

Global Europe 2050



Global Europe 2050
Executive Summary

October 2011

Table of contents

1	Introduction and methodology	4
2	Three contrasted scenarios.	5
3	The future in our hands	14
4	Research and innovation policies for a European renaissance	20
4.1	Overall	20
4.2	Nobody cares... but the European Commission	20
4.3	EU under threats... Jeder für sich; chacun pour soi; sálvese quien pueda; ognuno per sé; každý 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	22
4.4	An EU Renaissance... from European romanticism to European “reaal Politik”	23
5	Key messages	26
5.1	Investing in knowledge	26
5.2	Political and cultural integration	26
5.3	Business as usual is not an option	27

Figures

FIGURE 1 - REGIONAL SHARES OF THE WORLD GDP (CONSTANT USD) IN 2010	15
FIGURE 2 - REGIONAL SHARES OF THE WORLD GDP (CONSTANT USD) IN 2050: “NOBODY CARES”	15
FIGURE 3 - REGIONAL SHARES OF WORLD GDP IN 2050, “UNDER THREATS” (CONSTANT 2005 USD)	16
FIGURE 4 - REGIONAL SHARES OF THE WORLD GDP, 2050: “EU RENAISSANCE”	17
FIGURE 5 - EU27 GDP UNDER OUR THREE SCENARIOS (CONSTANT 2005 USD)	17
FIGURE 6 - GDP OF INDIA, SSA, MENA (CONSTANT 2005 USD)	18
FIGURE 7 - WORLD GDP IN 2050 (G 2005 USD) FOR EACH SCENARIO	18
FIGURE 8 - GLOBAL CO ₂ EMISSIONS	19

1 Introduction and methodology

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 (2030-2050) 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 experts representing a considerable variety of disciplinary expertise / specializations¹. 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. An extensive narrative is provided for each of the scenarios, along a common format that deals in sequence with six 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.

¹ The following experts were members of this group: Effie AMANATIDOU, Daniele ARCHIBUGI, Dragana AVRAMOV, Henri BOGAERT, Anette BRAUN, Maciej BUKOWSKI, João CARAÇA, Ged DAVIS, Jaap de ZWAAN, Lionel FONTAGNE, Nicole GNESOTTO, Joyeeta GUPTA, Helena HELVE, Nicolaas Sieds KLAZINGA, Heli KOSKI, Ana MORATO MURILLO, Geoff MULGAN, Andrea RICCI, Tomas RIES, Ingo ROLLWAGEN, Carlo SESSA, Luc SOETE, Kalheinz STEINMULLER, Leopold SUMMERER, Philine WARNKE.

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. 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).²

The bridge between the narrative and the quantitative analysis is a set of macro-variables that are explicitly represented in the modelling tools and that can be used to characterize and contrast each of the scenarios, notably including: energy price and energy efficiency, CO₂ emissions, global and sectoral productivity, migratory flows, education levels, mobility of capital, trade costs, tariff rates, and others.

2 Three contrasted 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. 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, 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 threats: 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

² Fouré J., Bénassy-Quéré A., Fontagné L. (2010), The world economy in 2050: a tentative picture, CEPII Working paper, 2010-27. Fontagné L., Fouré J., Ramos M.P., (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

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 continues to keep a relatively strong developmental pace.

- **“EU renaissance: further European integration”**. In this EU renaissance scenario (depicted as “ER” in the following) 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.

A summary overview of the main traits of each scenario is presented below.

Dimensions	Scenario “Nobody cares: standstill in European integration”
Demographic and social	<p><u>Population ageing</u>: 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.</p> <p><u>Immigration</u>: 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.</p>
Energy and environment	<p><u>Increased energy constraints</u>: 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 2009, 13-14% of the world’s electricity came from nuclear power. 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.</p> <p><u>Rising consumption of raw materials</u>: 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.</p> <p><u>Rising pressure on water</u>: 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</p>

	<p>wrong water in the wrong places at the wrong times of the year.</p> <p><u>Rising pressure on land, food production and biodiversity loss:</u> 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.</p>
Economy and tecnologia	<p><u>Accelerating globalisation:</u> 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.</p> <p><u>Asia-led global growth and trade:</u> 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.</p> <p><u>Economic consequences of ageing:</u> 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.</p> <p><u>European youth NOT on the move:</u> 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.</p> <p><u>A still vital European industry:</u> 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 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. 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.</p> <p><u>A challenging transition to digital Europe:</u> 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.</p>
Geopolitics and	<p><u>Redistribution of global power:</u> 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</p>

governance	<p>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.</p> <p><u>Change of military power balance</u>: 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.</p> <p><u>Challenged role of EU on the global stage</u>: 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.</p>
Territorial and mobility dynamics	<p><u>Global urbanization</u>: 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.</p>
Research, education and innovation	<p><u>A failing European Innovation Union</u>: In the "Nobody cares" scenario, the innovation system thinking and coordination capabilities at EU level fail to emerge, leaving the whole Europe in an unfavourable competitive position as compared to other regions of the world, and especially to emergent economies.</p> <p><u>Public Sector Information</u>: 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.</p> <p><u>Research governance</u>: 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.</p> <p><u>Research institutions</u>: 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.</p>

Dimensions	Scenario "EU under threats: a fragmented Europe"
Demographic and social	<p><u>A shrinking population in Europe</u>: 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 <i>not</i> decrease. More importantly labour force will stabilize, but not shrink. All in all K/L ratio will be kept stable to its 2010 level.</p> <p><u>A declining social capital</u>: 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</p>

	<p>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 behaviour 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 threats”.</p>
<p>Energy and environment</p>	<p><u>Global energy insecurity:</u> 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.</p> <p><u>The worst global warming scenario:</u> 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.</p> <p><u>Unabated degradation of water:</u> 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.</p> <p><u>Global food crisis and degradation of biodiversity:</u> 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).</p>
<p>Economy and technology</p>	<p><u>A declining labour input:</u> 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).</p> <p><u>Human capital circulation:</u> 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.</p> <p><u>A declining infrastructure investment:</u> 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.</p>
<p>Geopolitics and governance</p>	<p><u>EU fortress:</u> 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.</p> <p><u>Global insecurity:</u> 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.</p>

	<p>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.</p> <p><u>A widening governance gap:</u> 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.</p>
Territorial and mobility dynamics	<p><u>Increasingly vulnerable and unsustainable cities:</u> 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.</p>
Research, education and innovation	<p><u>Public Sector Information:</u> 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.</p> <p><u>Research governance:</u> 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.</p> <p><u>Research institutions:</u> 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.</p>

Dimensions	Scenario “EU renaissance: further European integration”
Demographic and social	<p><u>Preserving the standard of living:</u> 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</p>

	<p>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.</p> <p><u>Active ageing:</u> 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.</p> <p><u>An open European society:</u> Fuelled 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.</p>
Energy and environment	<p><u>Better energy and CO2 reduction prospects:</u> 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 behaviour 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.</p> <p><u>A sustainable roadmap to low carbon Europe:</u> 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 2050. According to the Roadmap, the transition towards a competitive low carbon economy means that the EU will achieve emissions in its <i>domestic</i> emissions by 80% by 2050 compared to 2005 - domestic meaning real internal reductions of EU emissions and not offsetting through the carbon market.</p>
Economy and technology	<p><u>A new global financial stability:</u> 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</p>

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.³ 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/accrediting/ 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 labour, 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 crowd sourcing, - 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

³ CEDEFOP, “Future skill needs in Europe”, 2010.

	<p>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 CO2 emissions, this would be an enormous step forward. 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.</p> <p><u>Smart investment in global and local infrastructure:</u> 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 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.</p> <p><u>Key enabling technologies:</u> 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.</p>
Geopolitics and governance	<p><u>Towards the European Political Union:</u> 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 defence dimensions. A real European Political union may be created, based on a new EU constitutional treaty which introduces reinforced versions of the present institutions.</p> <p><u>Global security:</u> 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.</p> <p><u>EU leadership on the global stage:</u> 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 neighbours, 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.</p> <p><u>Filling the governance gap:</u> 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.</p>
Territorial and	<p><u>A polycentric Europe:</u> The urban-rural picture in Europe is partially different from the rest of the World. While</p>

mobility dynamics	<p>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.</p> <p><u>Sustainable cities</u>: 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).</p> <p><u>Smart and sustainable mobility</u>: 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 CO2-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 behaviour 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.</p>
Research, education and innovation	<p><u>Public Sector Information</u>: 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.</p> <p><u>Research governance</u>: 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.</p> <p><u>Research institutions</u>: 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.</p>

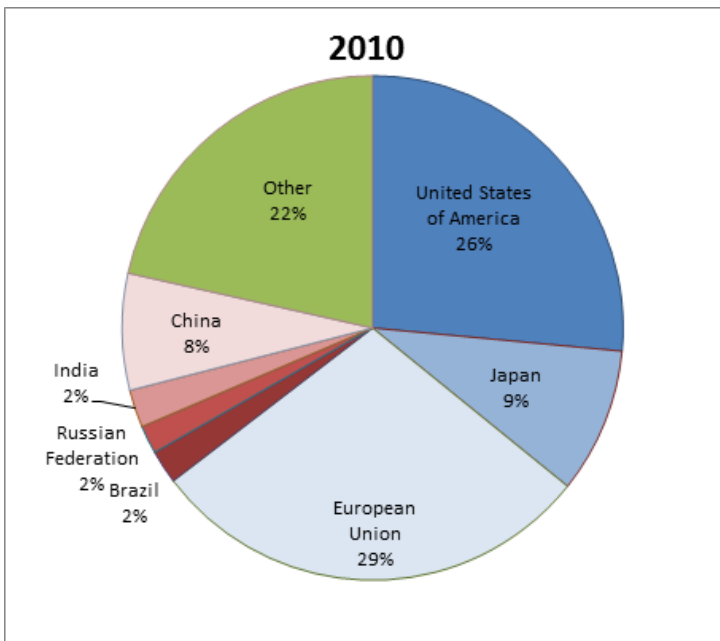
3 The future in our hands

As previously mentioned, the basic characterization of the three scenarios is translated in quantitative terms through the assignment of contrasted values to a set of macro-variables represented in the models.

Accordingly, scenario results cover a wide range of variables and indicators (GDP, global and sectoral productivity, education and skills, global and sectoral trade, energy consumption, emissions etc.). Highlights are presented below, while the detailed results are illustrated in the main report, together with the full narrative.

The redistribution of economic power at the world level is impressive in all scenarios. 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 1), in the “Nobody cares” scenario, by 2030 the US overtakes the EU (23% and 22% respectively), while China and India double their share (18% and 5% respectively in 2030), and Japan remains constant at 7% of the world economy.

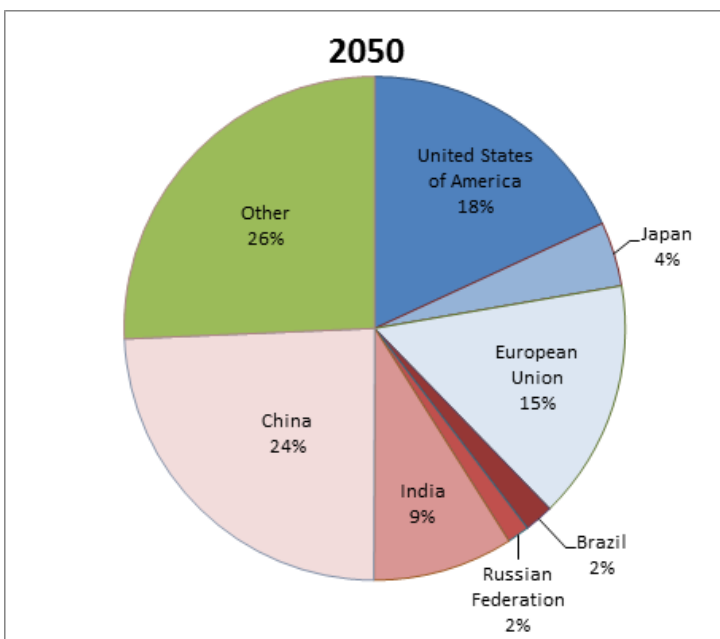
Figure 1 - Regional shares of the world GDP in 2010 (constant 2005 USD)



Source: CEPII

In 2050 (Figure 2) 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. The size of the world economy is multiplied by 2.7 compared to 2010, and Europe's GDP exhibits a 50% absolute increase, but the other parts of the world are growing faster, with the US GDP doubling.

Figure 2 - Regional shares of the world GDP in 2050: "Nobody cares" (constant 2005 USD)

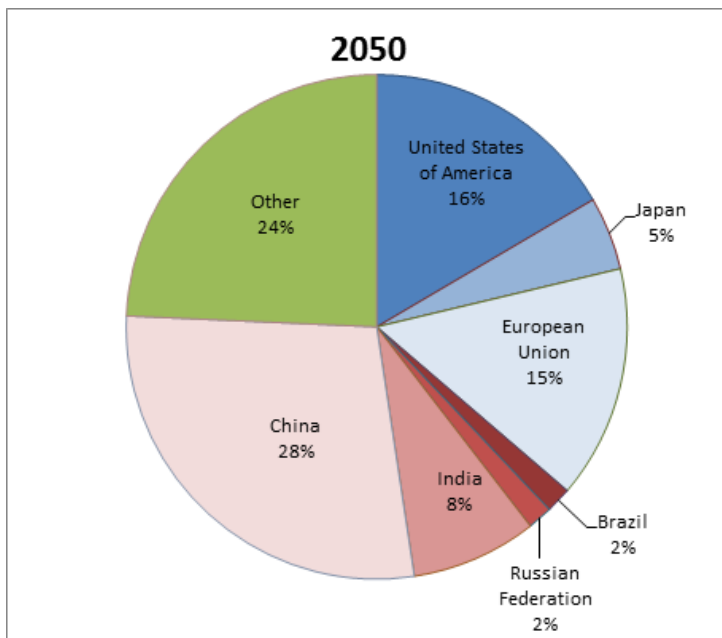


Source: CEPII

The “EU under threats” 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 a scenario would push Europe into a vicious circle of progressive decline.

Figure 3 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 GDP, does not fare much better, especially given its sustained demographic growth. 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 threats”.

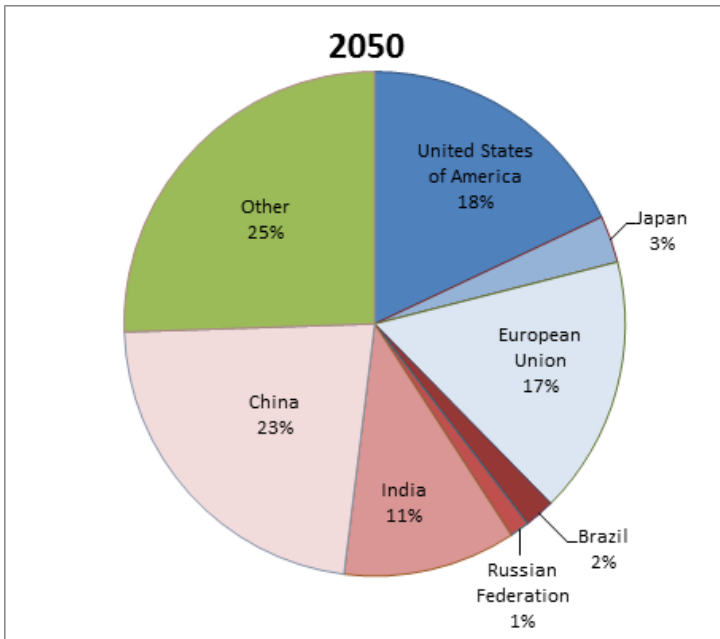
Figure 3 - Regional shares of world GDP in 2050, “Under threats” (constant 2005 USD)



Source: CEPII

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 4 accordingly shows the shares of world GDP in 2050 for the main actors of the world economy. At the end of the period the EU represents 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.

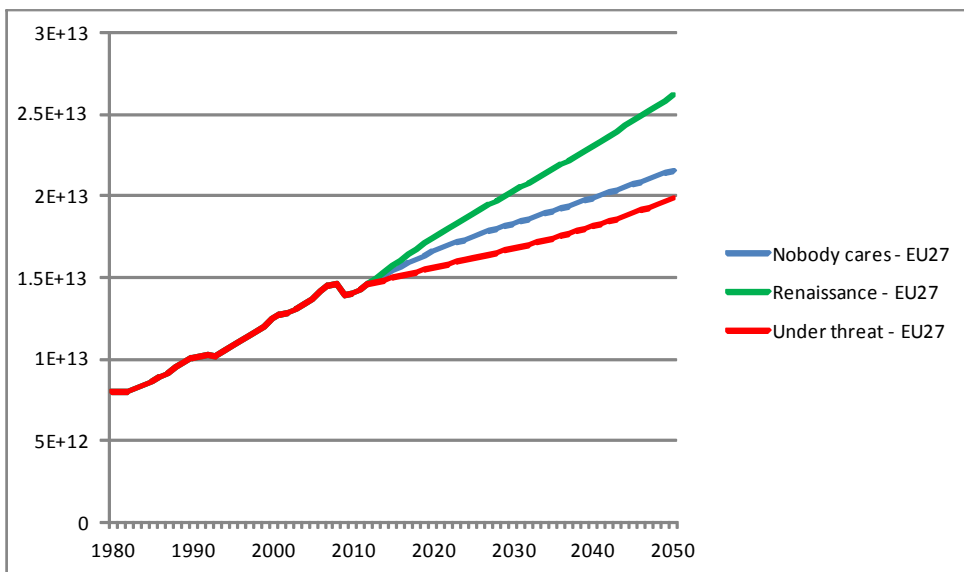
Figure 4 - Regional shares of the world GDP, 2050: "EU Renaissance"



Source: CEPII

Focusing specifically on the EU, Figure 5 below shows that 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 level is considerable. When the effects of these assumptions cumulate over time, the gap becomes impressive, with a EU GDP 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 combination of policies that Europe will be able to implement, and by the dynamics in the international context. Moreover, EU policies in the international arena can also play an important role in shaping that international context: in the renaissance scenario, free trade is preserved, international mobility of capital is ensured in the framework of a better global financial markets regulation, global imbalances are fixed. All these elements will contribute to EU future prosperity, beyond EU capacity in terms of innovation.

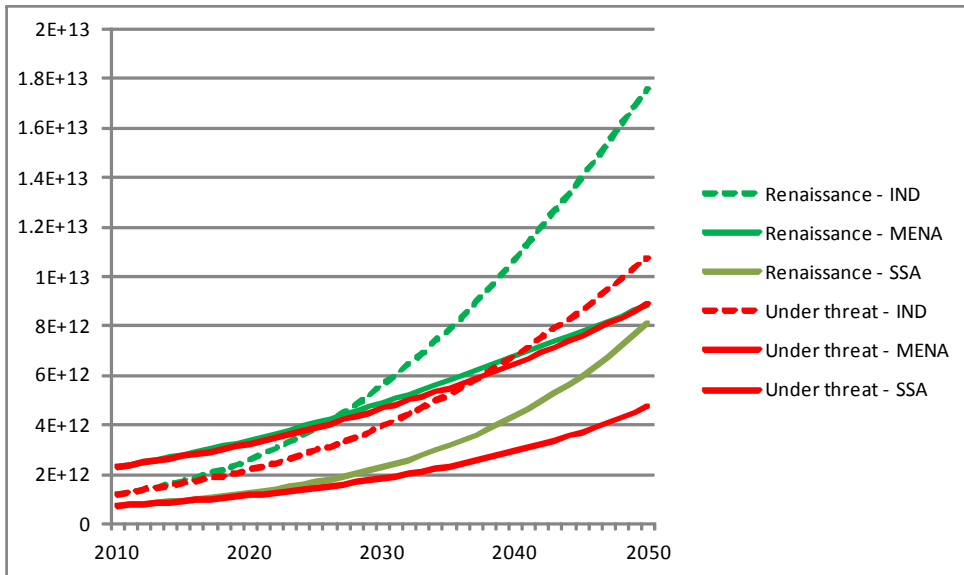
Figure 5 - EU27 GDP under our three scenarios (constant 2005 USD)



Source: CEPII

On the other hand, Figure 6 shows that the difference between scenarios is striking also at word level, notably for India and even more for SSA countries, pointing at the major contribution that the Renaissance scenario could imply for poverty reduction. The Mediterranean region, on the other hand, faces a different prospect, with future growth being in fact primarily tied to internal determinants, such as demography or technical progress, and thus hardly affected by other assumptions regarding macroeconomic imbalances.

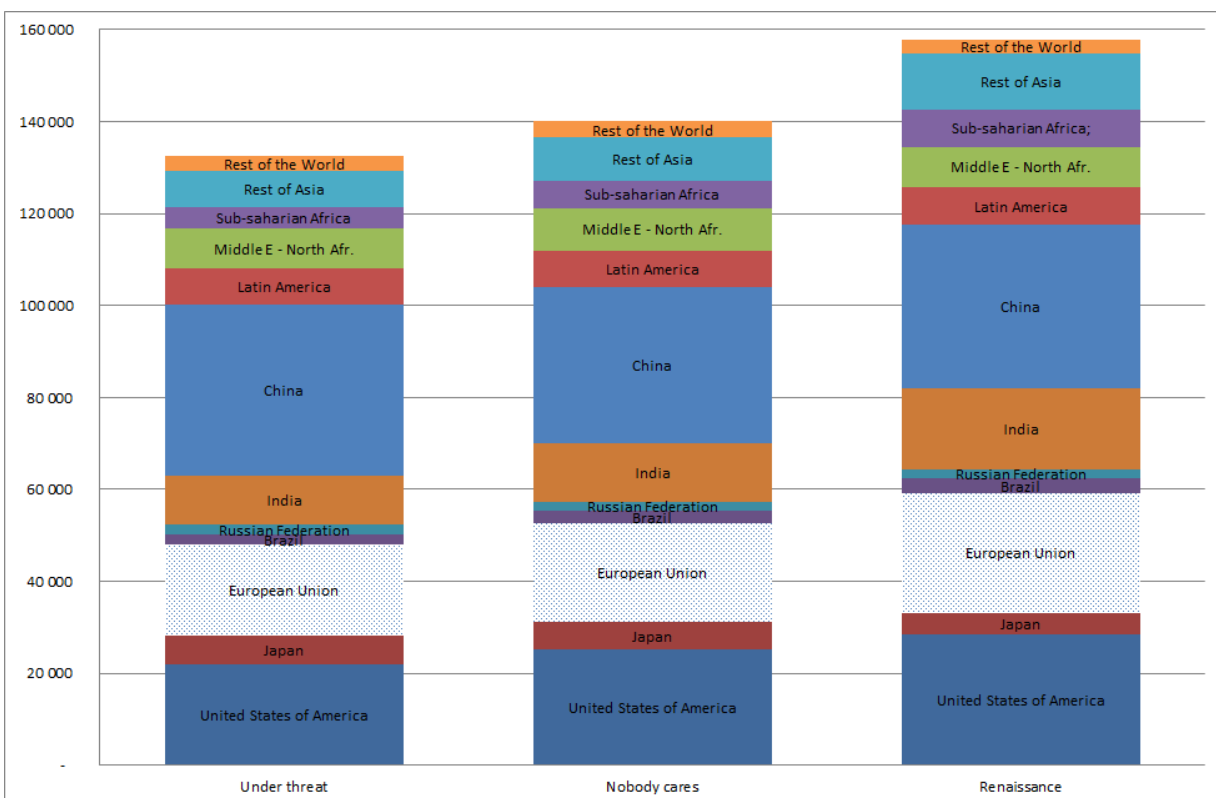
Figure 6 - GDP of India, SSA, MENA (constant 2005 USD)



Source: CEPII

Ultimately, the impact of the three scenarios on the world economy is summarized in Figure 7 where the impact of the scenario assumptions on policies at the European and international level is immediately visible.

Figure 7 - World GDP in 2050 for each scenario (G 2005 USD)

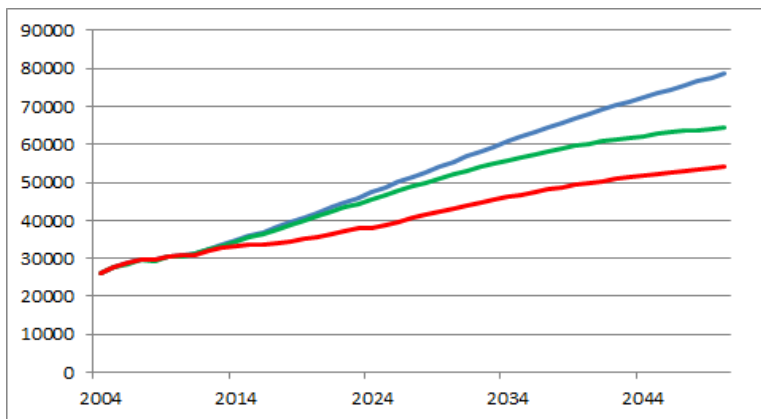


Source: CEPII

Figure 8 shows how the three scenarios compare in terms of CO₂ emissions. In the “under threat” scenario the assumption is made that the price of energy rises considerably, and that energy efficiency also increases as a technical response to such a constraint. In the “renaissance” scenario, on the other hand, the price of energy does not increase, as the boost in energy efficiency helps better match world demand and supply in a context of dynamic growth.

At world level, CO₂ 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 globally. The “renaissance” scenario, in contrast, can only rely on a sharp increase in energy efficiency. The conclusion is that technical progress will not suffice to address issues of scarcity and sustainability, with prices increasingly becoming a decisive instrument in the future management of energy.

Figure 8 - Global CO₂ emissions (Million tonnes of CO₂)



Source: CEPII, MIRAGE

4 Research and innovation policies for a European renaissance

4.1 Overall

Despite the prevalence of many long term research and innovation challenges the nature of EU research and innovation policy will be first and foremost a reflection of political decisions.

This section describes three, radically different paradigms of EU research and innovation policies that appear to fit best the three pathway scenarios described in section 3. The underlying assumption is that research and innovation will remain in the future essential components of policy making, not necessarily though of European policy making. While the detailed scenario narrative includes the representation of a number of “wild cards”, i.e. unpredictable events/shocks that might materialize at some point in the future, no attempt is made here to provide insights on possible policy responses to such “wild cards”. The impact of “wild cards” on EU research and innovation policy can be best translated in highlighting the continuing need for carrying out research with no immediate application or outcome in mind: the diversity of “wild cards” 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. 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.

In this sense the “eurocrisis wild card” signals the emergence over the last couple of years of a more fundamental division/schism in public policy opinion in Europe: a division along the lines of a vision of further European modernization and globalisation, European enlargement, environmental and climate change policies more or less imposed on EU society versus a growing vision in favour of preserving the national identity of nation states (in some cases even regions), 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 policymakers for more immediate popular support and recognition for sometimes highly specific policy proposals, as opposed to the old, sometimes more elitist tradition of policymakers 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.

4.2 Nobody cares... but the European Commission

As noted, the “Nobody cares” scenario assumes that current trends remain unchanged. Specifically, European research and innovation policies therefore remain by and large marginal both in the volume of research incentives provided compared to Member States (MS) national research and innovation policies, and in their impact on European growth, productivity and competitiveness. National policymakers follow their own national priorities in both research and innovation policies. European research and innovation policies are considered important only in as far as they provide an important source of additional research funding for public research institutions and universities and for the private sector.

European innovation policy aims to create the appropriate conditions for MS' own national innovation policies. In the area of new innovative products, European policy aims at productivity gains and organisational reforms. It focuses on 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, entails that 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. This scenario, described in quantitative and qualitative terms as a scenario in which nobody cares, can be best presented here as one in which *"Nobody cares... but the European Commission"*.

Available EU funds are primarily used 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 programs primarily from the perspective of getting as much out of them for themselves. Research - industry cooperation is dominated by national and regional/local interests, as is publicly funded research. The European Research Area 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 European Commission (EC) plays a more significant role. However, 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 relationships with foreign 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.

Ultimately: European research and innovation policies remain marginal, compared to national policies, notably resulting in numerous overlaps in policies.

4.3 EU under threats... *Jeder für sich; chacun pour soi; sálvese quien pueda; ognuno per sé; každý sobie; fiecare om pentru el însuși; ieder voor zich; varje man för sig själv; vceku sam za sebe cu; každý za sebe; hver mand for sig selv; jokaisen ihmisen itselleen; o καθένας για τον εαυτό του; a cada um por si*⁴

The “EU under threats” scenario in fact represents the return to national policymaking in research and innovation policy.

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 only 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 policymakers (Brussels, IMF, ECB, WTO, etc.) that national policymakers are quick to blame. In the “EU under threats” scenario, it is ultimately the distance between the European citizen and the European policymaker that leads to fragmentation and to the subtitle of this scenario’s narrative: everyone for him/herself, each in his/her own language.

As a result research and innovation policy becomes again a primarily national prerogative, even more so than in the 2010s. The Framework Programmes, including the latest Horizon 2020 version, are discontinued on the grounds that they are:

- too bureaucratic, as a consequence of 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 natural and social scientists and engineers can make in solving real, major societal challenges European society is increasingly confronted with, such as 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, food insecurity, etc.

The “grand” societal challenges are reinterpreted within each member state’s 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, cross-border local environmental issues, etc.

It is interesting - though rather alarming - to observe that the narrative of this “EU under threat” scenario includes many features which sound increasingly realistic, notably:

- A North-South trust divide following the financial euro-zone crisis leads to fragmentation of the EU as we know it today:

⁴ “Every one for himself” in the different national languages of the experts.

- 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 abandoned 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 privileged 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.

Ultimately: Research and innovation policies at the EU level are discontinued. MS claim full responsibility for their own national research and innovation policies, which are primarily, based on national competitiveness concerns. The EU does not achieve any advantage of scale in research and innovation.

4.4 An EU Renaissance... from European romanticism to European “real Politik”

The third scenario starts from a similar premise, but ultimately unfolds in an opposite narrative, whereby the financial crisis of the euro-zone underlines in this case the urgency of further political and economic integration. 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 for both the political left and the political right and for Euro-sceptics as well as 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 – of both policymakers and the public - that economic integration, and in particular the economic and monetary union with the formal introduction of the euro back in 2002, cannot survive without increased political integration.

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. As a result the performance of the public sector receives a dramatic boost in efficacy and efficiency.

In line with the plan for a Public Services Single Market, the national Research Councils in each MS are transformed into subsidiaries of the European Research Council, or at least – if they will continue to maintain their national prerogatives - they will form a tightly coordinated network. Joint research programs 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 truly integrated innovation systems with efficient and societal-purpose oriented business-science partnerships under the common umbrella of an

European EIT (European Institute of Technology and Innovation), 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. Researchers across the board challenge the unsubstantiated claims made by policymakers, opinion makers and in social networks with scientific facts and evidence, bringing back scientific evidence to the forefront of public trust. At the same time, innovation policies are carried out in close collaboration with regions.

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.

The ERA 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 policymaking 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 and NGOs. At the same time a variety of research is also carried out in the virtual world, requiring limited funds and based on concepts like peer production, shared economy, etc. 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, and applications across the world. 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.

Ultimately: this apparently idealistic, but in fact rather *realistic* scenario combines a number of structural reforms in European and national MS research and innovation policy which together with a broader desire for political integration leads to strong economic and welfare benefits to the EU and the rest of the world.

The Renaissance paradigm thus features:

- "Smart growth" which is now realized both across EU countries and regions and across sectors, including the public service delivery sectors with significant impacts 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 on the basis of innovative investment instruments 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 the 20th 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 the new smart region’s attractor poles;
- Multi-culture and multi-linguism 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 EU-27 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 EU-27 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 programme for agriculture;
- The EU becomes a showpiece for multi-level governance (EU, national, regional) in research and innovation.

5 Key messages

The group of experts was not only set out to take a look on probable future states of Europe. Part of the mandate was also to identify key triggers or potential actions that may be taken to shape the future in a favourable way. The following are the key messages of the group.

5.1 Investing in knowledge

1. The history of the science-policy interface over the last sixty years has witnessed both more structured relationships and more public scepticism 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, there is no doubt that the role of science (the natural and social sciences and the humanities) will become even more important in the future, but that this may remain contested in the view of the public.
2. To continue shaping the course of events, **Europe needs to regain cognitive leadership by re-invigorating 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 entrepreneurship 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 progress of **sustainability science** and its applications: a major cut in energy imports, while certainly a challenge in the short-term, would ultimately “free” considerable financial resources to be invested into future-oriented science and technology themes.

5.2 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 march 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 Mediterranean shores 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.

5.3 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 threats” 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 threats” 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 EU-27: 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 close down its 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 be 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.