in large conurbations. This will bear profound consequences for policy-makers in addressing poverty, crime and community relations. Other aspects to be considered include: (1) reconfiguration of cultural and religious centres as well as global cities; (2) failure of global urban governance; (3) disparities between social groups, cities and countryside.

Ninety-five per cent of urban growth in the next twenty years will be in the developing world and there, especially, dense cities are seen as the way forward to provide more sustainable places to live. The future cities of Asia have to be dense rather than sprawls. But, in this, people recognise that there is no single global solution, no silver bullet, for city design: Asia as a whole cannot have just one strategy. The solution must be different for different countries.[41] Outside Europe, world's mega-cities are already merging to form vast 'mega-regions' which may stretch hundreds of kilometres across countries and be home to more than 100 million people. The world's first mega-city, comprising Hong Kong, Shenzhen and Guangzhou, is already home to about 120 million people. Other mega-regions have formed in Japan and Brazil and are developing in India, West Africa and elsewhere. The top twenty-five cities in the world account for more than half of the world's wealth and the five largest cities in India and China now account for 50 % of those countries' wealth.

40 United States Joint Forces Command, Center for Joint Futures: The Joint Operating Environment (JOE) 2008.

41 Future Agenda, The World in 2020.

2.1.6
Research, education and innovation

A failing European Innovation Union

In the 'Nobody cares' scenario, the innovation system thinking and coordination capabilities at EU level fail to emerge, leaving the whole Europe in an unfavorable competitive position as compared to other regions of the world, and especially to emergent economies.

One important aspect to be considered is the role of public sector information (PSI) and how PSI policies and practices chosen by the EU countries may affect the dimension of research and innovation. Indeed, the availability of public sector information would be a prerequisite not only for an effective system thinking approach to research and innovation, but also to support more in general democratization and citizens empowerment, as well as other economy and technology prospects. Two other important aspects are R&I governance and institutions. How these aspects perform in the 'Nobody cares' scenario is illustrated below:

Public sector information

The public sector agencies of different EU countries collect and diffuse data in a fragmented manner, and pricing practices for PSI sectors vary among countries. In many cases, data is difficult to access and expensive. Some public sector agencies use IPR protection for restricting the re-use of data. As a consequence, in various EU countries, researchers particularly doing socio-economic studies use data from the United States or other countries providing accessible and cheap data. This has an impact also on citizens information and empowerment. Volunteers continue collecting data from the governments' web pages and form databases that enable people to monitor politicians and comment on their actions in some EU countries. Also, in certain countries having a more liberal approach than others, it is possible to monitor government activities in more detail such as public spending (e.g. for official trips or the costs of refurbishment of offices). Finally, due to the lack of a strong public sector information, the European markets for digital content and services grow slowly and lag behind those of the US and other major market areas.

Research governance

Although some improvement has been made there is still duplication of research and fragmentation across regions and countries with significant resources being wasted. At the national level the situation remains that the research world is separate from businesses and that the businesses still develop their major projects in house although largely using approaches like open-innovation. Research-industry cooperation is improving only to a small degree, research results from publicly funded research still remain largely unexploited and societal challenges not fully tackled. Some solutions are brought to solve some short term issues (e.g. in the energy or transport fields) but are not able to ensure sustainability. The environment is still Under threat. Each MS decides on its own whether to ban or not certain research areas and some are doing so without taking society's concerns into account. Thus certain scientific and technological developments without clear, or even with potentially negative, consequences for human health find their way to the market.

Research institutions

The European Research Area (ERA) has not fully been realised although significant improvements are evident. While the fifth freedom (free circulation of knowledge) is possible there are still institutions, legislations and rules which are MS-specific and not harmonised thus hindering circulation of research, and cross-border funding of research. However, strategic research agendas do take into account global challenges and are set at the supra-national level – with the EU playing a most significant role since the coordinating instruments are still based on EU funding to a large extent. But this is not enough. Of course there are exceptions to the rule

with specific regions having proceeded successfully to a fully-allied, EU funding-independent research strategies like the Nordic and other regions who enjoy close cooperation and coordination and are on the way to ensure sustainable solutions for the societal challenges they focus on.

2.2 Fragmented European Integration 'EU Under threat'

Quantitative spotlight

The EU Under threat scenario assumes a combination of rather pessimistic hypotheses, leading to a significantly reduced economic influence of the EU at the 2050 horizon, and to some extent of the US also. This is not only an economic issue: as economic power shrinks, so does political influence and the capacity to address societal innovation challenges. Such scenario would push Europe in a vicious circle of progressive decline.

Figure 34 shows that according to this scenario, the EU would account for only 15% of the world economy in 2050, with the US at 16%, compared to China (28%) and India (8%). While the EU share is the same as in the Nobody cares scenario, the major difference lies in the low value of the absolute economic size of Europe: a mere 40% increase between 2010 and 2050 is hardly sufficient to generate the jobs and address the problems that must be faced to adapt our societies. The USA, with a 70% increase of their GDP, do not fare much better, especially given their sustained demographic stance. In total, the world economy will be 16% smaller than in the Renaissance scenario. These 16 additional percent correspond to adding a second EU27 to the world economy in 2050: this is what the 'Renaissance' scenario is worth, compared to the 'Under threat' one.

Table 6 provides additional information on the world economy until 2050 under the 'Under threat' scenario.

Figure 34
Regional shares of world GDP in 2050 (constant 2005 USD): Under threat
Source: CEPII

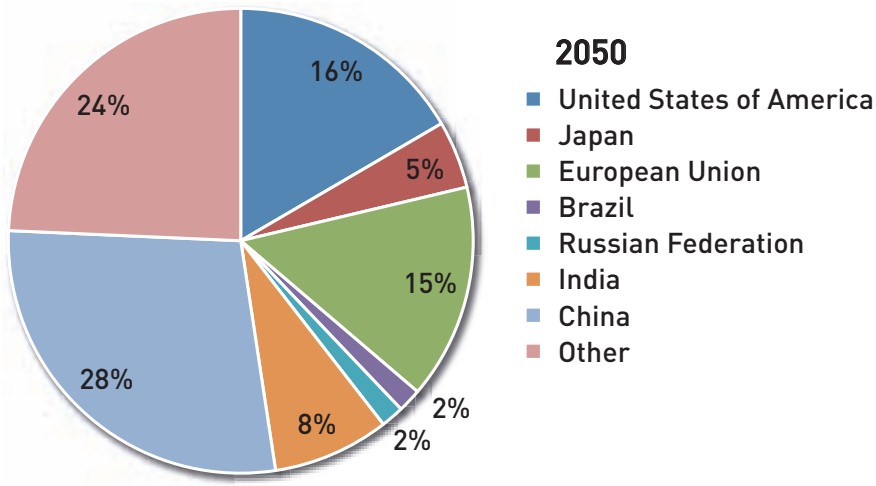


Table 6 – GDP for selected regions, 2010-2050, constant 2005 USD bn: 'EU Under threat'					
	2010	2020	2030	2040	2050
United Stades of America	12 873	14 791	16 681	19 119	21 993
Japan	4 541	5 053	5 533	5 868	6 238
European Union	14 024	15 597	16 756	18 123	19 831
Brazil	1 047	1 406	1 747	2 005	2 184
Russian Federation	882	1 172	1 547	1 887	2 114
India	1 176	2 159	3 934	6 783	10 755
China	3 637	8 178	16 099	26 375	37 253
Latin America	3 149	4 368	5 368	6 506	7 629
Middle east and North Africa	2 280	3 242	4 638	6 458	8 854
Sub-saharian Africa	730	1 153	1 840	2 936	4 708
Rest of Asia	2 508	3 511	4 680	6 066	7 679
Rest of the World	1 794	2 132	2 385	2 808	3 354
Total World	48 640	62 763	81 209	104 932	132 590

2.2.1 Global demographic and societal challenges

A shrinking population in Europe

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.[42] 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.[43] Terrorist organizations, wars, environmental catastrophes, and a global pandemic could eliminate large numbers of the population.

Recent studies suggest that for each decade from now on if fertility remains at its present low level, there will be a further fall in the EU population of some 30-40 million people. By 2050, over ten per cent of Europeans will be over 80 years old. The total fertility rate declined from above the replacement rate – defined as 2.1 babies per woman – in the 1960s, to around 1.5 now. Between now and 2050, the number of people aged 15 to 64 in the EU will fall by 48 million (a drop of some 20 %), and the number over 65 will rise by 58 million. On current trends, the EU27 population will rise from 490 million in 2005 to 499 million in 2025, but then fall back to 470 million by 2050. The working-age population in Europe will decline sharply, both in absolute and proportional terms. Europe will move from having four people of working age for every elderly citizen, to a ratio of two to one.

While the EU is ageing rapidly, the number of young people in prime migration age continues to increase in the EU's greater neighbourhood, but migratory flows are hindered by restricting EU Member States immigration policies, aimed to protect national workforce (especially young Europeans that continue to have low opportunities to find jobs in their stagnating countries).

Growth of GDP will be limited by shrinking number of employment but not growth of GDP per capita. In fact, as capital depreciates relatively slowlier than growth – much slower than population shrinks – GDP per capita can actually grow faster than in the reference case of constant population. In other words Europe can over the medium term benefit from 'reversed Malthusian effect' caused by the inheritance of large amounts of capital from the past. Europe will however continue to invest in capital, and this will compensate for depreciation: capital stock will *not* decrease. More importantly labour force will stabilise but not shrink. All in all the K/L ratio will be kept stable to its 2010 level. This is not capital inherited from the past given the rapid renewing. Indeed this constrasts with rapid accumulation of capital in Europe in the 'Nobody cares' scenario.

In addition, some caveats have to be made about the worst scenario of population ageing. If ageing is putting the health care system under too much stress and health services decline, life expectancy will decline too. Additionally, obesity is getting an increasingly severe problem – with reduced individual life expectancies and costs for the health system.

Shock (2030-2050): No immigration into European Union

The failure to integrate asylum seekers, refugees, third country nationals coming to EU for family formation or family re-unification reasons, and undocumented immigrants, could result in widespread fear of foreigners and pressure on governments to seal immediately

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

43 United States Joint Forces Command, Center for Joint Futures: The Joint Operating Environment (JOE) 2008.

borders for newcomers. With no immigrants coming from now on, the total population of EU27 would decrease by 36 million people between 2030 and 2050 – falling from 492 million to 456 million. There would be 51 million fewer working age persons (15 to 64 year old) as the number will decrease from 300 million in 2030 to 249 million in 2050. The dependent population (aged 0-14 and 65+) will grow by 15 million, from 192 million in 2030 to 207 million in 2050. The age-population ratio of those typically not in the labour force and those typically in the labour force, will increase from 64 to 83 dependents per 100 productive persons.

Zero migration would have a quite substantial effect on the total population size making Europe less crowded, and there would be less competition for paid work. At the same time shortages of workers in specific sector of economy would no longer be compensated by recruitment abroad. There would be no more brain gain through professional migration of talented and highly skilled workers. Pressure on public services for child care and old age care would increase as those immigrants who are already in EU would not be allowed to bring their kin as family and informal care givers.

European Universities would become less attractive and less competitive, with fewer foreign students and no foreign gatekeepers of excellence. Some University and research departments would close down. International geographic mobility would be partly compensated by digital mobility but Europe will no longer be significantly tipping into a wider talent pool for research and innovation. Added value of diversity and multi-layered cultural background of people would be lost and Europe would be less innovative in producing goods and services tailored for world markets.

The closing of borders to newcomers would be shaped by geographic permeability of EU necessitating strong dissuasive and punitive measures. This could imply that immigrants would be deported at their own cost and doctors and other professionals who help immigrants would be charged and punished.

The Council of Europe and national legislations on family reunification would have to be revoked. Europeans would be marrying Europeans, and adopting only European children. They would be reluctant to study abroad or work abroad to avoid falling in love with a foreigner. If they marry a foreigner they would either have to emigrate or live separate life from spouse and children.

EU Treaties would have to undergo substantial revision. The way people perceive and experience otherness would change together with values embedded in the European culture such as freedom of choice in family matters, or humanitarian principles.

With no immigrants coming from distant cultures there would be slowing down of growth in numbers of Muslims in EU that could result in weakening of Islamophobic attitudes. At the same time perceived differences between Christian and secular values, between denominational groups, ethnic minorities, and non-integrated natives could become more important than today. Fear and dislike of people from countries outside EU and within EU could resurge from the past eroding values of humanism including individualism and diversity.

Termination of the traditional European humanitarian actions to house and protect political asylum seekers persecuted in their home countries, and refugees fleeing conflict zones, would erode the European leadership in human rights and global governance.

A declining social capital

The changing role of families has an impact on social capital and consequently on the capacity of family life to develop values and moral for the 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. The gap between older and younger generation will be widened, also due to the difficulties that a continued state of global crisis and instability will create for the new generations to find or maintain decent jobs and create their own adult life. Trends in social values and lifestyles – referred to as 'post-modernism' – emphasize the ferment of change, fluidity, skepticism and irony, instability of relationships, which seems not only to reflect but also support uncertainty, and lack of trust. Different (in some cases more suspicious) cultural attitudes to science and technology, fragmentation among sub-cultures and diversity in cultural forms, consumer behavior and family and living factors will continue to emerge.[44]

An element connected to people's perceptions and response to changes is the degree of fear and distrust they feel. It is considered that people used to be less afraid (or interested one might say) about their future and security putting faith and trust in religion and then science. Through the years science has led to more knowledge but also to more areas of uncertainties and there have been several cases of risks where scientific knowledge has proven inadequate or even wrong. Thus, people today trust science less and the increasing fear and uncertainty about the future, security, health, the environment, etc. calls for new types of knowledge. Moreover, the scale of the situations individuals are called to cope with is going beyond what they have control over. With the increased awareness about global issues, we are called to deal with more generic risks, e.g. climate change, which are outside our individual control level. However, people still perceive that they can have control of things and this creates a tension as well as a different notion of uncertainty. This is a new sort of uncertainty we have to cope with today and increasingly tomorrow. If the behavior of society becomes too complex for the individual to comprehend than society becomes more risk averse, an attitude that will prevail in a world increasingly 'Under threat'.

2.2.2 Energy and natural resource security and efficiency, environment and climate change

Global energy insecurity

By 2030 a considerable increase in demand for energy is expected. 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. To meet even conservative growth rates, 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 %.[45]

EU's external energy dependency ratio has fallen from 62 % in 1975 down to 48 % today, but it is expected to rise again to 70 % by 2030. 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 worlds increased demand for oil.[46]

The worst global warming scenario

With the transition from 'easy oil' (easily recoverable and therefore cheap) to 'tough oil' (cost expensive in recovery, non-traditional kinds of oil), reserves are considerably growing. Therefore, current global fossil-fuels based energy trends continue and are expected to increase atmospheric greenhouse gas concentrations. Coal overtook oil in 2003 as the leading contributor to global energy-related CO_2 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. The global energy-related carbon dioxide emissions increase by 55 % between 2004 and 2030, at an annual rate of 1.7 %.[47]

However, the annual flow of emissions may even be more accelerated, as fast-growing economies invest in high carbon infrastructure and as demand for energy and transport increases around the world. The level of 550ppm CO_2 could be reached as early as 2035. 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.

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 may change, possibly with severe impact on low-lying coastal regions. The impact of global warming and its potential to cause natural disasters and other

44 U. Beck (1986) *Risk Society: Towards a New Modernity*; A. Giddens (1990) *The Consequences of Modernity*. Cambridge: Polity Press; D. Harvey (1990) *The Condition of Postmodernity. An enquiry into the origins of cultural change*. Oxford: Blackwell.

45 United States Joint Forces Command, op. cit.

46 Mapping global capital markets: Fourth annual report, MCKinsey Global Institute (2008).

47 The Business of Climate Change; Llewellyn, J. (2007).

harmful phenomena such as rising sea levels has become therefore 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.[48] This causes the global policy response to be delayed and eventually fail.

This is the worst scenario. The effect of global warming, mostly limited for the time being, will begin to be clearly felt only between 2025 and 2030, with the following features: an increase in the mean temperatures between 0.4°C and 1.1°C by 2025, the acceleration of thawing, the rise, warming and acidification of oceans, an increase in precipitation, more frequent natural disasters, and a growing scarcity of clean water along with the emergence of new pandemics threats. Gas concentrations will increase even more in the future. In terms of long-term consequences we may forecast reduction of ice cover in Greenland and its transformation into 'Green Isle' of Scandinavian sagas. Western Antarctic glacier would melt. Navigation across shelf Polar seas would become easier. The warming would be accompanied with masses of icebergs, which might be found far away to the south, up to 50th degree of northern latitude and further. Cyclonic activity would be pushed away to the periphery of Eurasian continent. It might, in turn, cause destruction of stable anticyclone of the Azores and creation of North Atlantic 'bad weather zone'. The growth of average temperatures would be accompanied with increase of humidity, growth of rivers and reduction of arid zones. These tendencies would be more noticeable in the Northern Hemisphere, than in the Southern.

Unabated degradation of water

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 %. 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.[49]

Extensive spreading of industrial fertilizers has upset the chemistry of the planet. Fertilizer use has more than doubled the flows of nitrogen and phosphorus through the environment, at a rate of 133 million tons of nitrogen and 10 million tons of phosphorus per year. Both flows are causing widespread water pollution, degrading numerous lakes and rivers and disrupting coastal oceans by creating large, hypoxic 'dead zones'. Needed are new agricultural practices that increase food production yet also sustain the environment. The risk of oil spill accidents is increasing, with possibly dramatic consequences as the recent Gulf of Mexico accident shows. The management of water will put increased demands for forms of global governance to minimize exclusion, which however will continue to lack or to have a weak influence in this pessimistic scenario.

Global food crisis and degradation of biodiversity

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.[50]

As it concerns the impacts on biodiversity, the enormous transformation and degradation of land by human activities will continue (in Asia largely unabated, in Africa much accelerated) during the first half of the twenty-first century, with the tropical deforestation and conversion of wetlands causing

the greatest losses of biodiversity. Even if quantifying this demise is difficult, the trend is clear. However, for the past century the rate of extinction may have been about 100 times faster than indicated by the fossil record, and depending on the rate of habitat destruction, it may become 1.000 times faster during the next 50 years.[51] Climate change could become a major cause of extinction in addition to excessive exploitation and extensive habitat loss (to which climate change directly contributes). There will be various severe environmental crises affecting the ecosystems (rising ocean levels, habitat destruction, increased disease transmission, declined crop productivity, overfishing, declined water availability, increased natural hazards, changed ocean chemistry).[52] 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). Biodiversity loss in terrestrial environments is projected to accelerate the 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. Special attention – also in the context of food shortages – should be put on oceans. The 'fish peak' is probably behind us and the resources of oceans are overexploited already.

48 United States Joint Forces Command, op. cit.
49 United States Joint Forces Command, op. cit.
50 The 2nd SCAR Foresight Exercise.
51 Millennium Ecosystems Assessment, 2005.
52 Jeffrey Sachs: Economics for a crowded planet (2008).

2.2.3
Economy and technology prospects

A declining labour input

In Europe, firstly, younger cohorts are declining and will continue to decline through to 2050, suggesting less intense competition among young people for jobs. Secondly, the trends towards a decline in European working-age population will continue, but altogether (see **Table 7**) EU27 labour force will not shrink but rather stabilise (as opposed to Japan) and become older, notably owing to migrants entering the labour force.

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. However, the labour input, measured by total hours of work in the EU is expected to fall by 12.9 % between 2020 and 2060. 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).

Human capital circulation

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.[53] 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.

Human capital will continue to accumulate despite the negative prospects of this scenario, although at a pace significantly lower than in India and China (see **Table 8**).

In the 'EU Under threat' scenario these elements are unfavourably combined for Europe, which shows a decline in the absolute number of population in tertiary education, while huge increases in numbers are observed in countries such as China and India that may generate quests for a European brain gain policy which is however lacking. We will get more and more brain-circulation rather than brain-drain. Individual talent will continue to be a crucial resource and companies as well as universities and other knowledge-intensive institutions will compete for talents. Schemes of brain-circulation will proliferate. Education in international top institutions will continue to be a growing business. But the role of institutions outside Europe will increase and the brain flows will be also increasingly directed outside

Table 7 – Labour force at 2050: 'EU Under threat'

	Labor force (million workers)						Human capital (average years of scholling)				
	2010	2020	2030	2040	2050		2010	2020	2030	2040	2050
United Stades of America	164	177	186	195	202		13.1	13.3	13.4	13.5	13.7
Japan	65	62	57	51	45		11.0	11.2	11.4	11.6	11.8
European Union	239	250	252	256	262		9.8	10.2	10.6	10.9	11.2

Source: CEPII

Table 8 – Human capital at 2050: 'EU Under threat'					
	Human capital (average years of scholling)				
	2010	2020	2030	2040	2050
United Stades of America	13.1	13.3	13.4	13.5	13.7
Japan	11.0	11.2	11.4	11.6	11.8
European Union	9.8	10.2	10.6	10.9	11.2
India	4.0	4.5	4.9	5.4	5.9
China	7.0	7.5	7.9	8.3	8.7

Source: CEPII

the EU. In some EU countries, an additional challenge is the reduction of structural unemployment and development of effective labor supply. Unemployment traps are important and would require specific reforms of the tax benefit system.

The changing structure of labor market, employment and brain drain is partly related to the extension of ICT technologies and also to the degree of representation of women in labor markets. The increasing share of employed persons working part-time means flexibility in labor markets but also precarious jobs and insecurity increase. In EU27 countries, up to a third of 15 to 25 olds are – and will continue to be – not in education, employment or training (NEETs). This influences their work values and future expectations.

A declining infrastructure investment

In OECD countries, traditional sources of public finance alone will not suffice to meet future infrastructure needs, which are huge and growing. A key issue is to assess if the financial, organisational, institutional and regulatory arrangements (the 'business models') currently in place will be able to respond adequately to the complex challenges they face, and if are they sustainable over the longer term. Finan-cing of infrastructure strongly depends on the domestic saving rate – shrinking saving rates can endanger the sustainability of the proper level of infrastructure in the OECD regardless of the private or public finan-cing scheme. Indeed, in the aftermath of the financial crisis and bearing the burden of indebtedness of former years, most EU countries and other international counterparts are restricted in their capability to invest and to mobilize resources for long overdue development and improvements of existing infrastructures and for investing in new innovations in sectors like healthcare, living, mobility, energy and the like, which are important for the well-being of citizens.

Wild card: EU disruption

On the EU side, the possibility that the EU will not survive the economic and financial crisis of 2010 exists. Even though this is not the most likely scenario, one cannot exclude a European failure, which will have a terrible impact on the economic and political shape of Europe. The Euro-zone will begin to fall apart, followed by the 'marché unique' and finally the European process itself. Germany could decide to be an independent power in the multipolar world, followed by France and the UK. Resentment, frustration, poverty will again spread alongside a majority of European countries, giving back to the US the responsibility of maintaining a sort of order in Europe.

53 OECD, Higher Education to 2030: What Futures for Quality Access in the Era of Globalisation?

2.2.4 Geopolitics and governance

EU fortress

This scenario envisages an increasing inward-looking view of the EU characterised by a European shield against the winds of global change. A Europe defined by 'negative integration', by the degree to which it is closed to flows of products and capital from the rest of the world rather than by its stance on the global rules governing these flows. A 'fortress Europe' with internal liberalisation but closed external borders to face crises and negative impacts from rising new markets and economies. Things may evolve even worst, with the break up and the end of the EU itself. Another global disruption with a relevant impact on the global economy and the future of Europe may consist in the implosion of Chinese power and society (see boxes below). One could also argue that also other 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.

Wild card: Conflict between Russia and Europe

The efforts to conclude a new and mutually profitable Partnership and Cooperation Agreement EU – Russia have failed. Russia has definitely decided not to become a WTO member. Because of intensive efforts in Western Europe to develop new and sustainable energy resources the Western dependence of Russian oil and gas has diminished. The country tries to find compensation for the loss of European resources and expertise in the East, more particularly in China. However, these efforts do fail: the gaps and differences, between Russia and China, as to economic growth and demographic developments have become too big! Therefore China and other Asian countries are not interested in the establishment of an intensive partnership, economic and military, with Russia. Also the Shanghai Cooperation Organization becomes more and more an 'Asian' project. As a consequence Russia develops into an inward looking and authoritarian country. Inside the country the democratic process has come to a standstill whereas human rights are regularly violated. In the context of the activities of the UN, more particularly the ones of the Security Council, Russia is an unreliable partner. The country also becomes aggressive. The first violent contacts take place with the former Soviet Republic Georgia and, after that, with Moldova and Ukraine. Because the last two countries in the meantime have become NATO members, the Article 5 obligation of the NATO Treaty becomes operational. The European continent gets into conflict.

Global insecurity

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.

Wild card: The end of the West

Since the Western world disappeared as a united and powerful actor at the middle of the XXI century. Three scenarios could be the framework of this historical revolution.

1) A strategic divorce. In May 2026, the United States have expressed their decision to withdraw from the NATO treaty. Many reasons were put forward to justify this strategic shift in US policy. Some argued that the cost/benefit ratio of keeping Nato alive had become heavily negative at the detriment of the US, with European defense spending hardly getting to 0.2% of EU GNP: at a time of endemic economic crisis, the US budget could not anymore afford the cost of common western defense. Others argued that the unwillingness, sometimes the incapacity, of European allies to send troops through Nato in the Asian theater had deeply concerned the US: what is the point to keep a military alliance if it cannot be used when the US needs it? Building a special defense relationship with India seemed more in the interest of the US than keeping an old and useless Atlantic alliance. Some others were more pragmatic: at a time when Russia is considering the possibility of being a candidate for EU membership, after the entry of Turkey, Ukrainia and the Caucasian countries into a 'softissime' EU, there is no need anymore for a special military alliance protecting European security: the EU should be able to defend itself, if ever it wants or has to be defended. In any case, the United States keep enough strength, will and resources to continue its own way in the global arena. With the new super-internet the US feel more knowledgeable and cultured than the sum of all nations of the Old Continent taken together.

2) A political divorce. More and more people in the 33-EU have expressed concern on domestic US evolution. Since the mid 30s, extreme-right groups have strengthen their national audience, after the double chocks of 2029: the catastrophic bankrupt of the state followed by the unprecedented economic recession which sent to misery 40% of the US workers and collapsed cyberspace, on the one hand; the two catastrophic riots in Philadelphia and Chicago, on the other. Civil rights have been drastically reduced, visa are compulsory for every non-US citizen including the European allies, a five stars general has been elected as President of the US, declaring a permanent emergency status within the country and a state of latent war against a list of more than 20 foreign countries perceived as hostile to US interests. Anti-European movements increase in the US, as Europe 'laxist' economic and emigration policies are considered by many as being at the origin of both crises. While expressing solidarity with the US citizens, Europeans leaders refuse to support the US military extremist government. Some countries have decided to freeze their participation in NATO. Others have proposed to put an end to the Treaty itself. A European defense organization is negotiated with Russia to replace the old Atlantic alliance. And China's Navy is quietly taking control of the Earth's oceans.

3) A common decline. Since two decades, the US and Europe have gone through a series of economic and financial crisis, increasing their foreign debts in a way that makes impossible any quick return to prosperity. Social turmoil, in many countries of the EU including in some US cities and regions, often leads to urban violence. The EU has closed its frontiers to economic migrants. Demographic decrease in the EU, lack of innovation policies, and the resentment against the external world accelerates European decline. On the US side, foreign students no longer come to former famous universities, which suffer a lot from the scarcity of financial resources and the bankrupt of big industrial companies. The Ameri-can way of life does not mean anything anymore, while European values and model are no more than an historical souvenir. The rest of the world is doing well, with China and India becoming the two first economic, demographic and strategic powers.

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. An additional insight is the possibility of 'regionalisation' of geopolitical spheres of influence around states that possess nuclear weapons, with economic integration developing within these 'regions' and growing rhetorical violence and border-conflicts with other 'regions'. This multipolarity will be relatively stable as long as wars for resources involve only one of these 'regions'. Also, the implosion of the center of one of these 'regions' (URSS-like) can bring further instability to the world scene and provoke a mutation. Indeed, the ongoing erosion of the international regime for nuclear disarmament and non-proliferation is also a most worrying of contemporary developments.

The terrorist threat is becoming increasingly decentralised and 'spontaneous'. The ultimate fear is of terrorists acquiring biological agents or nuclear material to move terrorism onto a new phase. Political attention to the disarmament agenda has receded, but the threat these weapons pose is growing. One of the most important changes in the strategic equation could be the failure of nuclear non-proliferation policies. One or more new countries, especially in the Muslim world, will become nuclear powers. Pakistan, which has acceded nuclear capabilities in 1998, may leave the 'Western alliance' and become an Islamist Sunni regime. Iran will be a nuclear Shiite power, while other countries, like Turkey, Syria and Egypt will follow or try to follow the same path of nuclear proliferation. The risk of clandestine proliferation to terrorist groups will increase. Consequences are difficult to foresee but they will be extraordinary important for oil and gas prices, for the redistribution of US power in the region, for the future policy of Israel, the relationship between the region and the rest of the world. Regional or preventive wars, trying to avoid such a black scenario, may occur in the next decade with equally strong incidences on energy security and prices. But the likelihood that these wars fail to prevent the nuclearization of the whole region is low. Early signs of failures of the strict nuclear proliferation scheme are already appearing. The period to 2050 might therefore already be dominated not by non-proliferation aspects but post-proliferation strategies.

For China and India, domestic, regional as well as global arguments may fuel the need to continue 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 defense activities. Lack of water and potential water conflict in the South Asian region may also reinforce the need for military investment. By 2020, China's continuing high economic growth rate will allow it to spend on its military as much as the United States today, and this will make it a real superpower impervious to any threat or pressure. This may not be wishful thinking. Exchange rate adjustments, with a possible doubling of the value of Chinese currency in ten years' time if growth continues and the exchange rate is allowed to float, would lift the China's 2020 real GDP close to $ 15 trillion, near to the expected US level at that time. Assuming that a higher share of it will go to military, China could indeed match US defense spending by 2020. Moreover, in contrast to the decades of Cold War when the United States was in no way economically dependent on the Soviet Union, China is already helping to prop up the US economy by supplying it with essential goods at cut-rate prices and by buying up part of ballooning US debt.

Wild card: China worst case

Since the mid 30s, China has been devastated by a long series of violent mass protests, regional rebellion and separatism, to which the communist government reacted with extreme violence and repression, including the use of force against demonstrators in the streets. Civil war is spreading throughout the country, in a bloody and

uncontrolled way. Many reasons are behind this explosion of domestic violence. For the young-urban- educated-prosperous Chinese who have been, since 1990, the actors and the main beneficiary of the economic Chinese miracle, the objective is mostly political: to replace the communist party by a new form of democratic system. For the poorest part of the population, in the countryside, the objective is simply to have their part of the economic growth, to get their revenge from the local communist leaders and denounce the corruption of the elites. Others have decided to protest because the relative slow down of Chinese economy, in the last 2 or 3 years, threatens their recent economic wealth. In order to prevent any foreign interference, the communist party has closed the country and put the army in alert. This Chinese civil war has tremendous consequences for the world and the momentum of globalization: foreign investors have withdrawn from the country, together with foreign companies and businessmen, the Yuan has lost most of its value, Taiwan has decided to claim its independence, China economy has entered a new cycle of recession and turmoil, putting at risk the whole process of globalization itself. World growth has become negative, putting at risk the stability of many countries in the world, beginning with the US and most of the EU countries.

In the Euro-Mediterranean area we can assist to a disruption of current relations. The Mediterranean Sea is increasingly seen as a dividing line between unchanging and inherently conflicting civilizations. Long-lived conflicts engulf the region and spread from one country to another. Failing to achieve sustainable development paths, most of the MED-11 countries will face economic, social and political volatility. Some of them will even suffer from a breakdown of the modern state, as a result of internal conflicts similar to those recently exploded with the civil war in Lybia. The absence of a stable authority will undermine the EU's and other countries' efforts to achieve cooperation on key issues of interest, such as immigration, security and energy. As a result, by 2050 the Mediterranean will be not a region, but a frontier – a border between Christian North and Islamic South. Tensions and conflicts will explode, cooperation will fail and sustainability will not be achieved. The Israeli-Arab countries conflict will continue to exacerbate and eventually deflagrate in a regional or even global war.

Wild card: Russia member of EU and NATO

There are many opportunities to improve the relationship EU-Russia in all domains: economic, political, military as well as in the 'soft' sector (education-research-culture). A mutual dependence with regard to energy supplies does already exist. Apart from that Russia will soon become WTO member. It is more particularly that membership which allows for far-reaching and intensive cooperation with the European Union, to start with the establishment of a free trade zone. Furthermore Europe can assist the Russian authorities in their efforts to diversify the Russian economy. More particularly the European business sector (not only the big firms, but also small and medium size ones) can profit from these opportunities. In parallel with the beneficial economic developments the standard of living for Russian citizens does rise and the Russian political system becomes more democratic. Human rights generally speaking are respected, the phenomenon corruption is combated successfully and in the regions ('Oblasti') the principle of good governance is ensured. The cooperation EU-Russia proceeds so positively that Russia is tempted to apply for EU and NATO membership. After having established that the (minimum) requirements to become member of both organizations have been met, the Russian applications for EU and NATO membership are accepted in the interest of peace and security on the European continent.

A widening governance gap

As it concerns global governance, due to the progressive marginalization of the UN – and notably of the UN Security Committee, where major players will pursue their interests unilaterally instead of seeking consensus and strengthening the system of collective security at the global level – different frameworks of governance will come to play a larger role. Trans-governmental networks will emerge as a key feature of global governance, combining the required expertise to address complex technical issues with the direct involvement of national officials. These networks will be active in domains as diverse as global financial architecture, antitrust rules, intellectual property rights, and international labor standards.[54] Yet another pillar of global governance may consolidate around the existing 'summitry' of national leaders. The G8 and G20 have become important focal points for shaping the agenda of global governance, combining the clout of national leaders with a degree of flexibility and the ability to establish issue linkages across sensitive, connected dossiers. These summits will succeed in ensuring proper follow-up and implementations of their decisions, acting as a parallel framework to, or a potential competitor of, the UN system.

However, networks, whether at the political or technical level, lack the inclusiveness and the unique legitimacy of the UN, and this will pose an accountability problem and entail the risk of competing networks running conflicting agendas. Overall, there will be a widening gap between governments and citizens. The legitimacy of the groups taking decisions about global governance will be more and more challenged. Citizens, organised in new ways and with new means, likely ad-hoc, will ask their national governments to be more accountable in the way in which they take decision. A great share of decisions will also be devolved to non-political (and therefore non-elected) actors, with technical expertise on specific domains (telecommunications, networks, regulations) but with no knowledge of the implications that their decisions may have on the society at large.

2.2.5
Territorial and mobility dynamics

Increasingly vulnerable and unsustainable cities

By 2025, nearly 2.5 billion Asians will live in cities. This urban growth is being fuelled by new levels of mobility and the migration of diverse populations within nations especially in China, India and Brazil. These rural-to-urban migrants are attracted to live in cities by a number of factors – more opportunities, better jobs, better education and better healthcare. However, while a better quality of life is the aspiration, often the reality is very different. Especially in Africa, unemployed urban populations frequently congregate in squatter camps. Indeed, as they grow, most cities experience an equal growth in slums. Having 'two cities in one' is common and the frequent attempts to shift the slums to the periphery increases the rich-poor gap and makes cities less sustainable. According to UN, already today one-fifth of all urban housing comprises temporary structures and a third of the world's urban population lives in slums.

Larger European cities are affected by this urban poverty problem too, but on a smaller scales, and often this is linked to the incoming of poor migrants and their concentration in the most deprived zones of the city.

Alongside urban poverty, another challenge for the cities is to ensure the quality of the urban environment. This is mostly but not only related to the problem of urban (im)mobility.[55] Although all cities are in many ways different in terms of layout and structure, and consequently have different transport options, many share similar issues and challenges, with an increasing recognition not just of the efficiency and emotional problems resulting from congestion but also of its environmental implications. In many developed world cities, primary challenges will continue to include encouraging people with different modalities (e.g. road pricing, awareness campaigns, etc.) to change their existing habits and behaviors, while in the developing world it is often a case of encouraging people to make different choices about mobility than others (in the Western countries) have made in the past. With car ownership rising steadily in many emerging nations, however, this is no easy task. For instance, in Asian cities, the car is still more than just about transportation. It is a status symbol. Especially in India and China, even though people don't need a car, they aspire to owning one. There will be an additional 300 million car drivers added to the world over the next decade, most of them in cities in the developing world.

Another big concern raised by some about major future cities is that many of them are continuing to be built on the coast where better trade and communication with other countries has been a traditional rationale. With highly probable rises in sea levels caused by climate change over the next century, there is an emerging issue that most of the coastal cities in the world are not designed to float, or deal with floods. This would not only mean that the likes of Calcutta, Mumbai and Dhaka will be under water; but also, without considerable flood prevention investment, so will London, New York, Tokyo and Shanghai. Or, to put it another way, around 10 % of the global population will be displaced.[56]

54 A.M. Slaughter, A New World Order, Princeton University Press, 2004.

55 Future Agenda, The World in 2020.

56 Future Agenda, The World in 2020.

2.2.6
Research, education and innovation

A fragmented European Research Area

Public sector information

The public sector agencies of EU countries protect IPRs of their data by various means (e.g. copyright, database protection) and sell it at market prices, often competing with private sector parties. The public sector information concerning the actions of governments is increasingly stored for internal information systems only. As a consequence, the leading research and innovation based on PSI takes place outside the EU. Socio-economic research undertaken in EU countries uses often data from the United States or other countries providing accessible and cheap data. Lacking the support of public information, the ideas of increased future democratization and citizen empowerment never materialize. The European markets for digital content and services grow slowly and lag behind those of the US and other major market areas.

Research governance

Most of research governance is fragmented within national borders even more than in the 2010s. Earlier steps taken towards research governance and coordination at the supra-national level have been withdrawn due to overall crisis (e.g. financial but may also be public outcry with various S&T risks materialising from new advancements or from developments put in the market long ago with negative consequences for health and environment which were identified only after a long time). This crisis towards science not only downsized research to a large extent but it has also put it behind national borders. Grand challenges are not a theme of common interest anymore but a topic addressed by individual nations as they see fit for their own interests and stakes. It's not only a 'fortress Europe' but also 'fortress-nations' within Europe. Duplication of research and fragmentation across regions and countries prevails with a lot of resources being wasted. At the national level the situation remains that the research world is separate from businesses and that the business still develop their major projects in house. With the research being downsized and with more limited budgets it is now industry and multi-nationals that undertake primarily profit-making projects. Concepts like open innovation and copy-lefts did not take up as the climate is now much more introvert with everyone more interested in their own benefits and in protection than in public common goods. Societal concerns and challenges are largely untackled. Each MS decides on its own whether to ban or not certain research areas. Yet, there is little control and research is being done in any S&T area without taking society's concerns into account. With Do It Yourself (DIY) methodologies largely available on the internet and the little control being exercised in the area of research terrorism CBRN (chemical biological radiological nuclear) attacks are a real threat. Public surveillance technologies are flourishing in this regard. Nevertheless, certain scientific and technological developments without clear, or even potential negative, consequences for human health find their way to the market.

Research institutions

The ERA concept is long forgotten as it has not materialised and the lack of trust in science has grown considerably. Trans-national research agendas exist in some cases where nations share the same interests but they are mainly driven by industry with profit-making motives. Global challenges are on the agenda but primarily for profit-making and increasing competitiveness reasons without ensuring sustainability.

2.3 Further European integration 'EU Renaissance'

Quantitative spotlight

In the 'Renaissance' scenario, the primary assumption is that the EU manages to optimally target its research and innovation policy. More generally, EU influence in the international arena grows and is used to push towards a reduction of global imbalances as well as to keeping a level playing field with open markets and circulation of capital flows worldwide. Benefitting from such sound policies Europe enters into a virtuous circle whereby its economic influence is reinforced by 2050, compared to the 'Nobody cares' scenario. **Figure 35** accordingly shows the shares of world GDP in 2050 for the main actors of the world economy. The EU represents at the end of the period the same share of the world economy as the US, despite a less dynamic demography on this side of the Atlantic. Europe and the US are still larger than China and India taken together.

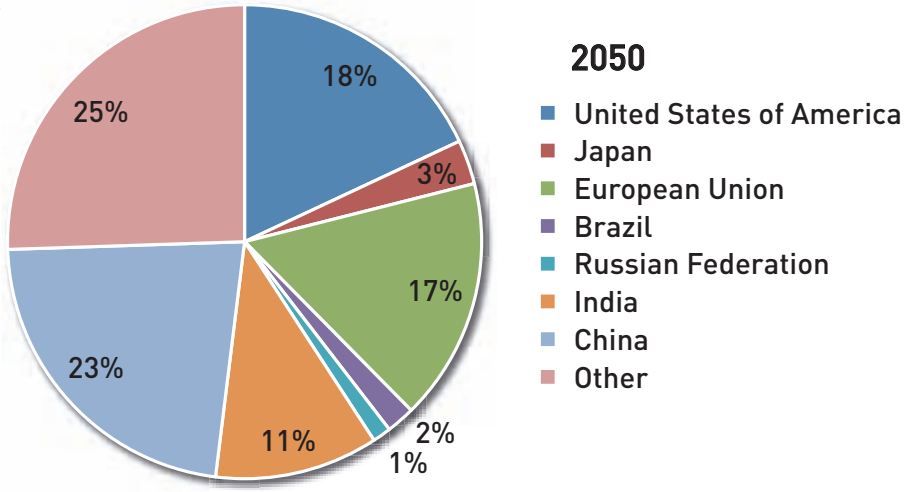
A more comprehensive view of the trajectory of the world economy under the 'Renaissance' scenario is provided in **Table 9**. The size of the pie, how much the world economy will produce of wealth each year, more than trebles from 2010 to 2050. The Renaissance scenario accordingly leaves much room for investing in alleviating poverty, educating people, or adopting cleaner and more efficient technologies. In this trebling world, the economic size of the US will 'only' double (factor 2.2), slightly more than the EU (factor 1.9 exactly). Here again, this leaves room on both sides of the Atlantic to adopt sound policies and address economically societal challenges. Meanwhile, the size of China increases ten-fold, India 15-fold and Sub-Saharan Africa 11-fold. The Mediterannean region also multiplies its economic size by four. In total, Africa and the Midde-East will have in 2050 an economic size comparable to the EU plus Latin America in 2010.

Table 9 – GDP for selected regions, 2010-2050, constant 2005 USD bn: 'EU Renaissance'

	2010	2020	2030	2040	2050
United Stades of America	12 873	16 567	20 323	24 340	28 454
Japan	4 541	5 121	5 276	5 048	4 766
European Union	14 024	17 381	20 224	23 033	26 110
Brazil	1 047	1 473	1 987	2 532	3 076
Russian Federation	882	1 212	1 534	1 815	1 990
India	1 176	2 582	5 567	10 688	17 594
China	3 637	8 801	17 218	26 954	35 539
Latin America	3 149	4 351	5 567	6 869	8 253
Middle east and North Africa	2 280	3 368	4 875	6 755	8 798
Sub-saharian Africa	730	1 245	2 280	4 319	8 078
Rest of Asia	2 508	3 742	5 492	8 184	12 089
Rest of the World	1 794	2 121	2 442	2 749	3 048
Total World	48 640	67 964	92 785	123 286	157 794

Figure 35
Regional shares of the world GDP (constant 2005 USD) in 2050: EU Renaissance

Source: CEPII



2.3.1 Global demographic and societal challenges

Preserving the standard of living

To maintain its standard of living also in the future, Europe will need to 'import' a substantial number of citizens from other regions of the world. Some countries, e.g. the UK, have managed to do it rather well. Other countries, like Italy, are much less successfull. However, good practices will eventually prevail. 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 takes place towards the South where the new opportunities are. Entrepreneurial individuals 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.

Population growth in the rest of the world may be accompanied by modern technologies that reduce the rate of growth of resources needed to meet basic needs. Already today mobile 'all-in one iPod telephones' help to replace many needs, and they promise to continue to support in the future lifestyle changes across the world. 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. Economic development, especially with the advancement of women through access to education, to microfinance, and to birth control contributes to reductions in birthrates in developing countries. The development of social security systems associated with paid work would also contribute reducing fertility levels.

Active ageing

Active ageing may impact positively on society, through the increased communication of values and expertise – when three, or four rather than two generations are involved. Life-long education, informal and non-formal learning will play a pivotal role. Already by 2020 there will be a greater proportion of older workers in the workforce than today: both experience and work place performance will be valued. Organizations are increasingly aware of the loss of collective memory that occurs when people retire and some, such as P&G, General Mills, Eli Lilly and Boeing, have been using programs such as youencore.com to tap into this resource. At the same time, attitudes to continued work will be shifting, with employees increasingly keen to keep working on part-time basis after retirement age. Third generation career workers are regarded as knowledgeable, flexible and experienced workers and are rising higher on the wishlist of many organizations. So we can clearly expect continued participation beyond 65 to be on the agenda for more employers by 2020. What makes this pretty well certain in many countries is the economic pressure to keep people working, delay retirement and so reduce the pension gap.[57]

Larger work participation of the elderly will be therefore a decisive factor. The regulatory system (retirement schemes, labor regulation...) will be adapted to population ageing. By 2020, several countries in Europe will substantially revise their pension system by allowing their citizens to adopt flexible retirement schemes in which, after a certain age, they can progressively decrease the number of working hours. 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. Disability-free years will increase.

57 Future Agenda, The World in 2020.

As for the health care, increasing pressure on public spending is probably true however the numbers can be disputed. They strongly depend on the shifts in relative risks of being ill in the old age today and tomorrow. 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, is expected to become an integrated part of the health system of the future.[58] 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. What is the impact of health care expenditure, including R&D, on labor force participation and consequently on growth? For instance, in Belgium employment in health care *lato sensu* is now of the same magnitude as in the manufacturing sector. This impact of the health sector is so important that it should be one of the main ingredients to recommend for the future EU research programming.

The diffusion of Internet and changing lifestyles may also help to improve the elderly life. Intellectual stimulation of the elderly via Internet facilities will reduce brain deterioration. Emotional stimulation of the elderly will take place via social network applications. Physical care systems may become more limited. Females in the family will all probably be working so there will be limited caregivers in the family. Families may however move closer to each other to increase proximity and social contact, if not physical care. Self-supporting groups of elderly people will be also more easily formed to help each other in old age. The rise of home robots as health care substitutes will help too. Indeed, shortfall of care staff and in particular limited time available to family members to provide long term sustained care will 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.

An open and attractive European society

Migration will continue to be an important challenge for the future of EU countries as well as for the emigration countries. In EU, a scenario with constant labor supply and even with increasing structural unemployment is not to be excluded: migrants could be attracted to replace the shrinking working population and enlarge the talent pool. The advanced countries will also face a shortage of qualified labor force (scientists, engineers, medical doctors, software programmers).[59] This will lead them to plan immigration and be more selective in terms of immigration policy. By recruiting one million workers each year EU will ensure modest population growth between 2030 and 2050 attracting skilled workers that would be easily integrated in the labour market and prone to sharing the European values particularly regarding gender relations. Cultural factors are also particularly relevant in a long-term perspective. The cumulative nature of crises – financial, economic, institutional, resources – points to a serious cognitive crisis in the Western nations: nature (the background of human events) exists no longer, it has been substituted by the environment (the site where events take place), so society is inseparable from its waste, good and evil seem superimposed. So the answer can only be cultural: (1) more participation by the citizens; (2) more intergenerational conversations; (3) a bigger role for curiosity and imagination in a new culture of innovation and entrepreneurship. Which universities are aware and responding to these trends? And will the systematic deployment of partnerships ensure the reinforcement of democracy worldwide in the coming decades? The evolution of national and 'regional' innovation systems – including technological, organizational and social innovation – will influence wealth creation patterns decisively in the EU Renaissance scenario.

Fueled by innovations in the field of electronic media and Information and Communication Technologies people in different contexts are beginning to be more active in communities. Some citizens/customers are more actively contributing to certain forms of issue-based discourse and sometimes activities (campaigning) on the basis of shared interest or the identification with a certain group of people or certain attitudes/values. Based on research in youth and the attitudes of younger people it also seems evident that through more active participation in certain forums, new forms of sociality, new forms of collaboration and new forms of solidarity are gaining ground (General Public License/Open Source Movement).

Indeed, the growth of the *'civil society'* sector is one of the major, but widely invisible, social innovations characterizing the modern societies. The birth of 'new' social movements reflect the emergence of novel problems and commitments such as 'post-material' values about personal and collective freedom, self-expression and quality of life (ranging from universal issues such as environment, novel risks, peace and feminism to more particularistic ones such as new issues of inequality or ethnic and sexual identities).[60] The increasing openness, availability of and access to information will contribute therefore in this scenario to increasing public awareness and sensibility against any type of unfairness and injustice around the globe. This affects the way people perceive and respond to changes and marks a difference from the past. The increasing importance of factors that fall outside the normal market structure also indicates that the market oriented economy model through which we have been analyzing developments may not be the appropriate approach anymore. Whereas the 1980s saw the world move towards a free market economy the early 21st century might see a shift towards 'international' governance as the primary driving force.

58 Danish Research Agency, Ministry of Science, Technology and Innovation: the-ageing-society-2030.

59 Report of the European Research Area Expert Group (2008), Opening to The World. International Cooperation in Science and Technology.

60 N. Stehr (2001), *'The Fragility of Modern Societies: Knowledge and Risks in the Information Age'*, Sage Publications, London.

2.3.2
Energy and natural resource security and efficiency, environment and climate change

Better energy and CO_2 reduction prospects

As economies grow, the demand for energy, food, protein, water and metals all pretty well scale linearly: increasing GDP per capita is largely directly linked to per capita resource consumption. The big challenge is to decouple resource use from economic growth by essentially using less and yet continuing to allow economies to grow. This is where innovation will have an essential role. Another key challenge is to reduce the CO_2 emissions associated to GDP growth and global warming. According to the IEA 450 Scenario, to limit the probability of global average temperature rise of 2°C even to 50/50 bet requires all OECD+ countries to take on emission reduction commitments from 2013, with everyone else joining in by the end of the decade. Rising oil and gas prices and shortage in supplies may lead to diversification in energy supply and decentralisation of energy generation, along with the increase in the proportion of biomass, wind and solar energy. We are also likely to see increased investment in proof-of-concept schemes for wave power. Geothermal and hydro will continue to be limited to certain geographies. Continued demand for fossil fuel and heightened public discussion on global climate change, may drive the development of new energy saving technologies. Suitable, more energy-efficient machines will be urgently needed.[61] It is also possible that there is a trend break. Climate change impacts may lead to a global breakthrough and agreements to focus on wind and solar energy. Technological developments may drastically cut down energy consumption in production, distribution and waste processes. Other factors include: (1) focus on dematerialization and decarbonization of society; (2) consumption behavior changes to more modest and environment conscious life styles; (3) spatial planning which improves local consumption patterns.

A pivotal issue in any assumption about the future for wind power is that of materials availability. Materials alternative to copper, such as high temperature superconductors, are now in trial applications, and the likelihood of being able to scale these up substantially within ten years is low, but they could be available on a large-scale basis on a later 2050 horizon. However, the diffusion of wind turbines will remain constrained to some geographical areas and off-shore sites, due to fundamental problems of wind variability. Solar energy is virtually a limitless clean resource. In its most common form, photovoltaic (PV) panels convert sunlight into electricity. Typical current panels have an efficiency of around 10 %, with more expensive ones achieving 20 %. In the next few years, experts expect that this may rise to around 40 %, close to the efficiency level already acheived in space.[62] According to the US Department of Energy's Solar America Initiative, PV solar energy will be competitive without subsidy by 2015. Just as with other technologies, increasing capacity will result in a steady cost decline and across the supply chain, manufacturers are increasing cell efficiency, using thinner silicon wafers and increasing power in low light levels. While some countries, such as those in northern Europe, could get around half their electricity needs from PV and solar farms within their national boundaries, if they had access to solar power from other countries, solar could meet nearly all electricity demand. Looking ahead, organizations such DESERTEC are promoting the adoption of concentrated solar power (CSP) systems in Mediterranean countries and high-voltage DC transmission lines as a credible way to provide Europe with secure, clean energy. The same arguments clearly apply elsewhere in the world and some expect that they are likely to occur first in either India or China. Within the study period, even today still futuristic looking concepts such as providing energy from space via space-based solar power plants can enter the energy market, possibly first as a flexible, not geographically bound, controllable, permanent and weather independent complement to the intermittency of terrestrial renewable power sources.[63]

Indeed, 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 will play a role. The other environmental impacts of coal lead to a closure of coal and fossil fuel mining. 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 could 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 CO_2e are likely to be around 1 % of global GDP by 2050, with a range from –1 % (net gains) to +3.5 % of GDP[64]. A global climate change control policy will be put in place, thanks also to the rise and frequency of extreme weather events that will open the window of opportunity to make far-reaching agreements on climate change.

A sustainable roadmap to low carbon Europe

In Europe, the flagship initiative 'resource-efficient Europe' under the Europe 2020 Strategy will tackle successfully the energy and resource security problems, and it will continue to provide benefits after the 2020 horizon, towards 2050.[65] This initiative provides a long-term framework for action in many policy areas, supporting European policy agendas for climate change, energy, transport, industry, raw materials, agriculture, fisheries, biodiversity and regional development. The EU Roadmap for moving to a competitive low carbon economy in 2050 is successfully implemented.[66]

According to the Roadmap, the transition towards a competitive low carbon economy means that the EU will achieve reductions in its *domestic* emissions by 80 % by 2050 compared to 2050 – domestic meaning real internal reductions of EU emissions and not offsetting through the carbon market. The Commission has carried out an extensive modeling analysis with several possible scenarios showing how this could be done. A consistent and cost-effective pathway of GHG emissions reductions in several sectors has been produced by means of this analysis, and it is illustrated in **Figure 36** (page below).

The figure illustrates the pathway towards an 80 % reduction by 2050, shown in 5 years steps. The upper 'reference' projection shows how domestic greenhouse emissions would develop under current policies. A scenario consistent with an 80 % domestic reduction then shows how overall and sectoral emissions could evolve, if additional policies are put in place, taking into account technological options available over time. Such a pathway would result in annual reductions compared to 1990 of roughly 1 % in the first decade until 2020, 1.5 % in the second decade from 2020 to 2030, and 2 % in the last two decades until 2050. The effort would become greater over time as a wider set of cost-effective technologies becomes available.

61 Deutsche Bank (2007) Germany 2020, new challenges for a land on expedition; Fragmented Power: Europe and the global economy (2007); European Ideas Network (2007), The World in 2025.

62 Future Agenda, The World in 2020.

63 L. Summerer et al. Roles of solar power from space for Europe: Space exploration and combinations with terrestrial solar power plant concepts, *JBIS*, 59, (2006); F. Ongaro et al. 'Space and a sustainable 21st century energy system', 57th IAC, Paper IAC-06-C3.1.01 (2006); M. Hoffert et al. 'Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet.' Science 298.5595 (2002):981.

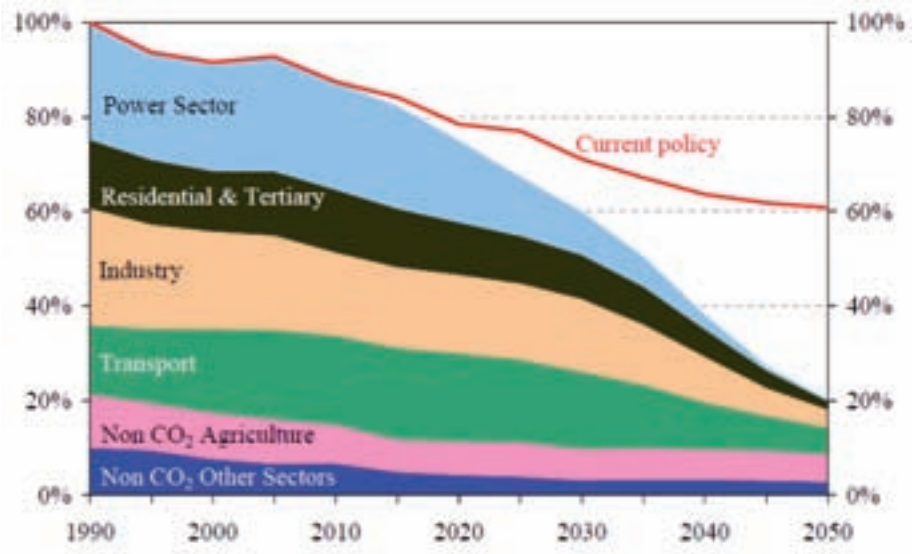
64 Stern review on the economics of climate change (2006).

65 European Commission, 'A resource-efficient Europe – Flagship initiative under the Europe 2020 strategy', COM(2011)21.

66 European Commission, A Roadmap for moving to a competitive low carbon economy in 2050, COM (2011)112.

Figure 36
EU GHG emissions towards an 80 % domestic reduction (100 % = 1990)

Source: European Commission, A Roadmap for moving to a competitive low carbon economy in 2050, COM(2011) 112 final



2.3.3
Economy and technology prospects

A new global financial stability[67]

Alongside individual national currencies and regional currencies such as the East Caribbean dollar and the West African franc, today there are essentially two key currencies that can be considered as global reserve currencies: the US dollar and the euro. These are the currencies in which key commodities such as oil, gold, steel and so on are priced; they are the primary currencies against which all others are compared; and there are the currencies that most national governments and central banks hold as part of their national reserves.

However, as G20 has as a matter of fact superseded the G7 in the global governance framework, many have recognized that financial management of the global system must become more equable. Momentum is building up for a change, or at least the addition of a third, alternative global reserve currency – one that is less dependent on the West and one that more readily supports the future needs of the global financial system. The fundamental drivers of this are a clear shift in the centre of economic gravity towards Asia, the associated growing economic importance of China and the increased risk stemming from growing levels of debt in the US. In addition, the recent problems in the Eurozone have raised increasing concern over the long-term credibility and viability of the euro as a common currency across hence many economically varying countries, and so its credibility as a stable global reserve currency.

The latter is needed as a pre-requisite for global world development and trade, and for the stability of the single economic regions, including Europe. In the 'EU Renaissance' scenario, we assume a movement towards a multi-polar world, which will be characterized by a much broader consultative process that extends to a large number of jurisdictions. Greater coordination amongst major economies on financial sector regulation will be needed, in order to achieve greater trust in the transparent and universally applicable working of the financial system.

In this multi-polar context, the perspective on the future of global currencies at the 2050 horizon is not that of substituting the US dollar – the unique dominant currency in the Bretton Woods system – with another currency, let say the Euro or the China's renminbi. The growing Asian economies will plausibly frame the global currencies evolution here. Many high-growth Asian economies are keen to move from needing to trade with each other via the dollar: not only they want to avoid having to use the dollar as the facto intermediary for many international trades, they also want to keep their money within the own control with less dependency on the US economy and the highly US-orientated global financial institutions. China, India and Japan as well as many others such as Thailand, Vietnam and Malaysia are keen to have an alternative option to the dollar, but this is increasingly seen as not being the euro. The evident weakness in the eurozone, where strong economies like Germany have clearly been carrying weak ones like Greece, creates instability and, besides that, the euro can also be seen to be just as much linked to Western financial imperatives as the dollar.

In this situation, there are basically two options for the future of the global currency. The first is to shift towards the adoption of one truly international currency, i.e. for all countries to adopt what are termed 'special drawing rights (SDR)' as a parallel reserve currency for international trade. SDRs are currently the international reserve assets managed by the IMF. However, the prevailing view here is that the IMF is not a super central bank and turning SDRs into a world currency is neither politically possible nor practical. A second option – which is assumed to be the successful one in this scenario – is the emergence of a third 'Asian-based' global currency, which will be used together with the US dollar and

67 This section is largely based on the *Future Agenda*, The World in 2020.

the euro to regulate international trade and financial transactions. The China renminbi could take the role of third global currency, but this doesn't seem the right answer: the rise of China's economic power creates a case for the renminbi revaluation to make it a global reserve currency but there are several fundamental barriers to this. In addition, China may not be prepared politically and culturally to assume such a position of global financial leadership and associated responsibility. Perhaps the most realistic option for the third global reserve currency is the creation of what has been termed the Asian Currency Unit or the ACU. This is a basket of Asian currencies that are used not as the primary currency in each country but as a secondary parallel currency for trade. Given the similarities to what happened in Europe in the late 1990s, many see that the ACU could be a precursor to a common future currency, just as the ECU was for the euro. However, this is not necessarily the case. The ACU is not implicitly linked to Asian monetary union, nor requires it, but it is rather a means by which the Asian economies can take greater control of their world.

New opportunities for the EU industry and employment trends

Globalization and the integration of the emerging countries of Asia and Latin America into the world economy, falling transport and communication costs, and on-going trade and investment liberalization in the emerging economies offer new markets and opportunities for the European industry. EU exports have expanded by 4.7% per year over 2000-2008, substantially faster than the growth of industrial production. Despite intensified international competition, the European trade performance has held up notably compared to the US and Japanese performance. In some sectors, and despite the appearance of new major global players such as China, the EU increased its share of world exports between 1996 and 2006, notably in chemicals, pharmaceuticals, and motor vehicles. In other sectors, the EU has better resisted the challenge of China than the US and Japan, particularly in metal products and electrical machinery. More recently, the effect of the economic crisis on EU exports was of comparable magnitude to the overall contraction in world trade, but increased economic integration is expected to continue enabling the rise of emerging economies as relatively low cost and potential high demand markets.

The process of globalization has increasingly resulted in tightly interlinked international value chains. As a result of the massive fall in both transport costs (e.g. containers) and communication (ICT) and of transaction costs and risks traditionally associated with doing business across borders, previously integrated industrial operations have been sliced up into highly complex smaller manufacturing and service packages and have to some extent been geographically redistributed across continents. Emergence of global value chains not only led to efficiency gains and a geographical fragmentation of production processes by fabrication of components in different locations around the globe but also moved some of the relevant know-how and services into these locations. The development of global value chains facilitates the rapid integration of developing countries into the global economy by the transfer of capital, technology and knowledge. Most foreign direct investment (FDI) is currently motivated by market expansion: e.g. investment by European car manufacturers in China to serve the Chinese market. This creates new jobs overseas while maintaining or even creating high quality jobs in Europe.[68] Consequently, by using available low cost resources and by building on the acquired know-how, the emerging countries have turned into strong competitors for developed countries. In particular, over the period 1999-2008 the share of EU imports from China, India and Brazil has gone up from 17% to 32%.

In this context, the employment trends by level of qualification show that the 'skill intensity' of jobs in Europe has been increasing in recent years and is expected to continue to do so in the coming years.[69] As a result, the proportion of high qualified jobs is expected to increase to over a third by 2020, whereas the proportion of jobs employing low

qualified people is expected to decrease to 15 %. Those requiring medium levels of qualification (ISCED 4a,b) will constitute half of overall employment. However, at present much of Europe is facing a skills lag: nearly one third of Europe's population aged 25-64 has none or only low formal qualifications, whereas only one quarter of Europe's population aged 25-64 have higher level qualifications.[70] Although looking into the future as regards the evolution of skills needs in Europe is complex, some assumptions may be made. Overall the 'tertification' of once industrial production as the lion's share of gross national income/gross value-added, can be projected to go on. The relentless growth of service industries drives a steady demand for both high skilled and low skilled workers significant job growth will predominantly be in service sectors. Yet, it is still unclear as to the extent of the job growth. On the one hand, the efforts of European industry players – be that large or small and medium enterprises – to sustain competitiveness through productivity and quality improvement results in a strong/growing demand for high skilled professionals and re- and up-skilling services. On the other hand, the increasing off-shoring of higher-skilled production activities in several value-chains is probably decreasing the demand for skilled workers in Europe. Let alone the fact of the extent of job growth, one thing to be assumed is that there will be some job growth accompanied by a shrinking supply as regards the workforce as a result of the effects of the ageing of populations in different EU countries (like Germany, Middle Eastern Europe and Italy).

Tackling the challenges of the knowledge economy

Talking about the service economy as one of the 'job motors' and closely connected to the progress made in information technology and the establishment of large information infrastructures, there have been intense discussions on the so-called 'knowledge economy and sometimes the learning economy' in the last decade. Yet taking stock of the phenomenon is still maturing, with its effects and the extent of its ramifications still not being clearly carved out. For the time being, it is still not clear what are the implications and possible pathways of a knowledge economy and its effects on industrial and service production, gross-value-added and last but not least job growth.

Scrutinizing the emergence of the knowledge economy, we may want to consider different types of knowledge-based economic value-creation activities with different ways of acquiring/accreditating/sharing or even defining knowledge (everyday creativity vs. formalized knowledge). What is for sure in some way is that, indeed, production patterns are rapidly changing.

First and foremost, the loci of production: the geographical patterns of production are changing in the wake of a more knowledge-intensive economy[71]. Production sites are being globally spread sometimes moving closer to markets and its core customers, sometimes – as it is the case in the electronics industry – making up global production networks with flagship production companies being locally or regionally concentrated, like the electronics cluster in Taiwan[72].

68 The EU is the world's biggest investor and the principal host of foreign direct investment. When intra-EU stocks are excluded, the EU owned 36 % and hosted 29 % of world investment stocks in 2008 (Eurostat and UNCTAD). At the end of 2006, cumulative EU FDI stock in the rest of the world is valued at € 3.3 trillion, whilst cumulative FDI by the rest of world in the EU was € 2.4 trillion (EU FDI Yearbook 2008). The EU is a net investor in all manufacturing industries except textiles and woodworking sectors. However, in business services inward investments exceed EU investment in the rest of the world.

69 CEDEFOP, 'Future skill needs in Europe', 2010.

70 European Commission, DG Enterprise and Industry, EU Manufacturing Industry: What are the challenges and opportunities for the coming years?, Working Paper presented at the 2nd High Level Conference on Industrial Competitiveness, Brussels, 26 April 2010.

71 D. Ernst (2002): Global Production Networks and the changing geography of innovation systems. Implications for developing countires. Economics of Innovation and new technologies 11(6), 497-523.

72 E. Dieter (2009): A New Geography of Knowledge in Electronics Industry: Asia's Role in Global Innovation Networks. Policy Studies of the East-West-Center 54.

Secondly, the production patterns are changing due to the change of customer needs. More informed customers often exert a pressure on companies and providers of services to deliver more and more personalized products for more diverse niches in the global market landscape. Solutions integrating products and services are requested. This is changing the paradigms of production. However looking into the paradigmatic shift of production, the 'dominant narrative' of more integrated products is not given to stay. Spatial patterns may either become fully dispersed or else heavily centralized (or both in different sectors). Disruptions of transport, security problems etc. may lead to more localised patterns. At the same time – enabled by the Internet and open source platforms – there is a growing tendency towards user innovation or even user production. This means that users change their role of just consuming pre-fabricated products with their inherent prescribed forms of use (scripts). They change the products by being integrated in more 'open' processes, by beta-testing certain products and giving their feedbacks, which result in alteration to product designs, or they just use products in non-prescribed contexts – e.g. people using IT-technologies to manage their daily living in households, which was not meant to by the initial design. This is reflected in researchers and futurists talks of (more or less radically) new patterns like open-source production, commons based peer production, interactive production, fabbing economy[73], creative economy or open innovation approaches[74]. Certainly more thorough user integration in product designs, more subtle market research, new training and also working methods of product designers and the changing needs – and also the more informed and subtle consumption of users who are only willing to pay for 'smart' comfortable service provisions – have been and will be changing industry, production patterns and supplier networks.

In this setting, some industrial structures in certain application fields, which are more proprietary, may be overturned by developments. Another impulse to the change of production patterns may also be exerted by more project-based value-creation activities.

New forms of value creation activities

The approach of one company and legal entity producing the lion's share of innovative industrial and service production is being altered by new and more flexible forms of value creation and organization of knowledge activities, for instance by means of projects (also instituted as own legal entities), with groups of workers and self-employed innovators working together loosely knit on a temporary basis to come up with new products and solutions. This is going to radically change the industry structure. Especially when it comes to building more decentralized infrastructures in fields like energy, housing, etc., the 'project economy' will alter the composition of future value-creation[75]. Together with more subtle forms of 'social innovation', which may play a much bigger role in the economy due to the reorganization of very important fields of gross-value-added like healthcare, social services, housing, real estate and business services[76], the future look of the economy may be altered.

A key pervasive feature of the transformation in the way added-value is produced in the service sectors – to support any kind of business, including industry, agriculture, environment, urban services etc. – is the dynamic development of knowledge bases and the use of knowledge, including in particular: (1) more distributed knowledge-creation, with cross-border, project economy value creation exploiting knowledge networks; (2) accelerated and temporally flexible generation and take-up of knowledge; (3) more hybrid/integrated/applied knowledge-creation; (4) smarter/specialized knowledge-creation, with the increasing need to integrate different knowledge fields, where specialisation counts; (5) more codified information, taking the form of patents and standards, commercial information; (6) more 'managed' information, with forms of 'automated' knowledge mining and creation on the basis of advanced knowledge technologies, distance learning packages, etc.; (7) more frequently collaborative and informal knowledge, with more peer-to-peer exchange of experience, experts and lay-people working together more intensively on common

'science in society' issues on the basis of new social knowledge and software technologies; (8) more project-oriented forms of knowledge-creation and use. We will assist in this scenario to a shift in the social logic of production, whereby the old logic (division of labor, functional organizations, hierarchy and standardization) is replaced by the new logic of sharing knowledge in networks and teams, with a focus on core competencies, continuous learning, absorptive capacities, and innovation. The success of firms, regions and nations will increasingly depend on their accumulated knowledge, skills and learning capabilities.[77] New forms of work (associated with information technologies), types of workers (multi-skilled, more responsibilities) and organization of work (re-concentration of multiple competences against the high division of labor of the 'industrial society') will increasingly emerge and become the dominant form of production. Since the key growth sectors of the 21st century seem to be energy, housing, health, education and care (which are sectors strongly shaped by public policy), different innovation models will be required from the traditional ones that were appropriate for sectors like automotive, microelectronics and biotechnologies.[78]

73 C. Doctorow (2009): Makers. Tor Books.

74 OECD (2008): Open Innovation in Global Networks.

75 Hofmann, J., Rollwagen, I., Schneider, S. (2007): Germany 2020. New challenges for a land on expedition. Frankfurt.

76 Tapscott, D., Williams, A.D. (2010): Macrowikinomics Rebooting Business and the world. Portfolio Hardcover.

77 Freeman in Archibugi, D., Lundvall, B., (edit), (2001), 'The Globalising Learning Economy', Oxford University Press.

78 Mulgan, G., et. al. (2007), 'Social Innovation: what it is, why it matters, and how it can be accelerated', Working Paper, Skoll Centre for Social Entrepreneurship, Oxford Said Business School.

Brake, shake, make, and not fake it – the refined rules of the production game in 2030: How the total change of production modes brought about new forms of innovation

Production follows a new logic now in 2030:

- Break the rules of the game on the basis of sound regional and international bottom-up networks
- Shake up dominant designs and paradigms as well as supplier structures by reorganizing supplier networks and organizing different pioneers and their pilot projects on the basis of advanced knowledge and networking infrastructures
- Make your own things for your own buddies and like-minded innosumers
- Scale fast on the basis of word-of-mouth and targeted marketing and certainly do not fake it matters.

It is a tale of new entrepreneurs that have learned their lesson: after a phase of stiffening structures in supplier networks and cut-throat competition on the basis of decreasing quality and fakes, some entrepreneurs set out on the basis of cooperative finance models, blue angel support and with their vast amounts of technical oriented knowledge to use the advances in materials and 3D printing to come up with new forms of production in knowledge-and value creation networks. Breaking the rules of the game unleashed more creativity and brought about suited, rather frugal, often seemingly tacky solutions to the ever-increasing challenges when it comes to making a living in a society that is characterized by increasing inequalities (see Gini-coefficients).

With applied knowledge generation and a lot of do-it-yourself projects dominant designs and the standards landscape has been shaken up in a seismic shift of the manufacturing landscape, opening up opportunities for a new class of entrepreneurs and producers. More jobs are created in communities and small circles, in which producers, design, re-design, shape, produce, consume and innovate in one. It is all about making something unique, exquisite or exquisitely frugal or making change happen as opposed to faking on the basis of conspicuously consuming prefabricated products.

While these trends may lead to new opportunities for innovative, highly skilled and entrepreneurial minded people, these changes to the system of production and new forms of collaboration like crowdsourcing, – which make it difficult to see who delivered what – may bring about total new challenges as to the reform of social security systems. Most social security systems in the EU have simply not been designed for coping with an increasing share of gross-valued-added being provided by part-time, self-employed, often 'nomadic' workers. Without changes, the transformation in industrial and service production may thus contribute to the erosion of social cohesion.

A fundamental issue embedded in this topic is the 'end of intellectual property (IP)'. Although this has been on the cards in some sectors for several years, it has now become a more widespread concern. Just as IP in the music and education industries has been challenged by new business models, many see that regulation will fail to keep up with digital collaborative platforms for innovation. With the growth of the creative commons and open source movements, core components of corporate and institutional knowledge will increasingly be shared without restriction and, in the eyes of some, result in further decline of copyright and weaker patents. Indeed, in the context of knowledge production, the main asset is not so much strong intellectual property rights protecting innovation creation but having internal capabilities to access and absorb knowledge produced externally, to negotiate the rights of access, and to be supported by an efficient system of distribution and access to knowledge and promoting 'positive knowledge externalities'.[79] Thus, the crucial role of the 'learning organization', 'organizational learning' and competence-building networks.

In particular, co-operative forms of knowledge generation and diffusion will increasingly take place. These imply the following arrangements: (1) inter-firm technology agreements. Even rival firms are more willing that in the past to share the costs and risks of knowledge generation. While so far this modality is particularly important in the US, it is likely that it will develop also in other continents. Particular relevance will have South-South co-operative agreements that will allow countries with similar problems to find solutions that are best suited to their economic and social reality. (2) Public Private Partnership to address global issues (such as vaccines for HIV, malaria, TBC). (3) Greater role of international public research ventures, both in the case of large scale facilities (such as CERN) and in much smaller and more focused programmes. (4) Tremendous impact of open forms of knowledge generation and diffusion on the model of open software. This will substantially increase the number of 'voluntary' and 'very part time' researchers working on specific issues, and will also substantially decrease exclusion to new forms of knowledge. Open forms of innovation, such as Linux, will proliferate and will act as powerful channels of innovation diffusion.

Due to the increasing knowledge-intensity but also on the basis of other trends, the definition of labor, and the (societal) prestige and the esteem that can be derived out of certain forms of labor/work is changing profoundly. In addition, the valorization of work in certain professions is changing, in the wake of the labor force diminishing and labor getting scarcer. Also with the increasing knowledge-intensity, other forms of labor like more project-oriented work and more collaborative/team oriented, self-motivated work are gaining ground. Moreover, 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 labor market. Brain circulation will probably increase, within the EU and with neighborhood countries. 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 firsthand experience of the arts.

The main additional insight needed in the description of this part is the almost certain emergence of the new techno-economic paradigm around the 2030 decade. So our horizon clearly holds and projects this central infrastructural change into the

world economy. But up till now (from the Industrial Revolution onwards) we have been used to watch the emergence of key radical innovations with an American or European origin only. What if in the horizon 2050 a mutation occurs, supported by a whole new techno-scientific economy deployed from a Far Eastern region? This will amount not to a 'new development in ICT-based economy' but rather 'new ICT and ICT-based society being developed' with tremendous impact. The connection of education to research and innovation – namely in connection to the capacity of leading technologically the world – merits attention in this framework.

New techno-economic paradigm from Asia and technological breakthroughs

Technological revolutions have initiated and shaped institutional, societal and organizational changes, best documented during the last 200 years; the current one is usually called the information revolution or, rather, the 'computerization of the entire economy'. Research has shown some regularities and characteristics of the patterns in which these revolutions occur as well as of the relations between technical and organizational change, economic performances and relative regional power levels.

Given that there are always many inventions (based on what is technologically possible) competing for being transformed into innovations (what is potentially profitable and socially acceptable), institutional frame conditions (rules and regulations, social norms, incentives for change, freedom to take risks etc) are playing a key role in determining where new techno-economic paradigms emerge and grow. Western countries, essentially Britain and the US, have been the initiating and core regions for the last five technological revolutions, reaping high and long-term benefits (political, economic) from these, strongly contributing to the leadership/dominance of western ideas, values, standards and industries. The West however does not enjoy a monopoly for being at the core also of the next techno-economic paradigms; on the contrary, high growth rates, dynamic, young societies, acceptance of higher risk levels indicate that Asia is rapidly improving the frame conditions for such changes to emerge. Such a situation would have lasting and profound impacts.

There is certainly no reliable method to foresee from where and based on what technological changes the next techno-economic paradigm will emerge. On the other hand, the scientific research and first technologies that enabled the current information and telecommunication paradigm appeared clearly visible already a few decades before the onset of the paradigm shift – therefore a close monitoring of early signs for potentially disruptive technological innovations and the rapid provision of the right frame for these to flourish are important. There are many candidate technology areas proposed for the horizon 2030-2050, essentially based on the expected rate and potential impact of perceived technical and scientific progress. These include a powerful possible integration between domains of nano-science, computer science and neuroscience; resource efficiency (potentially leading to entirely new approaches to dealing with environments and the 'value of nature'); synthetic biology (creating new life forms and eventually even leading to transhumanism: human nature has changed gradually with time, though with modern technologies we are able to make such changes orders of magnitude faster and eventually also more efficiently; this raises a whole spectrum of questions related to the very nature of humans, societal organisation, social fabrics etc); the large scale economic development of near-Earth space, unleashing entrepreneurial spirits.

79 P. Cohendet and Joly in D. Archibugi and B. Lundvall, 2001.

The continuing ICT revolution

Perhaps the currently most important trend in the area of science and technology is the continuing information and communications revolution and its implications. The fastest computers perform trillions of operations per second at time of writing with strong signs that Moore's law will uphold up to 2020+. If continued in the future, computers will have reached the computational power equivalent to one and possibly all human brains before 2050. In parallel to the computational power, new algorithms and general ways of using this power will be developed. Decisions and their consequences will increasingly be simulated before being taken, identifying options and providing decision support systems to start with. ICT developments are taking place so rapidly that we may be living in the world of holograms, telepresence, home robots. Many production, design and service activities may be taken over by ICT products. ICT revolution is to be considered therefore like a 'general purpose innovation'. The spreading of its application in all types of activity will continue only progressively and further increase total factor productivity growth. Several areas can be revolutionized like education, administrative and statistical information, health care.

However, is it really the pace of technological change here that makes the difference? Or is it not rather the massive diffusion of internet access and mobile phones that gives rise to new economic models, modes of communication etc. – so rather socio-technical than just technical change? Indeed, we are more experiencing a meta-trend that could be derived by the fusion of scientific disciplines and technologies. Moreover, 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 worldviews of the people. Established education systems that emerged in the industrialization period will increasingly struggle to cope with the 'learning economy'. By 2030 severe changes may have occurred in the way knowledge is defined, stored, accessed, acquired and accredited. Today's schools and universities may have disappeared.[80]

New developments in energy technologies

Energy efficient technologies will become available, and even breakthroughs in alternative forms of energy that reduces dependency on hydrocarbons may be likely by 2050, though their effect on the overall energy system might be only gradual. 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. This vision was actually 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, initiated by the latter. 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.

From a technological perspective, the viable 'clean solutions' of nuclear, wind, wave and solar are now all clear to many actors, but the timescales for action here are relevant. Building and commissioning nuclear power stations takes five to ten years and so, although China and others are now constructing a significant number, it is clear by just looking at which governments are yet to make this decision that any significant global shift to nuclear is a good way off – and now is also heavily challenged by the recent earthquake and nuclear accidents in Japan. In addition, although solar, wind and wave are all growing and receiving more investment, the

share of the world's energy needs that can be met from these sources by 2020 is at most 25%. Of course, the technological prospects are more open at the 2050 horizon, but in case of power generation and new 'green technologies' we should remember that there are tremendous uncertainties on the future exploitability of these technologies, resulting in the risk of large sunk costs without achieving satisfactory results. On the other hand potential benefits from successful inventions could be tremendous both economically and ecologically.

One of the much discussed, but yet to be realized, dreams of architects, engineers and progressive developers is the idea of the zero-waste, zero-energy building – one which, when in use, has zero net energy consumption and zero carbon emissions. As operation accounts for 85% of the total whole-life energy consumption of a building and buildings account for the majority of global CO_2 emissions, this would be an enormous step forward. If we need to reduce our energy consumption, this would mean a serious effort in terms of isolation of buildings and houses. A reduction of 80% of greenhouse gases in 2050-2060 would imply to rebuild the whole stock at more severe standards. Here again innovation in new technologies is key.

With the major technological advances taking place increased integration of control systems and, in some markets, regulation for the rollout of smart meter systems, all the ingredients for the high-tech option are falling into place. With several countries such as South Korea taking the lead, smart homes that control energy, ventilation, communication services and so on are starting to be built. A critical element in all this is the role of smart meters and grids. In the EU, smart meters are seen as pivotal to meeting the energy consumption targets that have been agreed for 2020. With their bidirectional communication capabilities, the smart meters installed in the new or retrofitted buildings will be the building stones of smart grids where energy is sent to, from and between different locations. With each building effectively acting as an active node in a grid, local energy production and storage can become far more efficient and consumption peaks and troughs can be smoothed. Taken in conjunction with more distributed sources of renewable energy supply as wind, solar and biomass, the smart grid and intelligent buildings can really make a difference in energy consumption and sustainable living.

Smart investment in global and local infrastructures

The nature of transport and energy infrastructure will change with the increasing use of smart technologies. For instance, 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 for new transport infrastructure building will decrease. Smart grids will reduce the need to build new centralized power plants. Local infrastructure upgrading (energy distribution grids, urban transport, other urban infrastructure) is another key issue, especially in developing countries. 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.[81] Geographical coverage of broadband as a major public infrastructure will acquire centrality[82]. However, if we consider the necessity to transform the global energy system towards low carbon sources, the investment needs become even bigger.

80 R. Miller, H. Shapiro and K.E Hilding-Hamann, *School's Over: Learning Spaces in Europe in 2020: An Imagining Exercise on the Future of Learning*: European Commission-JRC (2008), Editors: Y Punie, K. Ala-Mutka and C. Redecker.

81 OECD Infrastructures to 2030: Mapping policy for electricity, water and transport, Paris 2007.

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

The prevailing approach to finance infrastructure needs is to devolve to the business sector the provision of public services and infrastructures. But this is also generating great controversies. For example, the privatization of water, a more and more scarce resource, has implied an increase of the waste from 20 % to 30 % because of lack of investment in maintenance. This is also generating major opposition. An alternative option might be a growing demand for the socialization and nationalization of public goods, services and infrastructures.

Key enabling technologies

While technologies such as air travel and telecommunications transformed economies in the 20th century, growth is also now being driven increasingly by other key enabling technologies, such as eco, nano, bio and info-technologies. Alongside the latter info-technologies – and often convergent and integrated with those – there are nano-technologies and bio-technologies that will help Europe to address a number of societal challenges such as an ageing population, the effects of climate change, and reduced availability of resources.[83] These technologies may affect all areas of our lives, offering potential solutions in several fields, such as new treatments for life-threatening diseases, new solutions to improve the lives of elder people, ways to radically cut CO_2 emissions and other sources of pollution in particular in cities, alternative source of energy and substitutes for increasingly scarce raw materials, reducing and recycling waste and ending landfill, improvements in the quality of our water supply, smart transport with less congestion, healthy or high-quality food stuffs using sustainable production methods.

There is no reason to single out nano or biotechnology, and they are often discussed under the same label of 'converging technologies'. There are two different issues at stake here. At the one hand, there is the vision of an economy based on raw materials and energy generated from non-fossil fuels (white biotech, bio-refineries of 2nd generation). This is often termed Bioeconomy, and represents a very crucial trend, which will foster a transition towards sustainable resource flows/production and consumption patterns. On the other hand, there are several technologies, ranging from genetics via ambient intelligence and neuroactive substances to cognitive robotics, that are changing our perception of what it means to be human. This second aspect could be labeled human/technology boundary shifts, or 'transhumanism', and again is not only nor mainly technical, but rather a socio-technical issue. New developments in technology are dramatically redefining the way we see and conceptualise the human body, and even life itself. 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.

This is already raising a number of ethical problems and fears about the social impacts of such technology advancements. Clinical enhancement is the first manifestation of this phenomenon, and it has been boosted in recent years by the massive growth that has taken place in cosmetic surgery. The desire for the 'ultimate look' is being now replicated by a similar ambition for 'ultimate ability' as people seek to improve their physical and mental performance. In sport, the use of drugs to enhance performance is a long-standing problem that, despite all the bad publicity and shame that comes from being caught, is still a big issue in almost all disciplines. In the world of body-building the use of steroids to enhance muscle structure has long been widespread. In parallel there is also momentum building around drugs that can provide improved mental performance. New lifestyle drugs and the wider use of cogniceuticals are giving us the ability to manage the 'high and lows'. Not only can individuals control their emotions and senses with pharmaceutical products, but they can also get by with less sleep.

The increasing, largely still uncontrolled use of concentration or memory enhancing drugs among students is already raising new ethical, medical and societal questions. Education being presented and

used as one of the core instruments for social/class migration, access, affordability and side-effects of these drugs will be crucial for the evolution of social cohesion. Already by 2020, permanent rather than just a temporary change of capability from drugs, doping, implants or surgery will be available, and may contribute to increase the life expectancy of (at least the more wealthy) population. The world of the 'Bionic man' is not so far away.[84]

The impact of these technologies on healthcare is yet another relevant topic. Indeed, the 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.[85] 'Diabesity' and the Alzheimer disease are the most important fields of application. Indeed, diabetes is the world's most costly epidemic. Over the next ten years there will be an increasing number of technical solutions to help manage the condition but few expect this to counter its growth, particularly the escalation of type 2 diabetes, which is mostly caused by a high-calories diet and sedentary lifestyle. Globally, by 2025, it is expected that the direct costs of diabetes to society will € 300 billion, nearly double today's figure. Add on the indirect costs and estimates for the 2020 burden are in the order of € 500 billion.[86] Potential technological breakthroughs, such as drugs that aid weight loss and inoculations for type I diabetics, have already yielded positive results in animals but it will be four to five years before clinical trials are complete and humans can start to benefit. As it concerns the Alzheimer's disease, today, worldwide, 35 million people have this disease and, as the ageing demographic shift has greater impact, this is projected to rise to 115 million by 2050.[87]

While finding a cure for Alzheimer's is still a highly uncertain prospect, a capability of stopping degradation is highly probable. In fact, over the past few years, there have been some major developments which give hope. Key to many of these is the use of adult stem cells as a base for developing new healthy brain cells.

Another issue is automated people-care. Over the next decade, many predict this form of healthcare, where assistance is provided either remotely or by technology-enabled products within the home, will be a major focus of attention for many different sectors. Beyond pure healthcare providers, automated people-care has become an increasingly attractive arena for telecoms companies, software developers and IT hardware manufacturers. With continuing improvement in price/performance of electronic devices and the growing ubiquity of always-on fixed and wireless broadband communications, over the next decades we can expect to see strong demand for assisted-living services. However, public attitudes could result in some technologies 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 could also be mentioned as a health-related key issue. Still another issue is 'nutrigenomics' and the production of pharma foods. Interest is now rapidly expanding to foods with clinically enhanced properties. Probiotics, prebiotics, functional foods, clinical foods and

83 European Commission, 'Europe 2020 Flagship Initiative Innovation Union', COM(2010)546.

84 Future Agenda, The World in 2020.

85 OECD (2009) The Bioeconomy to 2030: Designing a Policy Agenda, Paris. 'Agricultural and health biotechnologies: Building blocks of the bioeconomy', OECD Journal: General Papers, Volume 2009/3, OECD, Paris.

86 Future Agenda, The World in 2020.

87 Future Agenda, The World in 2020.

nutraceuticals are all talked about and promoted as being 'good for you' either in general of by specifically targeting a bodily function, such as improving digestion, bone density and so on. As technology evolves and more is understood about how to tailor food and drugs combinations to better fit individual needs, the opportunities for tailored foods that use improved genetic profiling are burgeoning. By 2020, many in the pharmaceuticals and food industries predict biotechnical advances to combine foods grown in the field ('pharma foods') and drugs developed in the lab.

2.3.4
Geopolitics and governance

Towards the European Political Union

In the global strategic architecture for 2040, the most important breakthrough could be a further step of European integration, creating a powerful political union, not only in the economic and monetary dimension, but also in the political and defense dimensions. A real European Political union may be created, based on a new EU constitutional treaty which introduces reinforced versions of the present institutions. Such a European federal pole of power may be created first by a smaller – a core – group of countries than the present number of EU members in reaction to a serious EU crisis (see the 'EU Under threat' scenario above). This new power may follow indeed a EU disaster: it will emerge as an answer to a global, systemic and multidimensional crisis of the EU, one likely to destroy the existence of the EU itself. Speaking and acting in the global arena with one voice, one policy, one objective, the new EU will become one of the most important actors on the world scene, alongside the US and China. It will create again one market, one economy, one currency, one taxation system: acting as a political union with EU citizenship, one foreign and defense policy and, possibly, with one army.

Global security

Global security is achieved by enforcing human rights and rule of law, and enabling sustainable development and cohesion across the whole European territory. Traditional security issues outside European boundaries are tackled thanks to a better integration with larger geo-political areas (Latin America, Middle and Far East Asia, African States, etc.), with an increased international regulation and mutual acknowledgement of risks and security problems. Fears of the 'clash among civilizations' are escaped. On the contrary, Europe is able to show that in a substantial part of the world a different concept of security is possible. An alternative may emerge also in the sense of putting under control weapons through multilateral and international agreements. Nuclear proliferation will probably show that the West and its allies cannot impose a nuclear treaty to other countries. It is likely that severe confrontation with the nuclear programs of developing countries (e.g. Iran and others) will force to adopt a system of collective security. The proliferation of modern weapons' technologies in turn is likely to create greater demands for multilateralism in the control of force, combined disarmament by major powers and also the control on traditional weapons. International treaties such as the one for the ban of anti-person land mines are going to proliferate. The federal institutions ensure peace within the enlarged Europe, and military is used as last resort solution on the international arena.

EU leadership on the global stage

The new EU will be able to speak with one voice, but many votes, in all international forums, and to promote multilateralism by means of the support given to international agreements on key global issues (climate change, water, public health, global security and fight against crime, combating poverty). It will continue the enlargement process (or restart in the hypothesis of an EU crisis and Renaissance, reinitiating again from a narrower number of core members) including countries beyond the 27 members achieved in 2004, geographical widening the EU boundaries to neighbors, east and south. An (almost wishful thinking?) scenario will see growing peace, security, prosperity for an ever growing number of states and peoples, even beyond the borders of the European continent (including Ukraine, Belarus, Moldova, the Southern Caucasus – Georgia, Azerbaijan and Armenia – and the Mediterranean), with a strong European Union featured by a mix of 'hard' (federal) and 'soft' (multi-governance coordination) – so 'smart' – powers, and adequate structures of cooperation with third countries. The new EU will continue to promote cooperation and partnership with other regions of the world, and its influence will materialize in particular with the building up of a new 'Mediterranean Alliance' (see box below).

The Mediterranean Alliance Vision

The idea of 'Mediterranean Alliance' was presented by Andrea Amato of IMED – Mediterranean Institute – Rome at the Conference *Euromed-2030, Long-term challenges for the Mediterranean Region*, on 16 December 2010 in Brussels. This is a vision whereby in 2050 we will see the whole European countries, including also Turkey and Russia, to form one European Union and the whole Arab countries, including Southern Mediterranean countries and other Middle-East countries, to form one Pan-Arab League. The two regional realities will achieve both a strong cohesion and convergence within themselves – in particular with the Member States of each region adopting federal institutions to govern their common security, economic and social interests – and good cooperation between themselves, establishing a Mediterranean Alliance Treaty which will cover a number of key common issues: peace and security, co-development, shared citizens' rights, intercultural dialogue. As a result, strong complementarity and convergence will be achieved first in each region, with increasing trade, investment, migratory and energy flows between the countries within the two regions' boundaries (respectively North-East and South-South integration). However, also the flows across the Mediterranean and the convergence between North and South-shore countries will increase. The Mediterranean Alliance will enable forms of co-development of the two regions in common areas of interest, mostly by means of common 'win-win' projects to share the use of resources, technology, knowledge and multilateral agreements to achieve shared sustainable development objectives. The current tensions and conflicts in the Euro-Mediterranean area will be solved, including in particular the Israeli-Palestine conflict. Israel will establish cooperation agreements both with the countries of the Pan-Arab League – and in particular its neighborhoods – and with the European Union, and will adhere to the Mediterranean Alliance Treaty.

This vision considers the Mediterranean as a meeting place, a commonly shared *patrie méditerranéenne*, where different cultures and models of society mix and mingle to enrich each other. The historical precedent for this version of an open and cosmopolitan Mediterranean region is that of Al-Andalus and its impact on the European Renaissance through philosophers such as Averroes (Ibn Rushd) and Avicenna (Ibn Sina). The modern day equivalent of this vision of the Mediterranean is the idea of an open and shared regionalism that balances the interests and traditions of North and South and allows for common ownership and a more consensual project of region-building – i.e. a form of consensual regionalism.

This approach is currently underpinning the most recent development of the Barcelona Process, with the launch in the summer of 2008 of the Union for the Mediterranean (UfM) which is conceived as a 'Union of Projects', aiming to concretely enforce the linkages across the Mediterranean by means of six priority projects: the de-pollution of the Mediterranean; maritime and land highways; civil protection; alternative energies and the Mediterranean Solar Plan; higher education and research; supporting (small) business. Rather than being an EU-centered process that is driven and administered by the European Commission and shaped by its unique view of international affairs, once it is up and running, the UfM will be a co-managed scheme with a much narrower focus on specific development projects. However, after more than two years since its launch, many challenges and questions remain open concerning the shape, content and future efficacy of this new institution. As the key weakness of the UfM cooperation is its intergovernmental nature in the context of a poorly homogeneous membership, the vision of a greater European and Pan-Arab integration on the two shores of the Mediterranean will help to overcome many of the current obstacles, by enabling cooperation schemes and projects directly supported by strengthened regional institutions on both sides.

The EU will increasingly become therefore a world actor/model/leader on the global stage, increasing the power of Europe in defining global rules and being actively engaged in dealing with global challenges. EU will be characterised in this scenario by the role it plays in shaping its environment rather than by its economic borders, by continuing and further strengthening the open flows of products and capital, by defining the global rules governing these flows, and by actively promoting development and stability in its neighbourhoods. A balance is also envisaged for EU enlargement so as to avoid continual distraction of enlarging the Union and potentially weakening its ability to be a valid global partner. Another aspect of an increasing EU role in the world is also based on the argument that EU's institutional architecture can be a model for new forms of governance for many developing states. ASEAN, MERCOSUR, African Union try to follow the successful path of EU. These regional unions could compensate for any deficit of global governance architecture.

Filling the governance gap: global democratization and citizens empowerment

The governance gap – a feature initially shared with the other two scenarios – will increase in the EU Renaissance scenario the pressure to create a form of global governance that will be accountable, transparent, bounded by shared rules and ultimately democratic.

Already today, it is increasingly acknowledged that global challenges cannot be addressed by governments, corporations, NGOs, universities and intergovernmental bodies acting alone. Trans-institutional decision-making has to be developed.[88] A growing array of NGOs is beginning to participate in global governance. New systems of global decision-making are emerging that go beyond cooperation between states to a much messier agglomeration of ad hoc mechanisms for solving transnational problems. The private sector and the amorphous third sector of NGOs under the heading 'civil society' are becoming key figures in transnational governance. The role of non-governmental organisations will continue to increase. Regional organisations could be also complementary to global frameworks and/or partially compensate for their decline. Regionalism is a growing phenomenon, with bodies like the African Union, ECOWAS and ASEAN expanding their remit beyond the economic sphere to security matters. Interregionalism will gain further ground in the future, with the EU supporting regional partners.

As it concerns the democratization of global governance, by 2015 the United States, China, Russia and other reluctant powers will join the International Criminal Court. By 2020 there will be a reform of the International Court of Justice to make its jurisdiction compulsory. By 2025 the United Nations will have a World Parliamentary Assembly based on universal suffrage. As it concerns the democratization within nations, the more Asian countries will become rich, the more their citizens will insist on political rights and participation to their own government. According to some theorists, there is no country after 1945 that has not been democratic when the average GDP per head was more than 6 000 US dollars. On the ground of this figure, trends in economic growth can be associated to trends in democratization.

All this will contribute to democratization of power across the world. The number of countries run according to democratic rules has substantially increased over the last twenty years. Although recently there has been a halt to this favourable trend, and democracy is in retreat since 2008, it is likely in this scenario that the number of democracies will return to increase in the next decades. It is very likely that by 2040 all countries of the world will have a form of democratic government according to the standards of democracy accepted in 2010. However, already in the latest years it has emerged that

88 Millennium Project, (2007b) 'Global Challenges Facing Humanity. Capacity to Decide. How can the capacity to decide be improved as the nature of work and institutions change?', (http://www.millennium-project.otg/millennium/Global_Challenges/chall-09.html, last visited November 2007).

many countries have adopted democracy as their political system as a way to please or to be accepted by the Western (powerful and rich) community. Although there are serious differences among Western countries in the way in which democratization is promoted, serious re-thinking of democracy is needed in order to make it appealing to other civilizations. By 2030 all countries of the word could be democratic but the meaning of democracy may be different and different forms – with more impetus on good governance – may emerge.

An important trend supporting democratization is better information for citizens: in 2004 90% of the OECD countries enshrined information rights for citizens into law. An appreciation for people's concerns and the mediation of disputes by ombudsmen is also widespread in 2006 in 90% of the OECD countries. Also ICT related innovations are particularly important for driving this shift to empowerment. Different technologies support individuals in acquiring knowledge, organising themselves, to create, to produce and to deliver anytime and anywhere and thus: to be informed about government, to participate in public debates, to hold government accountable and to produce and deliver services that hitherto were collectively provided. Combinations of mature technologies with governmental roles are expected to lead to

Wild card: A democratic Middle East in 2040

During the last three decades, a wave of popular revolts in favor of democratic transition has deeply transformed the Maghreb and Machrek countries. Most of the dictatorships and authoritarian regimes have been replaced by more or less democratic systems. Some countries have gone through short but bloody and violent periods of civil war, but in 2040, reconciliation processes have been successfully experienced throughout the region. Only Saudi Arabia and Syria are still in a difficult phase of domestic turmoil and chaotic political transition. Human rights, gender equality, freedom of religion and political pluralism are the new political principles shaping the constitution of the countries. Economic reconstruction has led to a new form of regional integration, following more or less the European model of 1957: an Arab economic community (AEC), was set up and has become one of the most important partners of the EU. Turkey, which decided in 2027 not to join the EU, is a leading member of the AEC, together with Algeria, Egypt and Morocco. Economic development is spreading at such a pace that emigration flows towards the Northern part of the Mediterranean tend to become marginal. Iran has decided to stay apart from theses new regional groupings, but the new democratic Iran has become, after a bloody revolutionary phase, one of the most advanced countries in the region. Teheran welcomed the 2035 World Fair. Radical Islamic movements have been marginalized throughout the region, but the religious authorities of Shia and Sunni Islam are part of the national consensus everywhere. All the Arab countries have decided to recognize Israel, which in return has given back lands and accepted the creation of a new Palestinian state. The UN is the guarantee for the new Camp David II agreements: one of the most important clause of this Treaty is the fact that all countries have renounced any nuclear military ambition. A new structure has been set up to deal with possible tensions and conflicts: a Cooperation and Security Conference for the Middle East, where the EU and the UN are the only external actors to be included. The main security concern of all countries lies from water scarcity, which has become a regional collective challenge, and a strong incentive for regional cooperation. As oil and gaz reserves are diminishing throughout the world, at a time when all the region is also in great demand for energy consumption, a new international cooperation with the US and the EU was just set up to boost research and exploitation of renewable energy: the Middle East countries offer tremendous opportunities for the development of solar and wind energy technologies.

Wild card: China best case

After 50 years of reform and rapid economic growth, China has entered a new phase of its revolutionary modernization. Since the last decade, the country has become the first economic and commercial power of the XXIst century. Chinese attractiveness also apply to the scientific and technological world: Chinese universities are challenging the American ones in the competition for Nobel prices. Income per capita is roughly the same as in the USA. 100 millions of tourists visit the country every year. Google has been bought by a Chinese company. On the political side, the last Communist congress, in 2033, has decided to begin a new 'bond en avant' towards Chinese democracy. Free elections have been organized, giving power to a new class of political leaders throughout the country. Surprisingly, the transition has been peaceful, controlled, well organized. A new concept of 'centralized federalism' applies to the country, allowing a new and stabilizing combination between democracy and nationalism. Taiwan itself is part of the system. The rest of the world has been deeply transformed by this Chinese democratic Revolution. Economic growth seems assured for a long time. International cooperation, particularly in the United Nations, has replaced old rivalry. The United States are not anymore the leader of the western world: China has got a similar aura. Some in the 'West' wonder if this is finally a good thing...

transformation within the majority of EU Member States already within the coming 15 years.

Indeed, everything may evolve faster than one thinks. Governments will have to work round the clock (no 9-5 systems) to cope with globalization. Perhaps it is wishful thinking, but the next twenty years may be 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 favor 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.

The struggle to find a system of global governance will be influenced by the levels at which the decisions are prepared and taken, as different decision levels (regional, national, supranational) will result into different compromise spaces. The potential emergence of non-national, interest based, direct-democratic mechanisms to express opinions and convey influences would provide an additional type of compromise.

2.3.5 Territorial and mobility dynamics

A polycentric Europe

The urban-rural picture in Europe is partially different from the rest of the World. While the global mega-city is one extreme interpretation of a dense urban environment valid for Asia and elsewhere, others see that groups of midi-cities are in many ways a better solution, especially for some regions in Europe. A network of interlinked cities, with efficient transport systems operating between them can create a highly effective urban area without the challenge of growing in one place. Some commentators propose that the Netherlands, one of the most densely populated and interconnected parts of Europe, is fast becoming a network of mid-city.[89] Urbanization will continue also in Europe, but the trend is near a saturation point, and the European cities tend to be smaller and much less exposed to the danger of 'no go areas' or 'slum like zones'. Moreover, in some states – e.g. Finland or Poland – rural population is still quite large although in many cases live in urban-like style. Indeed, for many European regions, the differences between rural and urban life get blurred, partly due to the existence of infrastructures that makes the daily mobility (transport) or instant communication (Internet) between urban and (peri-urban) rural areas relatively easy. Another point in case is the recent trend towards the Renaissance of urban agriculture, which was typical in the pre-industrial cities (and revamped later, during the World War II, in the UK to solve food shortage problems).

Finally, one important aspect is connected to the ICT revolution and the extension that teleworking could take, and how this possible revolution could change our location of residence and work. Possibly as employment opportunities change, especially if work can be done without the need to commute daily, young people will move from peri-urban locations where the cost of housing and living is more affordable for young families as it would be in the core cities. At the same time, possibly the older generation will increasingly move out of cities into rural areas where the environment is cleaner and where life is slower.

Sustainable cities

In the positive scenario, future cities will succeed in becoming more sustainable, especially in Europe: ideally, they will produce more energy than they need, become net carbon absorbers, collect and process waste within city limits and collect and clean recycled water, thanks to the pervasive diffusion of clean urban technologies and processes in the different sectors. Eco-cities and eco-communities will develop to respond to oil shortage (resilient cities).

A primary focus for future cities – again especially in Europe – is to more quality open spaces – spaces that all can enjoy. Much more public space will free up for children. Why not pedestrianise 50 % of our streets as this would help to promote social interaction? Cities will be increasingly designed and adapted for people, not for cars. In terms of alternatives, many in Europe advocate walking and cycling and so, over the next decade, we can expect ever more dedicated cycle lanes within and around cities. However, the situation outside Europe looks different; in Delhi many of the pavements are in a dangerous condition, while in a number of US cities they are no-existent. Cycling might be an attractive option in places like Amsterdam, Bogotà and San Francisco, but, in temperatures of 40°C and high humidity, persuading people that it is a progressive option for transport can be an uphill struggle. What many agree upon is the role of an integrated public transport system that fits the purpose. By 2020, although globally we will clearly have more drivers in the world, the hope of the planners is that the overall miles travelled by car will be stable and that the increase in numbers will be offset by a reduction in distance.[90]

Smart and sustainable mobility

Concerning the future of mobility, this scenario recognizes that the mobility patterns of people and

goods are changing, as well as the mobility infrastructure and vehicle systems, due to the effects of climate change, more strict regimes and rules as regards CO_2 emissions, a growing scarcity of fuel, a growing scarcity of clean air and space for new mobility infrastructures (roads – especially in agglomerations in Emerging Markets). The changes are also enabled by tremendous progress in location-based services, information processing & satellite technology ('Galileo'). In these changes existing (logistics/transport and road) infrastructures are modified making way for changed forms of mobility in 2030 worldwide. Especially the fast developing markets will succeed in leapfrogging, thus establishing new mobility infrastructures and also pioneering, with their goods delivery and most importantly their users of mobility services, new patterns of mobility provision. As a recent study (ifmo 2010) summarizes, the most important changes will be in the individual mobility paradigm (the 'Mobilitätsleitbild'). This means that people will change their behavior and their attitudes towards existing forms of transport and traffic. Taking a broad look on probable scenarios, the mobility of goods and people will be more intermodal than today. Another important strand of developments in respect to mobility is that – based on more and more refined available location-sensitive data and new sensor technologies (RFIDs and follow-on technologies), and new forms of collaboration of providers of vehicle, mobility integration and mobility infrastructure technologies, new forms of tracking and new mobility services will gain ground. The 'intelligent highway' is a term used by many in the automotive industry and government bodies to describe a world where cars don't crash, congestion does not occur and there are no accidents; a world where cars automatically detect a problem ahead and avoid it through either slowing down or taking alternative routes. Intelligent highways, when they arrive, will significantly reduce the number of deaths on the road and make travel smoother and faster, which will also mean that we will use less energy for mobility.

Another important development is electric mobility. This is not new: in the late 19th century, many of the first cars to be produced were electric. Before the internal combustion engine took over, electric cars were making a mark, breaking the 100 km/h barrier in 1899. Now, a century after the electric car gave way to the internal combustion engine, the combined action of many governments, companies, NGOs, investors and entrepreneurs is bringing about a Renaissance that is on course to produce a significant shift in the way our mobility is powered. Only 1 % of the 50 million cars sold in 2009 were hybrids, the rest having petrol and diesel engines. By 2020, several predictions indicate that up to 20 % of the world's car fleet will by hybrids but 10 % will be electric powered. Electric car recharging networks are already being built in Denmark, Israel and, most significantly, France. According to *McKinsey Quarterly* of August 2009, 'a global electric car sector must start in China and the United States, and it must begin with the two countries creating an environment for automotive investors to scale their bets across both nations. Although private companies will compete to provide the technologies, charging stations and the vehicles, the two governments can no doubt create the conditions for them to succeed – for example, by setting standards, funding the rollout of infrastructure and sponsoring joint R&D initiatives.' The same source shows that if the penetration of electric vehicles rises above 45 % by 2030, oil imports and CO_2 emissions would fall dramatically.[91] However, in reality, the CO_2 reductions claimed could be less than those being delivered. In many countries, the switch from hydrocarbons to electrons for transport is a diversion because they will still be largely relying on oil, gas or coal (the latter is the case for China) to generate the electricity in the first place.

89 Future Agenda, The World in 2020.

90 Future Agenda, The World in 2020.

91 Future Agenda, The World in 2020.

2.3.6
Research, education and innovation

An integrated European Research Area

According to the European Commission Working Document accompanying the Europe 2020 Flagship Initiative Innovation Union 'research and innovation' are inter-related but independent concepts. Research involves the investment of resources in attempts to expand our scientific and technological knowledge base, often in order to solve particular problems that confront different sectors of society, but also to satisfy the demands of intellectual curiosity. Innovation, on the other hand, involves the creation of value via the introduction of new products, processes, services and ways of doing things. Innovation requires knowledge inputs drawn not only from the arena of scientific and technological research, but also from many other sources. All types of innovation can be expected to have a range of downstream socio-economic impacts, and there is now a solid body of evidence describing the relationship between research, innovation and economic development.

In the 'EU Renaissance' scenario the EU target of increasing the share of Research & Innovation volumes to 3% of GDP (1% of public R&I and 2% of private R&I) is achieved. Macro-economic model simulations suggest that this could have significant and positive impacts on GDP growth in all Member States over a 25-year period. More in detail, a recently completed simulation of the impact of increasing average R&D investment across the EU27 to 3% of GDP by 2020 suggested that GDP could increase by 3% and employment by 1.5% by 2020. The corresponding figures for 2025 are 5.4% for GDP and 2.5% for employment, leading to overall potential gains of € 795 billion in GDP and 3.7 million jobs.[92] Investment in 'intangible assets' that give rise to innovation (R&D, software, human capital and new organizational structures) now account for up to 12% of GDP in some EU countries and contributes as much to labor productivity growth as investment in tangible assets (e.g. machinery and equipment).

As for the previous scenarios, one important aspect to be considered is the role of public sector information (PSI) and how PSI policies and practices chosen by the EU countries may affect the dimension of research and innovation. Two other important aspects are R&I governance and institutions.

Public sector information

The government data is opened up for public use in all EU countries – subject to security, privacy and privilege limitations – and it is made easily accessible in the Internet. Public sector agencies may not have IPR such as copyright for the data they gather, manage and allocate. The public sector agencies encourage citizen participation by developing online systems gathering together also free and timely information concerning the work of government and politicians. Similar information is available concerning the functioning of European Commission and Parliament. The publicly available data is extensively utilized by research institutes, universities and firms. Socio-economic research strengthens its position in the EU and the European decision makers benefit from research enabled by the high-quality databases that have been made largely available for research purposes. Also researchers outside the EU utilize the European databases due to their accessibility and good quality providing further information that benefits decision making in the European Union countries. Firms combine data and information from various public sources and generate new products and services. As it concerns the impact on democratization and citizens empowerment, increased availability of information makes the work of governments more transparent and enhances democracy. Citizens can monitor the performance and actions of their representatives both in their own country and in the European Commission and Parliament via the web pages collecting timely data on the political decision making process. The reuse of public sector information increases by private sector parties as well. New firms emerge and new markets evolve. The European markets for digital content and services grow rapidly. Some

leading global firms in the markets based on the re-use of PSI are established in the EU area.

Research governance

National interests are tackled within national programmes focusing on specific strengths and weaknesses but taking into account the overall international strategies which are primarily devoted to tackling global problems like hunger, poverty, regional inequalities, energy shortages, etc. Trans-national interests are also tackled among interested countries based on the variable geometry principle. All countries however include the international dimension in their national research policies to facilitate participation in trans-national and international activities. Duplication of research and fragmentation across regions and countries exists in new areas where it contributes to fruitful competition. The EU plays an important role in research governance at international level but the role of MS has grown more in importance as they are the main players and funders of research activities both at the national and international levels. At the national level there is good collaboration between research and businesses as well as societal organisations. While businesses still do their major projects in house many public funded research results find their way to markets as the entrepreneurial activities of researchers are facilitated with significant incentives and societal organisations are actively taking part in the process. Societal challenges are largely tackled. Concepts like open innovation, user-centred innovation or open source products and services are largely applied.

Research institutions

The ERA has accelerated to more than what it aspired to be in 2015. It is fully realised and even more, there are uniform rules and regulations in setting research agendas taking into account societies concerns and interests with societal organisations fully engaged in research policy-making alongside the research community and businesses. The research capacity and activity of societal organisations has grown considerably as well as the role of research foundations. A lot of research is also done in the virtual world not requiring large amounts of money and also based on concepts like the peer production, the shared economy, etc. Users have become innovators to a large extent as the doing research in various areas is largely possible through DIY tools or the virtual world. The fifth freedom (free circulation of knowledge) is possible and alongside measures target a 'free circulation of power' (on line) social movements being able to change decisions by gathering signatures to protest or favour certain cases all over the world. Third world countries have managed to tackle corruption and are now conscious and competent to exploit their resources for the benefit of their people and the planet as well as exploit the innovations from advanced countries who have largely tackled the first wave of grand challenges in the 2010s. There are still institutions, legislations and rules which are MS specific but are harmonised thus enabling circulation of research, cross-border funding of research. International strategic research agendas are devoted to emerging global challenges (net waves) and are set at the supra-national level – with the EU playing a most significant role in the global research strategy arena.

92 A. Fougeyrollas, P. Haddad, B. Le Hir, P. Le Mouel and P. Zagamé. (2010), DEMETER Project – R&D effort during the crisis and beyond: Some insights provided by the NEMESIS model simulations, ERASME, 20 May 2010. Paper presented at the 'Europe 2020 Strategy – Innovation insights from EU research in socio-economic sciences' conference, Brussels, 1 June 2010.

3
Shaping the future: EU research and innovation policy

It is of course impossible to sketch out in a similarly detailed narrative and analytical coherent fashion the long term implications of the three scenarios described above for EU research and innovation policy. The Innovation Union Europe 2020 Flagship initiative took as reasonable forecasting period the end of this decade, the period covered by the current Framework Programme (as approved back in 2007 as part of the current financial perspectives), and the new Horizon 2020 programme covering the period of the next financial perspectives 2013-2020 which defines both the extent and priority given to EU research and innovation policies over the current decade. Beyond 2020, and despite the prevalence of many long term research and innovation challenges – as spelled out above in the previous sections – the nature of EU research and innovation policy will be first and foremost a reflection of political decisions. It is difficult in other words to provide here any long term story covering the next twenty to forty years based on trends or 'macro-certainties' which would in any way be comparable to those presented in the two previous Chapters.

The purpose of the present Chapter is hence different. It is to describe three, radically different 'caricatures' of EU research and innovation policies which appear to fit best the three alternative pathway scenarios described above. The underlying assumption is that research and innovation will remain also in the future essential components of policy making, not necessarily though of European policy making. We explicitly use the term 'caricatures', as also reflected in the subtitle we have added to each of the three scenarios, because in the real world policies, even those on European research and innovation, never have the simplicity, let alone clarity, of the ones described here. Nevertheless, the priorities and choices made in research and innovation policies, as discribed below reflect in a similar coherent fashion as the quantitative scenarios and qualitative narratives in the previous Chapters, each of the three future pathway scenarios.

In a similar vein, no attempt will be made to provide any insights on possible policy responses to the various 'wild cards' described in the previous Chapter. 'Wild cards', certainly when they refer to major future events, are 'wild' in the sense of their unpredictability in timing. Their impact on EU research and innovation policy can be best translated in highlighting the continuous need in Europe for serendipity in research: for carrying out research with no immediate application or outcome in mind. The diversity of 'wild cards' as described before, illustrates from this perspective the crucial need for continuous support not only of fundamental and/or basic research but also of research across the full spectrum of scientific disciplines, including humanities and social sciences. By contrast, with respect to innovation the wide diversity of 'wild cards' does not provide us with any such general policy recommendation. At most, one could argue that the level of democratic representation within Europe, both at

regional and national level, and at the European level with respect to global 'wild card' challenges might well provide the best guarantee for coming up with the best portfolio of appropriate policy responses and provide sufficient resilience in implementing the required policy response. Whether global institutions or global regulatory frameworks will have the capacity to respond in an appropriate way remains to be seen though and will ultimately depend on the specificities of the particular 'wild card'. The presence and renewal in European society of large numbers of NGOs might provide from this perspective, a continuous feeding ground for creative reflections on appropriate policy responses to 'wild cards'.

There is of course one 'wild card' which is in its immediate impact likely to affect European future growth and development directly for the years to come: i.e. the sovereign debt crisis in a number of eurozone countries. While the 'eurocrisis wild card' will probably have faded away in the mind of most Europeans by 2030, let alone by 2050, its immediate and medium-term impact on European growth and competitiveness might be such that it could well represent a turning point in European integration with either having pushed the EU27 in a scenario 'Europe Under threat' or alternatively in a scenario 'Renaissance Europe'. Below we describe two narratives of this sort.

In this sense the 'eurocrisis wild card' signals the emergence over the last couple of years of a more fundamental seizure in public policy opinion in Europe. A seizure along the lines of a vision of further European modernization and globalisation, European enlargement, environmental and climate change more or less imposed on European society which citizens are asked by European policy makers to accept because there is basically nothing they or anyone else can do about versus a growing vision in favour of preserving the national identity of nation (in some cases even region) states, the prerogatives of decision making at the national government level and the respect for national culture, family values and norms. This divide is fed by the immediacy and transparency in the feedback of public opinion to policy making through the Internet and in particular digital media and social networks. It is reflected in a search by policy makers for more immediate, popular support and recognition for sometimes highly specific policy proposals, as opposed to the old, sometimes more elitist tradition of policy makers sticking to an overall political strategic vision ready to be defended sometimes even against popular opinion. This process is of course not unique to Europe, but its interplay with the dynamics of European integration, the maturing of the organisation of democratic representation with the increasing complexity of intergovernmental and supranational interplay, make Europe much more vulnerable to this process. Depending on the outcome of this process, the narrative of EU Renaissance versus the narrative of Europe under threat will be more likely. The outcomes in terms of European research and innovation policy will be, as explained below, similarly striking.

3.1
Nobody cares...
but the European Commission

The main characteristic 'research and innovation policy' feature of this first, 'reference' or 'business as usual' scenario is the way European research and innovation policies ultimately remain by and large marginal both in the volume of research incentives provided compared to Member States national research and innovation policies and in their impact on European growth, productivity and competitiveness. Ultimately, national policy makers follow their own national priorities both in research and innovation policies. European research and innovation policies are considered as important but only in as far as they provide an important source of additional research funding for public research institutions and universities and for the own private sector.

In the case of research, the value added of European research programmes as opposed to national programmes, remains based on a minimalistic interpretation of subsidiarity[93] by MS. The future evaluations of FP7 and of the new Horizon 2020 programme point to the relative success of some specific European instruments such as the ERC, ESFRI and the EIT but a real *joint* programming of research policy between national (sometimes regional) and European policy makers remains, however, subject to continuous consultation and to put it in Stephan Kuhlmann's terms 'other forms of policy moderation' primarily because of problems of financial accountability and distrust. In political terms, European research policy remains 'subsidiary' – in the sense of 'dependent on' – national MS' research policies: only when problems (and their solutions) are of a cross-border nature, cooperation within Europe will be appropriate. The actual choice between the priority given to national vs European policies will be dependent on the priorities of national governments weighting their own national advantages in terms of reaping economies of scale as in the case of large research equipment (ESFRI), benefiting from risk sharing and/or addressing external effects against the perceived disadvantages in terms of lack of control, reduced possibilities to follow one's own course, less clear political responsibility, more bureaucracy and (for the richer MS) higher direct solidarity costs. While there is in other words, general acceptance that in fundamental research cross-border European collaboration and networking and the reaping of scale economies are important, preference is given to programmes outside of the direct control of Brussels such as EUREKA. Furthermore, there is strong awareness in MS, and in particular those with the highest scientific and research base, of the disadvantages of a further 'Europeanization' of fundamental research which goes beyond the usual complaints about EC bureaucracy. As policies for fundamental research would become overtly concentrated in Brussels, there is e.g. to quote the recent report of the Dutch Advisory Council on Science and Technology on Europe (2011) likely to be growing 'alienation of science and research policy within Dutch society, an attenuation of the concept of knowledge society, and a decline in the motivation of youngsters to become interested in science.[94]

In the case of innovation, the link is first and foremost made with the EU's internal market policies. The Innovation Union flagship initiative shifts the focus away from direct supply driven innovation support policies funded by the EU for large and to a much more limited extent 'small and medium sized enterprises' to demand side policies closely linked to the functioning of the internal market, including the assistance in the development of common standards, common procurement rules with special SBIR type of advantages to small firms and the maintenance of a competitive level playing field at the EU level. The central aim of European innovation policy is to create the appropriate conditions for MS' own national innovation policies. In this sense, the focus of European policy is in line with reaping now in the area of new innovative products, productivity gains and organisational reforms, the growth achievements of the past in terms of having

realized a Single Market in manufacturing production, an Economic and Monetary Union limited to the group of euro-zone countries and labour mobility within the framework of the Schengen agreement. However, and in line with past experiences, such extension of Single Market policies to some of the essential services, including national procurement policies, underlying innovation remains subject to opposition from individual Member States. The difference in size of individual MS and the sectoral specialisation in innovation between MS all hamper smooth implementation of such policies at the EU level, the costs and benefits of further harmonisation being too different between MS. As a result EU innovation policy, despite the Innovation Union flagship initiative, remains a slow and by and large ineffective process.

The narrative of this scenario as described in quantitative and qualitative terms previously as a scenario in which 'Nobody cares', can be best described here as one in which 'Nobody cares... but the European Commission'.

Under pressure of the European Commission, the policy debate in Europe continues in line with the original Lisbon strategy to be concerned with the major issues associated with internal challenges such as low productivity growth within the EU27 as compared to the US and the emerging countries; the rapid ageing of European population with severe consequences for Members States' public funding in terms of both health costs and pension support schemes; the EU's fossil fuel energy dependency and the difficulties in achieving reductions in CO_2 emissions; the growing foreign food dependency with a need for agricultural reforms within the EU; a continuous financial instability within euro-zone countries with the EC attempts at balancing cross-border savings and investment; and a structural trend towards growing income inequality between regions and European citizens access to work, income, pensions, welfare schemes. In most of those areas, research and innovation policies do have a central role to play. However, individual Member States depending on their own national priority setting, prefer to address those issues individually. The EC is considered a useful, if expensive 'think-thank' to raise those issues. Available EU funds are primarily used though by MS with the overt purpose of strengthening one's own, national research and innovation position.

As a result European innovation system advantages and capabilities fail to emerge, leaving the EU particularly with respect to research and innovation in an unfavourable competitive position compared to the US and the emerging countries.

The multi-annual European research framework policies continue over the next decades – from Horizon 2020 to Horizon 2030 and 2050 – as Member States are keen on continuing those programmes primarily from the perspective of getting as much out of them for themselves. The concept of 'competitive retour' rather than the old 'juste retour' concept becomes now popular in national research policy making. As a result there remain significant duplications amongst MS in research funding with growing competition between MS with the EC as arbiter. Research – industry cooperation is dominated by national and regional/local interests, as is publicly funded research. The ERA is further developed as the instrument for improving the free circulation of knowledge, but remains frustrated by MS specific legislations and rules hindering the circulation of researchers and limiting cross-border funding of research.

With respect to external, global policy challenges, the EC plays a more significant role. The latter role is primarily based on the legal articles (Article 187, 189)

93 Article 5, para 3 TFEU: under the principle of subsidiarity, in areas which do not fall within its exclusive competence, the Union shall act only if and insofar as the objectives of the proposed action cannot be sufficiently achieved by Member Sates, either at central level or at regional and local level, but can rather, by reason of scale or effects of the proposed action, be better achieved at Union level'.

94 In the words of the 2011 AWT report 'Scherp aan de Wind': 'Dat kan leiden tot verschraling van de kennissamenleving, een vervreemding van de ontwikkeling van de wetenschap en een afname van de motivatie van jongeren om zich te bekwamen in de wetenschap.'

of the Lisbon Treaty. However, in so far as those articles do not specify in which global and societal areas of research and innovation, prioritisation and organisation should be at the EU-level and which ones should be at national level, confusion and friction continues to dominate the societal, 'grand challenge' research agenda. Thus, next to EC initiatives with respect to global challenges in the areas of climate change and energy efficiency, MS are also actively involved through bilateral relationship with foreign privileged partners both in the OECD and emerging country world, in major societal research and innovation activities. As a result, the EC's role in research and innovation policy at the global level remains weak and fragmented.

Finally, in terms of international political developments, the EU is further gradually enlarged with a number of the Balkan countries. The research communities of those new MS are rapidly integrated within the rest of the EU. However, neither in volume, not in quality terms do they add much to the researchers stock in the rest of the EU which is suffering from ageing and rapid replacement. At the same time, Turkey with its significant human and intellectual capital potential has decided not to become a European Member State, but rather to become a new European-Middle-Eastern knowledge growth centre attracting researchers both from the Middle-East, Russia and Eastern Europe, including some of the 2nd generation immigrant population of Turkish origin from both the old and new EU27 MS.

To summarize the research and innovation policy 'caricature' of this 'business as usual' scenario:

- R&D policies remain primarily decided at national levels, the Barcelona targets are kept but something for MS to decide how and when to achieve (a soft criterion);
- FPs continue even though they are given a different name and are broadened to include innovation (CIP) such as Horizon 2020/2030/2050 with MS monitoring more intensively what they get out of them in terms of 'Competitive Retour';
- ERA continues to remain hampered by MS' specific regulations and rules on employment of researchers and immigration;
- Global societal challenges are designed and implemented at the EU level but with different MS giving priorities in different areas;
- Innovation Union flagship confronted with continuous individual MS oppositions
- In areas of 'national interest' and demands for particular exceptions;
- Innovation policy remains not very effective. The productivity gap with the US and emerging countries remains: a lot of overlap in policies between MS.

Overall: European research and innovation policies remain marginal, compared to national policies, resulting in significant policy overlaps.

3.2
EU Under threat... Jeder für sich; chacun pour soi; sálvese quien pueda; ognuno per sé; każdy sobie; fiecare om pentru el însuși; ieder voor zich; varje man för sig själv; всеки сам за себе си; každý za sebe; hver mand for sig selv; jokaisen ihmisen itselleen; ο καθένας για τον εαυτό του; a cada um por si[95]

The second 'EU Under threat' scenario represents the return to national policy making in research and innovation policy.

It is actually not too difficult to imagine today a future scenario whereby research and innovation policy making is fully reclaimed by national policy makers. The one narrative, we describe here, appears today even more realistic than it might have been ten years ago. It starts from the way the trust basis between the EU's Member States is becoming gradually eroded as the euro-crisis unfolds and is putting growing pressures on national MS to blame Europe for the failure of national growth and productivity convergence. While at first sight a lot of emphasis seems to be put under the 'EU Under threat' scenario presented here on a rather short term event – the euro-crisis – it is illustrative of the overall long term trend towards a return to the prerogative of national (and in some cases even regional) policy making. This trend is visible today both in the knowledge intensive MS which appear to have successfully emerged out of the financial crisis – we will refer to those countries as 'Northern European' countries which includes EU MS which have remained outside of the euro-zone such as Sweden, Denmark, the United Kingdom and the core European euro-zone countries such as Germany, The Netherlands, Austria, Finland, France, Belgium, Luxemburg – and the Southern European countries which are today confronted with severe fiscal budgetary cuts as illustrated in the cases of Greece, Portugal, Ireland, Spain and Italy.

Underlying this return to a belief in national policy making is a growing disillusionment with the achievements of the EU for European citizens. The latter are not just unequally distributed between sectors (export as opposed to import competing sectors), countries and regions (centrally versus peripherally located) and skilled versus unskilled, but appear also 'out-of-control': imposed by external policy makers (Brussels, IMF, ECB, WTO, etc.) which national policy makers can also easily blame. In the 'EU Under threat' scenario, it is ultimately the distance between the European citizen and the European policy maker which leads to fragmentation and to the subtitle of this scenario's narrative: everyone for him/herself in the different national languages of each of the experts. At the political level, Europe increasingly suffers from the fact that administrative election borders are national (or regional), even in the case of European elections. There is effectively no possibility for politicians to acquire European votes beyond the votes of their own national or regional circumscription. As a result, defending broader European as opposed to national interests in political campaigns becomes gradually eroded. As a result the advantages of European integration while scientifically well established become politically, and in the popular media, more or less invisible. By contrast, the disadvantages, the contradictions with MS' or region's own national or regional policy making preferences become increasingly visible and questioned in national public opinion debates.

The euro-zone crisis translates ultimately into a crisis of distrust. On the part of the Northern MS there is no longer the readiness to allocate substantial European funds to cohesion and structural change policies; on the part of the Southern MS there is no longer readiness to participate in common European research and innovation policies which only lead to substantial brain drains. By common agreement, a new consensus is developed amongst MS:

95 'Everyone for himself' in the different national languages of the experts.

bring back the purpose of the European Union to its essence: a free trade zone leaving each Member State responsible for its own structural policies, including policies aimed at research and innovation.

As a result research and innovation policy becomes again a primarily national prerogative, even more so than in the 2010s. The euro crisis has in any case already led to a highly differentiated set of responses of MS: some investing in reaction to the crisis more in a further strengthening of their national research and innovation system at the cost of cutting other depenses; others having little option but to reduce also the public funding of research and innovation by lack of fiscal room of manoeuvre. As a result Member States' growth rates in the underlying structural 'total factor productivity' continues to diverge even further with the strongest scientific and technological clusters across the EU becoming further concentrated in the richer Northern EU Member States who have also the means to further strengthen their domestic publicly funded research infrastructure and support local firms' innovation strategies. Furthermore, between those richer MS, the national R&D policy focus leads to growing intra-European competition in private R&D tax schemes with ultimately no overall positive EU effect but rather beggar-thy-neighbour shifts in the R&D location of large European and foreign MNCs' research labs as a result of the widening differences in firms' R&D personnel costs. As a result, overall privately funded business R&D in Europe lags increasingly further behind the US and now also behind Korea and China, who have become the second research and innovation place in the world. Europe's limited attractiveness to foreign R&D is a reflection of its fragmented research and innovation market and the growing global opportunities for private R&D investment, also for firms of European origin. Compared to other regions in the world, the fragmentation of European national markets increases significantly the uncertainty on the expected rate of return to R&D investments.

The Framework Programmes, including the latest Horizon 2020 version, are discontinued for a number of reasons:

- Too bureaucratic given the growing need for control and accountability on European funds;
- Too costly with low rates of return to European research and innovation support;
- Providing too little additionality compared to MS' national research and innovation programmes;
- Too large and complex to manage with too many European partners from countries, institutes, universities who are included purely for strategic reasons; and finally
- Too narrowly European in focus.

In addition, there is growing distrust amongst the population at large in the contribution scientists and engineers can make in solving real, major societal challenges European society is increasingly confronted with such as food insecurity, the regular outbreak of pandemics, the continuous re-assessment of environmental hazards, the failure to come up with new antibiotic drugs capable of addressing new resistant bacteria, the lack of predictability of natural and man-made disasters, etc. Blaming other countries' scientists and engineers becomes something of a national sport in the media. Trust in MS own national science and research institutions by contrast forms an important leverage factor for the national public funding of research and innovation.

The ERA concept has not further been implemented because ultimately 'the costs of Europe' appeared too high to some of the weakest European Member States and the 'the costs of non-Europe' too low to the richer and larger MS. In general the 'costs of non-Europe' in research are too low compared to the potential advantages of brain drain from developing countries, in particular from some of the old colonies to the more advanced European countries.

Old notions such as the Commonwealth or l'Alliance Française become the new forms of international research collaboration bringing together scientists and engineers with similar cultural and language backgrounds and more in line with the national histories of different European countries. The integration of highly skilled immigrants and knowledge workers from old colonies has actually a much longer tradition than the European integration one.

The 'grand' societal challenges are reinterpreted within each Member States own national priority setting, leading to substantial duplication of publicly funded research. Trans-national European research agendas exist primarily with respect to common cross-border issues: water basins, nuclear safety, trans-border infrastructures in electricity, road and rail transport, local environmental issues, etc. Global issues are dealt with in international fora such as the G-20 where the large European countries are fighting each for themselves for the maintenance of their position. The small European Member States on the other hand attempt forming alliances between them based on close neighbourhood and old historical linkages. In areas such as climate change they attempt to form global alliances with other small countries world-wide, considered just like them as the 'victims' of the (lack of) policies of the dominant world players.

It is interesting to observe that the narrative of this 'EU Under threat' scenario has many features which sound increasingly realistic: features which appear less of a caricature:

- A North-South trust divide following the financial euro-zone crisis leads to fragmentation of the EU as we know it today:
  - Northern Europe is no longer ready to allow for the transfer of structural and cohesion funds to the South;
  - Southern Europe is no longer interested in participating in European research and innovation policies which leads systematically to a brain drain of scientists and engineers to the North;
  - The EU moves back to its 'free trade zone' essence. The goal of a Single Market going beyond the trading of goods and traditionally traded services is abandoned. The EU is no longer involved in any kind of structural change or research and innovation policies;
- There is increasing intra-European competition in national research and innovation policy, the Barcelona targets are left to individual MS to aim or not to aim for. The EU has abandonned any overall R&D target;
- The FPs and the structural funds are discontinued as is the notion of an ERA because the 'costs of Europe' are too high to the weakest MS and the 'costs of non-Europe' too low to the richer MS;
- New non-ERAs emerge in some MS based on old priviliged colonial and/or historical links with other non-European countries;
- The harmonization and standardisation features of the Innovation Union flagship are integrated within the Single Market principles of DG Internal Market; the innovation policy aspects are brought back to MS's own interests;
- Innovation policy is now part of MS' national and/or regional competitiveness policy;
- Global issues are dealt with primarily in international organisations with the large MS trying to keep their positions and small MS uniting.

Overall: Research and innovation policies at the EU level have been discontinued. MS claim full responsibility over their own national research and innovation policies which are primarily based on national competitiveness concerns. The EU does not realize any of its scale advantages in research and innovation.

3.3
An EU Renaissance... from European romanticism to European 'Realpolitik'

The third scenario starts from a similar, but ultimately opposite narrative. The future trend is now towards further political and economic integration as a result of the financial euro-zone crisis. At the political level, there is gradual recognition that the financial crisis can only be solved through stronger European as opposed to national political representation and control. This holds both for the political left and political right and for Euro-sceptics and pro-European parties. It is, in other words, not based on any future romantic vision of a European identity, rather it is the outcome of the political realisation both with policy makers and public opinion that economic integration, and in particular the economic and monetary union with the formal introduction of the euro back in 2002, cannot survive without a increased political integration. The huge financial investments in each others economies, both between euro-zone MS and with other MS, leads to the political realisation even within the most euro sceptic MS that close mutual control of each others' fiscal policies, of the functioning of MS' internal labour markets, of the sustainability of MS' social welfare systems including their pension schemes, etc., is in one's own direct interest. What was politically unthinkable in the EU, appears now economically the only way forward: more political coordination leading to some form of European political union via the backdoor of monetary integration: in short further European integration not out of love but out of need.

The external pressures, and in particular the regular complaints from the US, China, India, Brazil, South Africa and some of the other emerging countries about the EU having to get its act together and talk with one voice, further reinforce this trend. Slowly, public opinion and policy makers start to realize that a number of political integration steps are needed for the EU to fully benefit from its integrated 'union' status. In the meantime, the EC provides the underlying technocratic support for such reforms which also fully benefit from the wide variety of institutions within the different MS. The ECB is often used as the example of a centralized European institution created with the full support of the national bank institutions who each kept their specific national role, but other more decentralized institutional reforms are also explored, e.g. in the area of statistical evidence where Eurostat is transformed into a decentralized organisation exploiting at the EU level each MS' comparative advantage in one particular national statistical area. The result is a pragmatic approach to EU reform whereby subsidiarity and additionality are the key concepts in providing legitimacy to newly created European, decentralized institutions with locations in different MS. The best performing MS' public services take the lead in a new phase of economic integration in the EU: that of public services[96]. As a result the performance of the public sector receives a dramatic boost in efficacy and efficiency. Tax revenues increase substantially in some of the Southern MS as tax evasion and large parts of the over-sized black market economy in some MS become integrated into the formal national economy. As a result there is a significant impact on TFP growth for the EU as a whole, as the private sector also benefits from a more efficient public sector. At the same time, mutual trust in MS' national public sector capabilities, culture and ethics receives a boost. European diversity has again a positive connotation across the EU. The EU becomes internationally the place to be.

It is within this new, rational 'European Renaissance' context, that one rediscovers some of the old, early ideas of the building of a European Community on the basis amongst others of a Common Research Policy[97]. In line with the plan for a Public Services Single Market[98], the national Research Councils in each MS are transformed in subsidiaries of the

European Research Council. Joint research programmes become effectively the only way forward for most research support policies, involving both public and private actors. National public research organisations with leading national technical universities and the most research intensive private firms form the building blocks for a truly European Institute of Technology and Innovation EIT, and for a whole set of other new European research institutions such as the European Institutes of Health with leading academic institutions and hospitals, the European Energy Agency incorporating the SET plan, the European Environmental Agency. Individual MS commit themselves to coordinate their national research policies both in volume (3 %) and in the sort of R&D support oriented towards sectors with the most significant externalities such as EFRI. At the same time, social sciences and humanities research become more closely involved in bridging the gap between the citizen and society's problems.

At the same time, innovation policies are carried out in close collaboration with regions: no longer on the basis of the EC as distribution agency, but on basis of two central policy concerns:

- The extent to which support policies are successful in leveraging private funds so as to enhance European knowledge externalities (the effective creation of European technological hotspots);
- The extent to which the peripheral/locational position of the region has resulted in much lower European integration advantages than would be the case for more centrally located regions. The innovation support aims here at the development of local knowledge externalities and entrepreneurship enhancing European growth diversity (technological diversification)[99].

The result is an enhanced impact of various general purpose technologies (not just ICT, but also biotechnology, life sciences, nanotechnologies, renewables and other green technologies and eco-innovations) on European TFP growth. Macro-economic model simulations suggest that combined, this will have a significant positive impact on GDP growth in all Member States over the next 20 to 40 years. The simulation of the impact of increasing average R&D investment across the EU27 to 3 % of GDP by 2020, using the NEMESIS and GEM-E3 models, suggest e.g. that GDP will have increased by 3 % by 2020 and employment by 1.5 %. The corresponding figures for 2025 are 5.4 % for GDP and 2.5 % for employment, leading to overall potential gains of some € 795 billion in GDP and 3.7 million jobs.[100]

Two more aspects described in more detail in the previous Chapter under the 'EU Renaissance' scenario are worthwhile repeating here.

First, the particular role of public sector information (PSI). Government data is opened up for public use in all EU countries and is made easily accessible in the Internet. The public sector agencies encourage citizen participation by developing online systems gathering together also free information concerning the work of government,

96 The idea here is one of 'smart' public service specialisation with each MS becoming specialized on the basis of its own, national best-practice performance in the organisation and delivery of a particular public service delivery at European level (e.g. internal revenue service, customs union, welfare services, etc.). It does so by becoming responsible for the services in the 26 other countries.

97 See in particular P. Tindemans et al. (2007), European Institute of Technology, a UNU-MERIT study for the European Parliament.

98 The basic principles of this Public Services Single Market follow the idea of smart public service specialisation while recognizing at the same time the differences in tastes and cultures amongst European MS and regions. Thus, there were public services do not involve co-location service provision needs, European single market advantages can be fully exploited and productivity gains will be leading. In case co-location provision is essential for the quality of the public service, the focus will be on comparative learning across European nations/regions in public service innovation and improving the quality of public service.

99 Ph. McCann and R. Ortega-Argiles (2011). 'Smart Specialisation, Regional Growth and Applications to EU Cohesion Policy', Economic Geography Working Paper 2011: Faculty of Spatial Sciences, University of Groningen.

100 Fougeyrollas, A., Haddad, P., Le Hir, B., Le Mouel and Zagamé, P. (2010), DEMETER Project – R&D effort during the crisis and beyond: Some insights provided by the NEMESIS model simulations, ERASME, 20 May 2010. Paper presented at the 'Europe 2020 Strategy – Innovation insights from EU research in socio-economic sciences' conference, Brussels, 1 June 2010.

national, regional and European and politicians. The publicly available data is extensively utilized by research institutes, universities, firms and many societal actors, including social networks. As highlighted above the fact that social sciences and humanities are more actively involved in socio-economic research, helps European as well as national policy makers to benefit more from evidence and problem based research using the high-quality databases that have been made available for research purposes. Also researchers outside the EU utilize the European databases due to their accessibility and quality providing further information that also benefits decision making in the European Union countries. Firms combine data and information from various public sources and generate new products and services corresponding to both new consumer and broader societal needs including sustainability. At the same time, the increased availability of reliable and transparent information counters tendencies both with policy makers and opinion makers of 'confirmation bias' while making the work of governments more transparent, empowering citizens and enhancing democracy. Citizens can now monitor the performance and actions of their representatives both in their own country and in the European Commission and Parliament via the web pages collecting timely data on the political decision making process. The re-use of public sector information increases by private sector parties as well. New firms emerge and new markets evolve. The European markets for digital content and services grow rapidly. Some leading global firms in the markets based on the re-use of PSI are established in the EU area.

Second and with respect to the ERA, the latter has accelerated to more than what it aspired to be in 2015. It has become the acronym for European Research (and innovation) Access. There are now uniform rules and regulations in setting research agendas across Europe taking into account the national, regional and local variety of citizens' concerns as well as the multitude of actors' interests from science and technology organisations fully engaged in research policy-making to business, finance and societal organisations, including NGOs and social entrepreneurs. Europe's research capacity and activity of societal organisations has grown considerably as has the role of universities, new young entrepreneurs (yollies) and NGOs. At the same time a lot of research is also done in the virtual world not requiring large amounts of money but based on concepts like peer production, shared economy, etc. Users across the world have become a source of innovation[101]: sometimes radical, sometimes frugal, sometimes narrowly niche based, sometimes widely and globally applicable. The open innovation paradigm leads to a multitude of applications being developed for a few world wide platforms. The fifth freedom (free circulation of knowledge) is accompanied by a 'free circulation of on-line power': social networks and movements are able to change decisions by gathering signatures to protest or favour certain cases, products, processes, applications across the world. As population size takes on a new meaning going beyond markets but including now also user feedback, sources of new ideas, of communication, of common interests, the emerging large developing countries become a more important source both for research and innovation. Europe's new ERA becomes effectively the attractor place for scientists, researchers and engineers worldwide less in a physical than intellectual sense. The result is that research and innovation become again not just Europe, but the world's future hope for long term development and welfare. As a result Europe plays a central role in the international strategic research agendas devoted to emerging global challenges.

Overall: in many ways ideal as presented here, the similarly realistic third European Renaissance scenario combines a number of structural reforms in European and national MS research and innovation policy which combined with a broader desire for political integration leads to strong economic and welfare benefits to the EU and the rest of the world. We would list the following main features as characteristic of this scenario:

- 'Smart growth' is now realized across the EU both across countries and regions and across

sectors, including the public service delivery sectors with at a result a significant impact on TFP growth and the perceived quality of public services across European MS and regions;
- Increased investment in R&D and innovation in MS both by the public and private sector and by the EC in a harmonious fashion so that many synergies are realized in terms of joint research efforts;
- The creation of a number of European institutions alongside a truly European EIT, organized in different ways pulling together national public research organisations, universities and private firms reaping now fully the advantages of the large European market;
- Sustainable growth as a central priority in the new FPs such as Horizon 2020/2030/2050 and in large parts of the structural funds (SET plan, NER300, renewables, energy efficiency, etc.) in close cooperation with the private sector;
- Inclusive growth is enhanced through social innovation, including ageing which have become new comparative strengths of Europe, opening up new areas to creativity and private investment;
- A new Treaty is proposed to formalize the further integration process;
- Scale advantages at EU level in research and innovation are now reached with a.o.:
  - a European harmonized patent of high quality;
  - European procurement with a successful SBIR scheme leading to a spurt of European 'yollies' (R&D intensive young innovators) growth;
  - the standardisation of some key applied products following the successful example of GSM of last Century, now in electric cars, biofood, etc.;
- Financial alignment between private and public funding for research using the large amounts of private savings in some MS with a competitive venture capital market, booming blue angels sector, innovative social funding systems, etc.;
- Savings and investments within the EU are becoming more balanced and the EMU is now illustrating its strong macro stability advantages in limiting debt variance between MS;
- Europe becomes attractive to 'skilled' migrants: local 'skill shortages' become the most significant illustration of new smart region's attractor poles;
- Multi-culture and multilinguism are the new assets of Europe's education system (a new European university statute is introduced) and local design schools (product diversity);
- Concerns over growing inequality within MS bring to the forefront a new debate on equity and inequality, including the way it affects immigrants. Special policies are developed to enhance educational integration of immigrants' children.

At the same time, the European Innovation Union has been redesigned to play a much more significant role in the global world setting. Its most important features can be summarized as follows:

- Global societal challenges are identified and research coordinated in collaboration with the G-20 but with the EU as pilot;
- Specific European societal challenges: healthy ageing, local energy independence (smart energy mix), green cities, sustainable transport are discussed at EU27 level but so as to be open to global research interests;
- Open access characterizes European research which develops a new ERA: European Research Access;
- The EU27 becomes attractive to foreign scientists and entrepreneurial innovators from all over the world because of the open European values and lifestyle (democratic, multi-cultural, local variety, environmental conscience, etc.) and the quality and efficiency of public services;
- Agricultural demand of the EU on the rest of the world leads to significant reforms of the CAP leading to a new innovation program for agriculture;
- The EU becomes a showpiece for multi-level governance (EU, national, regional) in research and innovation.

101 See Ghosh and Soete (2006).

4
Key messages

4.1
Investing in knowledge

1. The history of science-policy interface over the last sixty years has shown both more structured relationships and more public skepticism of elitist science. This at once shows both the **increasing importance of science in shaping policy** and the increasing unwillingness of political systems in many EU countries to continue to **invest more in science**. Extrapolating from the past, it is without doubt that the role of science (the natural and social sciences and the humanities) will become even more important in the future.

2. To continue shaping the course of events, **Europe needs to regain cognitive leadership by reinvigorating its capacity to invent the future**. The research and innovation policy is clearly central to this process: more investments are needed in the different kinds of science, and science must be willing and capable to make its social contributions more visible in order to generate public support.

3. A major innovative effort must be made to create and disseminate knowledge through the promotion of **new forms of entrepreneurism that focus on learning and education**, in order to provide the basis for both public and private actors to invest in knowledge.

4. **Mobilizing the financial resources for massive investments in knowledge** in turn requires the provision of a sound legal, organizational and operational framework involving a multitude of actors: public officials, regional economic players, financial institutions, education institutions along with the full range of investors including wealthy philanthropists and individual citizens.

5. On the other hand, well inspired research and innovation policies, rooted in long term visions, can themselves significantly help in steering financial resources towards innovation- and knowledge-driven research. A good example is the potential economic and financial benefits that could be accrued from a **rapid decarbonisation of the energy system** and, in general, from radical progresses of **sustainability science** and its applications: a major cut in energy imports, while certainly a major challenge in the short term, would ultimately 'free' considerable financial resources to be invested into future-oriented science and technology themes.

4.2
Political and cultural integration

6. Among the most striking conclusions that can be drawn from the scenario analysis is that the intuitive, common sense belief whereby **pooling forces is beneficial for all parties** concerned, finds a decisive confirmation in the projected dynamics of the main modelled indicators. What really characterises the 'Renaissance' scenario is its forceful process towards further European integration, both geographical and, most importantly, political and cultural, and the long-term performance of Europe is consistently better in this scenario than in the other two.

7. But this will not happen unless the commitment of Member States is radically enhanced, and translated into concrete policy changes and initiatives: **a future 'Union of European Nations' will be only as strong as its members commitment to it.**

8. A good example of the benefits that can only be expected if European political unity is radically enhanced is the possible role of the EU in promoting **EUMENA (Europe+Middle East+North Africa) as an integrated energy system** relying on solar and wind sources, thus contributing to address with one major initiative several critical policy issues such as the balance between North and South interests in joint industrial ventures, the growth of industrial manpower in the South, the reduction of migratory pressure from MENA countries, the reduction of energy dependence, the development of trans-European infrastructure uniting the continent, the enacting of decisive clean/green energy policies and measures, etc.

4.3 Business as usual is not an option

9. As previously noted, despite the significantly contrasted assumptions behind each of the three scenarios, the 'Nobody cares' and the 'Under threat' options ultimately yield results that are often closer than one would expect, underlining that **only the 'Renaissance' scenario appears to convincingly outline a real break with the current trends.**

10. Concretely, the scenario analysis has in fact shown that only the Renaissance scenario can provide all the ingredients for the EU to address both its internal and its external challenges. Referring for instance to recent or/and current 'internal crises' faced by the EU, the 'Renaissance' scenario provides meaningful evidence of how **the pathway of solutions inevitably goes through reinforced political integration:**

- ***Financial crisis:*** dependency on each other implies ultimately the need to move in the direction of a political union;
- ***Environmental crisis:*** common position in international negotiations is a must, with EU as the show case (emission trading, SET plan enlarged to CAP, etc.);
- ***Demographic crisis:*** Schengen as tool for migration solution to EU's ageing and population needs;
- ***Fossil fuel energy dependency crisis:*** will lead to regional experimentation with smart mix within an EU energy policy framework;
- ***Skills crisis:*** European universities, lifelong learning schemes and territorial and mobility dynamics;
- ***Innovation crisis:*** efficiency of EU2020 smart, sustainable and inclusive growth depends on EU integration of national policies.

On the other hand, it is also clear that **'external crises'** affect a fragmented Europe – as described in the extreme 'Under threat' scenario – much more than in the 'Renaissance' option:

- As shown in case of the financial crisis: EU banks and countries are today much more affected, than their American counterparts which were at the origin of the financial crisis back in 2008;
- The EHEC bacteria crisis is illustrative of how pandemics are likely to impact the EU27: MS blaming other MS to be at the origin of the crisis with the EU being blamed (see the initial response from Russia on banning vegetables from the whole of the EU27);
- The immigration inflow of North African refugees and immigrants in Lampedusa following the Arab spring and the differentiated responses of MS wanting to reinstate Schengen border controls;
- The nuclear crisis in Japan affecting European fossil fuel energy dependency with the German unilateral decision to quit nuclear industry;
- The emigration of young European researchers to the US, but also increasingly China, but also Turkey...

To conclude: **incremental changes, small adjustments to the current policy framework will not do the job.** In order to avoid catastrophic declines (more or less accentuated in the first two scenarios), bold, ambitious and coordinated policy actions are required, and must formulated in such a way that they speak directly to citizens, in order to stimulate the emergence of a fully fledged European mind and identity.

Annex 1
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Annex 2
Experts' biographies

Effie AMANATIDOU

Since 2007, Effie Amanatidou is a free-lance research and innovation policy analyst, after having served as Director of the Science and Technology Policy Studies Unit of ATLANTIS Consulting S.A. (GR) for 10 years. In 2010, she is also concluding her PhD research with MIoIR (University of Manchester) on 'Assessing the contribution of Foresight towards a more participatory 'knowledge society'. Foresight related experience includes her PhD research; participation as expert for 'Governance, Social Cohesion and Information Society' for the study 'EU and the World in 2025' carried out by JRC/IPTS; participation in the 'Foresight study on themes and issues for CEDEFOP Report on vocational education and training research in Europe'; participation in the European Foresight Monitoring Network (EFMN) funded by EC/DG Research (2005-2008); creation of the Regional Foresight Guide for Greece based on the FOREN Guide (2002); participation in the European Knowledge Society Foresight (EUFORIA) project funded by the European Foundation of Living and Working Conditions (2002-2003). She is also included in MIoIR's team for the SESTI Project (Scanning for Emerging Science and Technology Issues) recently funded under FP7 Foresight Blue Sky Research. Apart from foresight, her expertise extends in the fields of regional and national innovation systems, policies of science and technology, research evaluation and impact assessment.

Daniele ARCHIBUGI

Daniele Archibugi is a Research Director at the Italian National Research Council (CNR-IRPPS) in Rome, and Professor of Innovation, Governance and Public Policy at the University of London, Birkbeck College. He works on innovation and on the political theory of international relations. He has worked and taught at the Universities of Sussex, Naples, Madrid, Cambridge, Rome, London School of Economics and Political Science, and Harvard. In June 2006 he was appointed Honorary Professor at the University of Sussex. He is an adviser to the European Union, the OECD, several UN agencies and various national governments. He has led many research projects for the European Commission and other international organisations. He has chaired the European Expert Group on international cooperation in science and technology, *A Wide Opening of the European Research Area to the World* (released in April 2008). In the field of political theory he has co-edited *Cosmopolitan Democracy* (Polity Press, 1995), *Global Democracy* (special issue of 'Peace Review, 1997), *Re-imagining Political Community* (Polity Press, 1998), and has edited *Debating Cosmopolitics* (Verso, 2003). His latest book, *A Global Commonwealth of Citizens. Toward Cosmopolitan Democracy* was published Princeton University Press in November 2008.

Dragana AVRAMOV

Dragana Avramov, a sociologist (PhD, University of Belgrade), director of an independent consultancy, Population and Social Policy Consultants (PSPC), Brussels, has more than 20 years research experience in the domain of demography and socio-economic development, and public policies. She has devised and implemented, and reviewed and evaluated, research projects for a range of European and international organisations including the European Commission (DG Research, DG Education and Culture, and DG Information Society and Media), the Council of Europe and the United Nations. Former Director of the Demographic Research Centre, Institute of Social Sciences, University of Belgrade, she was Council member of the International Union for the Scientific Study of Population – IUSSP. She has chaired several Marie Curie actions under FP6 and FP7, and was member of the EC 'Network of Social Science Policy Reviewers'. Her current research is

focused on migration, identities and integration of immigrants, and access to education and lifelong learning. She is author of 14 books and over 70 scientific articles. Recently co-edited monographs are: 'Acceptance of immigrants in Europe?' (2008); 'People, Population Change and Policies' (2008); and 'Integrated Policies on Gender Relations, Ageing and Migration in Europe' (2005). She is author of 'Active ageing in Europe' (2003); and 'People, Demography and Social Exclusion' (2001).

Henri BOGAERT

After studying economics at the University of Namur (Belgium), Henri Bogaert worked for the Federal Planning Bureau, a Belgian government agency mainly carrying out economic studies. He was a member of the team in charge of the macro-economic analyses and forecasts. Henri Bogaert worked especially on the construction and use of macro-economic models. From 1989 to 1990, he participated in the setting up of a private company (ADE) specialized in economic studies. From 1990 to 1992, he was appointed deputy director of the economic advisers of the Prime Minister. Since 1993, Henri Bogaert has been appointed director of the Federal Planning Bureau by the Government. He has also been member and chairman of the European Economic policy Committee as well as Chairman of the Working Group on ageing population and sustainability during 10 years. For the OECD, Henri Bogaert has been Deputy Chairman of its Economic Policy Committee.

Anette BRAUN

Dr Anette Braun works as a senior technology consultant in the Future Technology Division of the Association of German Engineers in Düsseldorf. She studied Health Economics at the Catholic University of Leuven, Belgium where she obtained her PhD degree in 1995. Before she joined the VDI she worked for the EU Commission (DG Health) and the Health Ministry of Luxembourg. Since 1997 she coordinates on behalf of VDI various European Prospective Innovation and Technology Studies, analyses and scenarios on technology innovation. As a Member of the 2005 EC High Level Expert Group 'Key Technologies for Europe 2020', she was responsible for the analytical synthesis of existing Foresight work at national and European levels in relation to Health.

Maciej BUKOWSKI

Maciej Bukowski has Ph.D. in Economics. He is the President of the Institute for Structural Research – independent think-tank located in Warsaw. He is a lecturer at Warsaw School of Economics, and member of a Team of Strategic Advisors to Prime Minister Donald Tusk. As a macroeconomist he deals, among others, with public sector's economy, labour economy, development economy, paying special attention to structural macroeconomic modeling aimed at applying the economic theory to economic policy evaluation. He is an author, co-author and scientific editor of many articles, reports and scientific studies from that range. He is also a co-author of strategic documents such as 'Social Expenditures' Rationalization Programme' (so-called Hausner's Plan), National Development Plan 2007 -2015' and the 'Poland 2030 – development challenges' report.

João CARAÇA

João Caraça obtained the D. Phil. in Nuclear Physics at the University of Oxford (1973) and the Agregação in Physics at the Lisbon Faculty of Sciences (1974). He is Director of the Science Department of the Calouste Gulbenkian Foundation, in Lisbon. João Caraça is also Full Professor of Science and Technology Policy at the Instituto Superior de Economia e Gestão of the Universidade Técnica de Lisboa. He was coordinator of the M.Sc. Course on Economics and Management of Science, Technology and Innovation from 1990 to 2003. He is member of the Governing Board of the European Institute of Innovation and Technology – EIT. He also integrates the Steering Group of the European Forum on Philanthropy and Research Funding and is President of the Advisory Board of the Portuguese Business Association for Innovation – COTEC. João Caraça was Science Adviser of the President of the Portuguese Republic (1996-2006) and has published over 150 scientific papers. His main interests are science and technology policy and prospective studies.

Ged DAVIS

Ged Davis is Co-president of the Global Energy Assessment. He was until March 2007 managing director of the World Economic Forum, responsible for global research, scenario projects, and the design of the annual Forum meeting at Davos, which brings together 2400 corporate, government, and non-profit leaders to shape the global agenda. Before joining the Forum, Ged spent 30 years with Royal Dutch/Shell, which he joined in 1972. He was the vice president of global business environment for Shell International in London, and head of Shell's scenario planning team. Ged is a member of the InterAcademy Council Panel on Transitions to Sustainable Energy, a director of Low Carbon Accelerator Limited, a governor of the International Development Research Centre in Ottawa and a member of the INDEX Design Awards Jury. He was the director of the UNAIDS 'AIDS in Africa' scenario project from 2002 to 2003. Ged has led a large number of scenario projects during his career, including the multi-year, multi-stakeholder scenarios on the future of sustainability for the World Business Council for Sustainable Development and was facilitator of the last IPCC emissions scenarios. Ged first graduated with a degree in Mining Engineering from Imperial College London. He holds postgraduate degrees in Economics and Engineering from the London School of Economics and Stanford University.

Jaap DE ZWAAN

Professor Jaap W. de Zwaan is Professor of the Law of the European Union at the Law School of Erasmus University Rotterdam. He studied Law at Leiden University and the College of Europe in Bruges, Belgium. In 1993 he obtained his PhD degree in Law at the University of Groningen with a thesis entitled 'The Permanent Representatives Committee, its role in European Union decision making'. De Zwaan started his professional career in 1973 as a member of the The Hague Bar. From 1979 until 1998 he worked for the Dutch Ministry of Foreign Affairs in The Hague (European Integration Department and Legal Service) as well as in Brussels (Permanent Representation of the Netherlands at the EU). During his work in The Hague (1979-1983 and 1988-1995) he acted inter alia as Agent for the Netherlands Government in numerous cases before the Court of Justice of the European Communities in Luxembourg. As Legal Advisor of the Permanent Representation (1983-1988 and 1995-1998) he was involved in the negotiations on and the drafting of several European treaties, such as the Treaties of Accession of Spain and Portugal to the European Communities, the European Single Act and the Treaty of Amsterdam. In the period 1995-1998 he also was involved in the development of the Justice and Home Affairs cooperation of the European Union. In 1998 Jaap de Zwaan was appointed full time professor of the Law of the European Union at Erasmus University Rotterdam. In that capacity he was involved in teaching and research with regard to European law and policy. He also participated in several international frameworks of interuniversity cooperation. In the period 2001-2004 he served the Rotterdam Law School as Dean and in the period 1999-2001 he was also Dean of International Affairs of his faculty. From 2001-2004 he was also Dean of his Faculty. In September 2005 De Zwaan was appointed Director of the Netherlands Institute of International Relations, 'Clingendael', a think tank as well as diplomatic academy specialized in European studies, international security issues, diplomacy studies as well as international energy questions. In May 2011 De Zwaan returned to the University.

Lionel FONTAGNE

Lionel Fontagné is Professor of economics in the Paris School of Economics, Université Paris I Panthéon Sorbonne. He is also a scientific advisor to the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), an advisor to the International Trade Center (UNCTAD-WTO, Geneva) and a consultant with the Banque de France and the World Bank. He has formerly been the Director of the CEPII, a Supply Professor at the Free University of Brussels and a Professor at the University of Nantes, as well as a member of the Council of Economic Analysis to the French Prime Minister, a consultant to the OECD Development Centre, to the OECD Directorate for

Science Technology and Industry, to the Ministry of Finance of the Luxembourg, and to the French Ministry of Finance. He has written numerous studies on international trade and integration issues. In 1999, Open Economies Review recognized Prof. Fontagné for his joint-contribution to the debate on the endogenous symmetry of shocks in monetary unions. In 2007, he was awarded the Reseach Fellowship of GTAP (Global Trade Analysis Project, Purdue University). In 2008, he was awarded an Emerald Management Reviews Citation of Excellence for his contribution to the understanding of the economic impact of the competition of emerging countries. He is currently working on trade policy issues, offshoring, outsourcing and the economics of the deindustrialisation. He has previously worked on competitiveness, on sanitary and technical barriers to trade, on the relationships between trade and FDI, on tax competition, on intra-industry trade, and on the evaluation of the Single market program.

Nicole GNESOTTO

Nicole Gnessoto holds the Chair 'European Union: institutions and policies' at CNAM (Conservatoire national des arts et métiers). She is member of the Committee of the white paper on French foreign and European policy. Between 2002 and 2007, she has been director of the European Union Institute for Security Studies in Paris. Before, she was professor at *Institut d'études politiques* de Paris responsible for the security issues at the *Institut français des relations internationales* (Ifri). Member of the editorial board of *Esprit*, she has written or co-authored several publications including: 'The New Global Puzzle – What World for the EU in 2025?', 'Crescent of Crisis – US – European Strategy for the Greater Middle East', 'La sécurité dans un monde post- occidental', 'The growing powerlessness of the West', 'Europe and America's different visions of how to help the Third World' and 'Reconsidering the Future'.

Joyeeta GUPTA

Joyeeta Gupta is professor of climate change policy and law at the VU University Amsterdam and of water and environmental law and policy at the UNESCO-IHE Institute for Water Education in Delft. She is editor-in-chief of *International Environmental Agreements: Politics, Law and Economics* (IF 1.128) and is on the editorial board of journals like *Carbon and Law Review*, *International Journal on Sustainable Development*, *Environmental Science and Policy*, *Current Opinion in Environmental Sustainability, Catalan Environmental Law Journal,* and the new *International Journal of Water Governance*. She was and continues to be lead author in the Intergovernmental Panel on Climate Change which recently shared the 2007 Nobel Peace Prize with Al Gore and of the Millennium Ecosystem Assessment which won the Zaved Second Prize. She has published extensively. She is on the scientific steering committees of many different international programmes including the Global Water Systems Project and Earth System Governance. She has published several books including Gupta, J. (1997). *The Climate Change Convention and Developing Countries – From Conflict to Consensus?*, Environment and Policy Series, Kluwer Academic Publishers, Dordrecht; and Gupta, J. (2001). *Our Simmering Planet: What to do About Global Warming*, Zed Publishers, London. Edited books include Faure, M., J. Gupta and A. Nentjes (eds.) (2003),*Climate Change and the Kyoto Protocol: The Role of Institutions and Instruments to Control Global Change*, Edward Elgar Publishers, Cheltenham Glos; Van Ierland, E., J. Gupta and M. Kok (eds.) (2003). *Issues in International Climate Policy: Theory and Policy*, Edward Elgar Publishers, Cheltenham Glos; Gupta, J. and M. Grubb (eds.) (2000), *Climate Change and European Leadership: A Sustainable Role for Europe*, Environment and Policy Series, Kluwer Academic Publishers, Dordrecht; Dellapenna, J. and J. Gupta (eds.) (2009). *The Evolution of the Law and Politics of Water,* Springer Verlag, Dordrecht; and Gupta, J. and N. van de Grijp (eds.) (2010). *Mainstreaming Climate Change in Development Cooperation: Theory, Practice and Implications for the European Union*, Cambridge University Press.

Helena HELVE

PhD Helena Helve is Professor at University of Tampere and Adjunct Professor at University of Helsinki.

Her research interests have been multidisciplinary youth research, comparative and longitudinal studies, attitude and value changes of young people, formal and non-formal education and transition to work, identity and social capital. She has directed national and international research projects and she has been a coordinator of Nordic youth research and director of Nordic-Baltic Youth Research PhD Network. Her books include *Youth and Social Capital* (Helve&Bynner, 2007); *Mixed Methods in Youth Research* (2005), *Contemporary Youth Research, Local Expressions and Global Connections* (Helve&Holm, 2005); Ung i utkant (2003), Arvot, muutos ja nuoret (2002) and *Youth, Citizenship and Empowerment* (Helve&Wallace, 2001).

Nicolaas Sieds KLAZINGA

Niek Klazinga is a Medical Doctor by training and obtained a PhD on quality of care at the Erasmus University Rotterdam. After working at the Dutch national agency for quality of care (CBO) as (chief) scientific officer for 15 years he was appointed in 1999 as professor of social medicine at the Academic Medical Centre at the University of Amsterdam. At present he is coordinator of the Health Care Quality Indicator project of the OECD in Paris. Niek Klazinga has (co)authored many international articles on health services research and health system performance and has extensive experience with European and national research projects and policy initiatives in health care. Present engagements are the presidency of the Dutch Public Health Federation, board of trustees of the Isala Clinics in Zwolle and the largest mental health care organization (Arkin) in Amsterdam and a visiting professorship at Corvinus University Budapest.

Heli KOSKI

Heli Koski is affiliated with ETLA, the Research Institute of the Finnish Economy, as the head of the unit of the business economics research program. Previously, she has been affiliated with Helsinki School of Economics and the London School of Economics and worked as a special advisor of the EU Commissioner for Enterprise and Information Society, Erkki Liikanen. She has also been a visiting scholar in Stanford University, Free University of Amsterdam and Stern School of Business, New York University. She has published articles in various books and journals such as Review of Economic Research on Copyright Issues, Review of Industrial Organization, Journal of Industry, Competition and Trade, Information Economics and Policy, Economics of Innovation and New Technology and Research Policy. Her current research concentrates into the economic analysis of the entrepreneurial business strategies and innovation, diffusion and usage of new technologies, and to the related technology policy questions.

Ana MORATO MURILLO

Ana Morato Murillo is the General Manager of the Observatory for Industrial Technology Foresight (OPTI Foundation). In this position, she manages all OPTI's foresight and technology watch activities at both, the national and international level. In her former position of OPTI's General Director, she was in charge of the design and coordination of foresight studies at national, regional and international level. She manages a foresight expert's network in Spain and in Latin America, where she works in Brazil, Peru, Ecuador, Bolivia and Colombia. Besides, she has managed a number of European and international foresight studies, and has been member of various high level expert groups from the European Commission and UNIDO. In addition, she has been involved in several international committees of foresight experts. Along her professional life, she has given many lectures in Spain, Europe, Latin America and Asia in relation with Environmental, Quality Control, Innovation Policies and Technological Foresight issues. Prior to her working experience in OPTI, she has been the Director of the Environmental Management division at Royal HASKONING and the Institutional Relations Manager at ASEINCO International.

Geoff MULGAN

Geoff Mulgan (born 1961) is director of the Young Foundation based in London and Visiting Professor at University College, London, The London School of Economics and University of Melbourne as well as being the chair of Involve. Previously he was

Director of Policy at 10 Downing Street under British Prime Minister Tony Blair, Director of the Prime Minister's Strategy Unit (formerly known as the Performance and Innovation Unit), Co-founder and Director of the London based think tank Demos (from 1993-98), and Chief adviser to Gvordon Brown MP in the early 1990s. He obtained his PhD in telecommunications from the University of Westminster. He was a Fellow at the Massachusetts Institute of Technology and obtained a First Class degree from Balliol College, Oxford. He has written a number of books including: Communication and Control: networks and the new economies of communication (1991), Politics in an Anti-Political Age (1994), Connexity (1997) and Good and Bad Power: the Ideals and Betrayals of Government (Penguin 2006). He has written numerous Demos reports and pamphlets. His current base, the Young Foundation, mainly works on social innovation – design and launch of new social organisations.

Andrea RICCI

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Acknowledgements

This report was prepared by a high-level group of experts at the request of DG Research and Innovation (DG RTD) in close collaboration with the Bureau of European Policy Advisers (BEPA).

This publication benefited from the inputs of all the experts (see below biographies): Effie Amanatidou, Daniele Archibugi, Dragana Avramov, Henri Bogaert, Anette Braun, Maciej Bukowski, João Caraca, Ged Davis, Jaap de Zwaan, Lionel Fontagné, Nicole Gnesotto, Joyeeta Gupta, Helena Helve, Niek Klazinga, Heli Koski, Ana Morato, Andrea Ricci, Tomas Ries, Ingo Rollwagen, Leopold Summerer and Philine Warnke.

Special thanks are dedicated to the *rapporteurs* of the group: Andrea Ricci and Carlo Sessa for the scenarios description, Lionel Fontagné for the modelling work, Luc Soete for the chapter on EU research and innovation policy, and Anette Braun for the initial forward-looking literature review.

At the European Commission, this work has been led by DG RTD and in particular by Octavi Quintana-Trias and Jean-Michel Baer, Robert Burmanjer, Pierre Valette, Parskevas Caracostas and Vasco Cal from the BEPA.

This group of experts and this report have been supervised by Domenico Rossetti di Valdalbero from DG RTD.

Other Commission colleagues provided useful insights for this report: Afonso Ferreira, Franco Accordino, Jean-Claude Burgelman, Mega Paraskevi, Pierre Dechamps, David Mair, Jean-Paul Malingreau, Fabiana Scapolo, Mike Rogers, Mantas Sekmokas, Zsolt Pataki, Erastos Filos, Jesús Maria Alquezar Sabadie, Kristiina Urpalainen-Menon, Nicholas Deliyanakis, Michel Poireau, Benoit Paul and Carmen Madrid.

The results of this foresight exercise have been discussed during a final stakeholder conference held in Brussels on 20 November 2011 at which the following stakeholders participated: Adriënne Heijnen and Henning Klarlund from Aarhus University, Silvia Luber from Representation of the State of Baden-Württemberg to the EU, Patrick Kennedy from European Factories of the Future Research Association, Vivian Linssen from International Multidisciplinary Neuroscience Research Center, Ruth Fisch from The Hebrew University of Jerusalem, Anu Heinonen from Helsinki EU Office, An Appelmans from Institute of Tropical Medicine, Jonathan Nguyen from Commissariat à l'Energie Atomique et aux Energies Alternatives, Yegor Dubynskyi from Mission of Ukraine to EU, Line Lassen Pedersen and Maisa Mahmutovic from Danish EU Research Liaison Office, Claudia Labisch from Leibniz Association, Davide Vietri from Moverim, Gabriella De Rose and Antonio Sergio Ferraro from Puglia region, Hugues de Jouvenel from Futuribles, Koen Coppenholle from ArcelorMittal, Pierre Verdoodt from Flemish governmen, Muriel Desaeger from Energy Research Group- Toyota Motor Europe, Victor Van Rij from Netherlands Council for Science and Technology, Leena Ilmola-Sheppard from International Institute for Applied Systems Analysis, Franz Eversheim from Bayer CropScience,

Barbara Chiappini from Italian Ministry for the Environment, land and sea, Céline Laisney from French Ministère de l'Agriculture, de l'Alimentation, de la Pêche, de la Ruralité et de l'Aménagement du territoire, Bert Mosselmans from Vesalius College, Anne Fierens from Belgian Science Policy Office, Daniel Schaubacher from Club of Rome, Elie Ratinckx from Flemish Council for science and Innovation, Uno Svedin from Stockholm University, David Price from Schuman Project- Bron Communications, Zohar Ben-Asher from European Centre for Research & Financing, Justyna Gorzoch from Polish Ministry of Economy, Marlène Simeon and Chiara Mazzone from Région Provence-Alpes-Côte d'Azur, Jean-François Drevet, Maria Luisa De Natale from Catholic University in Milano, Yury Lavrov from Lukoil, Majda Cernic Istenic from University Ljubljana, Denis Lacroix from Ifremer, Francesca Maria Giorgio from Tecnopolis, Romain Weikmans from Université Libre de Bruxelles, Kitty Kubo from Estonian Development Fund, Jonas Bak from Capital Region Denmark, Mirjam Rinderer from Permanent Representation of Austria to the EU, Leena Sarvaranta from VTT Technical Research Centre of Finland, Jocelyn Mawdsley from Newcastle University, Rob Hagendijk from University of Amsterdam, Tiago Santos Pereira from University of Coimbra, Emma Carey from UK Research Office, Alain Henry from Bureau Fédéral du Plan, Sophie Lainé from University of Birmingham, Pamela Ferraro from S-Com, Justyna Herbut from Bavarian Research Alliance, Raffaele Marchetti from Libera Università Internazionale degli Studi Sociali, Guy Gallic from EADS, Marieke Zwartjes from United Nations University- Bruges, Emmanuel Babatunde from University of Bergen, Claus Seibt from Austrian Institute of Technology, Angelina Hermanns, Gloria Peasso from Agency for the Promotion of European Research, Kirsten Kunkel from Freie Universität Berlin, Gabriele Quinti from Laboratorio di Scienze della Cittadinanza, Marco Boscolo from Unioncamere del Veneto, Paul Zagamé from Ecole Centrale de Paris.

European Commission

EUR 25252 – Global Europe 2050

Luxembourg: Publications Office of the European Union

2012 — 158 pp. — 17.6 x 25 cm

ISBN 978-92-79-23357-9
ISSN 1018-5593
DOI:10.2777/79992

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KI-NA-25-252-EN-C

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