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**COMMISSION STAFF WORKING PAPER**

**Innovation Union Competitiveness report 2011**

## 5. Addressing societal challenges

### Highlights

Research and Innovation coupled with market development measures can help provide a solution to the societal challenges, such as climate change, a healthy aging or energy dependency that Europe faces. At the same time, these fields represent new areas for potential economic growth. As a result, many of the research programmes in Europe and elsewhere, including the economic recovery packages, have oriented towards these fields.

Overall, the EU is increasingly reinforcing its position in developing new technologies aimed at addressing societal challenges. The EU accounts for around 43% of all the climate change mitigation related patents filed under the Patent Cooperation Treaty (PCT). The impressive record of the EU is due to a determined public investment decision that has in the past decade increased the funding of environmental sciences and technologies. Among the different technologies for climate change mitigation, the EU has made good progress in technologies for developing and deploying renewable energies. Nevertheless, more market pull measures would further improve the competitiveness of these new technologies, making them more affordable.

Health research has the potential to provide "exception returns", both in terms of reduction of direct costs of treatments or labour absenteeism, and by increasing longevity and quality of life. In this field, the United States is the world leader. It accounts for almost half of all the health related patents, either on pharmaceutical or medical technologies, and its public and private research investment is much higher than any other country. In this field, the EU lags behind the United States, but the situation is not homogeneous across Member States. Denmark, Sweden or the Netherlands have developed strong specialisation capacities in particular health technologies and proportionally rank above the United States in terms of health technology patent applications.

Finally, since most societal challenges are global by nature, the EU research instruments in these fields, notably the Framework Programme, have opened themselves to further international cooperation. Environmental and health related research are two of the fields more prone to international cooperation, especially with other advanced economies such as the United States, Japan or increasingly other Asian economies.

## 5. Addressing societal challenges

***Science, technology and innovation can help provide a solution to the growing societal challenges faced by Europe. The Innovation Union initiative calls for a re-focusing on innovation to address the major societal challenges***

Science, technology and innovation are increasingly regarded as key solutions to the challenges that can affect our economic progress and quality of life. Increasingly, citizens turn to science and technology to obtain an answer for mitigating climate change, improving citizens' health or enhancing energy and resource efficiency.

The Innovation Union initiative of the European Commission has echoed these demands and has asked for a re-focus of R&D and innovation policies on the challenges our society faces. In order to provide innovative solutions, every link in the innovation chain will have to be strengthened, from 'blue sky' research to commercialisation.

This chapter will focus on a analysis of the way in which European research — including the role of the Framework Programme — is contributing to addressing these challenges in two particular areas that are the first objectives of the future European Innovation Partnerships<sup>56</sup>: (1) Climate-change mitigation and preserving the environment (including renewable energy technologies), and (2) Healthy ageing. These two areas are of particular interest for Europe because no single country can provide the solutions to these challenges. International cooperation is needed and there is a clear European value added in pulling research resources together to avoid the fragmentation of research investment, especially in a context of fiscal consolidation.

***Many EU Member States — as well as the United States — are orienting their research policies to embrace societal challenges in the framework of their recovery packages***

In 2008 and 2009, many EU Member States undertook large policy responses, including fiscal stimuli and structural reforms, to address the negative consequences of the worst financial and economic crisis of the last 70 years. These efforts were to a large extent coordinated on the basis of a European Economic Recovery Plan (EERP) that was endorsed by the European Council.

The overall size of public investment in the stimuli packages has been roughly estimated at around 65 billion euro, i.e. 0.32% of EU GDP, and grouped under three main areas: investment in infrastructure, 40 billion euro, investment in energy efficiency, 20 billion euro; and investment in R&D, 5 billion euro<sup>57</sup>.

In terms of R&D investment, the EERP encouraged Member States to research green technologies and energy efficiency. The reason for this lies on the need to focus European research on developing new environmental technologies that help mitigate climate change and pollution, and that in addition, can become important sources of economic growth.

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<sup>56</sup> Please, refer to the Innovation Union Communication for a detailed description and areas of action of the European Innovation Partnerships ([http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication\\_en.pdf#view=fit&pagemode=none](http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf#view=fit&pagemode=none)).

<sup>57</sup> Source: European Commission, DG ECFIN.

As a result, plans to invest in green technologies can be found in several National Reform Programmes, such as those in Estonia, Spain, France, Italy, Latvia, Germany and the United Kingdom. In addition, France, Germany and the United Kingdom are also implementing research on green technologies in the automotive sector as part of their strategies, and the EERP announced two major partnerships between the public and private sectors in research on (1) a European green-cars initiative and (2) European energy-efficient buildings initiative. Both initiatives are under implementation

The United States also implemented a similar plan to fight against the economic crisis — The Recovery Act: Transforming the American Economy through Innovation. As for the EERP, the American USD-800-billion investment plan has also emphasised the need to accelerate significant advances in science and technology that not only cut costs for consumers, but that also help to improve health and develop new technologies for the exploitation of renewable energies.

**Box X: The United States Recovery Act: Transforming the American Economy through Innovation**

The Recovery Act has invested nearly USD 100 billion in science, technology and innovation projects across the country, ranging from the construction of a nationwide smart-energy grid and health-information technology infrastructure to growing the emerging electric-vehicle industry, expanding broadband access and laying the groundwork for a nationwide high-speed rail system.

Thanks to the Recovery Act, the United States is now on track to achieve four major innovation breakthroughs that will keep America competitive in the 21<sup>st</sup> century economy and make new cost-saving, energy-saving and life-saving technology affordable for and accessible to consumers. These innovations are:

1. Cutting the cost of solar power in half by 2015. This will bring the cost of generating solar power down to the cost of electricity from the grid.
2. Cutting the cost of batteries for electric vehicles by 70% between 2009 and 2015. This means that the cost of batteries for the typical all-electric vehicle will fall from USD 33 000 to USD 10 000, and the cost of typical plug-in hybrid batteries will drop from USD 13 000 to USD 4 000.
3. Doubling the United States' renewable-energy-generation and renewable-manufacturing capacities by 2012. This means that the over USD 23 billion investments in support of renewable energy will double the energy generation capacity from wind, solar and geothermal sources by 2012.
4. Bringing down the cost of a personal human-genome map to under USD 1 000 in five years. This means that it will be fifty times cheaper to obtain the DNA information that could unlock cures and give insights into some of the most debilitating diseases that exist today.

Source: Executive Office of the President of the United States, 2010

## **5.1. Is European research addressing climate change and the need to preserve the environment?**

*Climate change will have significant costs for the economy. New technologies can help reduce the greenhouse gas emissions and therefore mitigate these costs.*

In recent years, climate change has been recognised as a global phenomenon that may cause an irreversible build-up of greenhouse gases and global warming at a potentially huge cost to the economy and society.<sup>58</sup> According to the Stern Report<sup>59</sup>, the estimated costs of inaction in addressing climate change are high, and when all market and non-market impacts are taken into account, the costs can rise to 14.4% of per capita consumption.

New technologies can help reduce the emissions of greenhouse gases and therefore mitigate the negative effects of climate change. According to the Energy Technology Perspectives<sup>60</sup>, developments in new technologies such as carbon capture and storage, nuclear energy, renewable energies and end-use efficiency gains could reduce CO<sub>2</sub> emissions by up to 50% by 2050.

There are also new European initiatives in this field. As an illustration, two of the three Knowledge and Innovation Communities (KIC) selected in 2009 inside the European Institute of Technology (EIT), focuses on enhancing Europe's innovation capacity in the field of sustainable energy, and climate change mitigation. The KICs are set up as very focused and European-wide clusters.

### **5.1.1. Investments in science and technology for climate-change mitigation**

*The EU allocates a relatively important part of its public research budgets to the development of environmental technologies, including climate-change technologies.*

The public nature of climate change and other environmental technologies enhances the role that public research plays in the development of new technologies. The EU devotes more public research resources to environmental-related sciences than any other research system in the world. On average, EU governments invested in 2009 almost EUR 5 per inhabitant, while South Korea invested around EUR 4 and the United States and Japan around EUR 2.

Moreover, the EU has maintained this investment in environmental research over time and has slightly increased it since 2004.

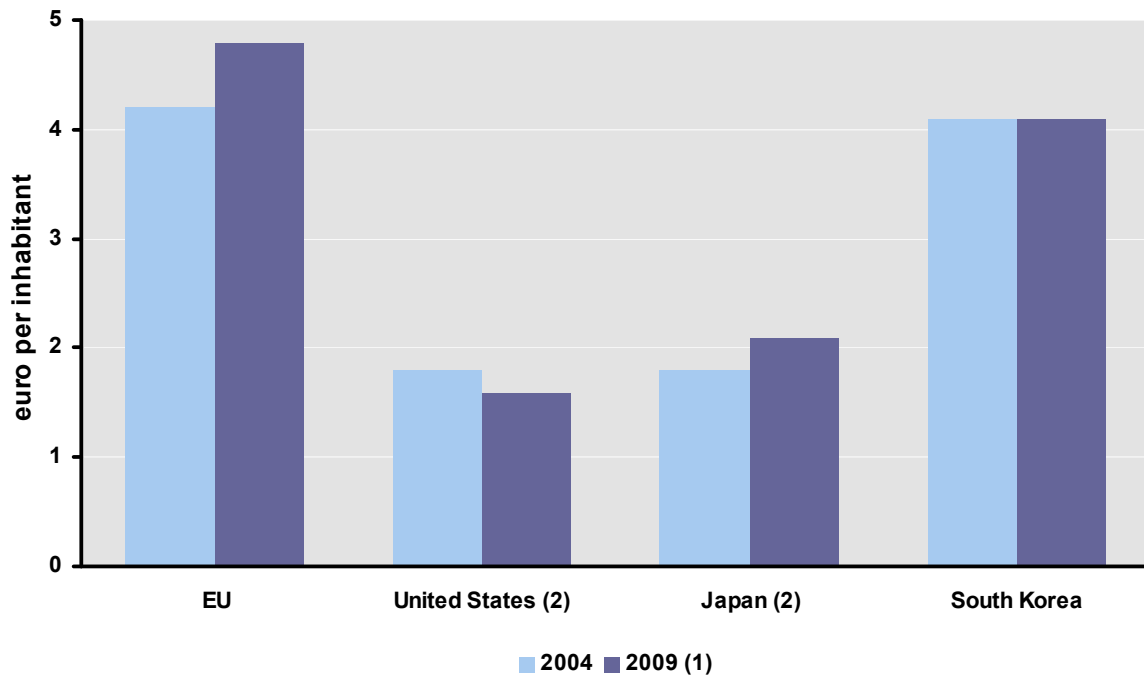
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<sup>58</sup> OECD, 2009.

<sup>59</sup> Stern, N (2007) 'The Economics of Climate Change. The Stern Review', Cambridge University Press.

<sup>60</sup> IEA, 2008.

Figure III.5.1 GBAORD for environmental related R&D, 2004 and 2009 <sup>(1)</sup>



Source: DG Research and Innovation

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Data: Eurostat

Notes: (1) US: 2008.

(2) US, JP: GBAORD refers to federal or central government only.

**Box : European Research Collaboration to develop a nuclear fusion reactor in Europe-  
ITER**

The energy challenge of the EU, and the World, is to assure sustainable, affordable and safe energy production with the diminishing availability and rising costs of carbon based energy, combined with the need to lower environmental impact of energy production. One of the very few candidates for large-scale carbon-free production of base-load power is fusion energy, which could potentially benefit from: (1) abundant and geographically fairly distributed fuel, (2) enhanced safety, (3) no production of CO<sub>2</sub> or atmospheric pollutants and (4) no long-lasting radioactive waste.

ITER is an international project aimed at developing the knowledge needed to have fusion available as a future energy alternative. The project counts on the membership of the EU, Japan, China, the United States, South Korea, India and Russia, who signed in 2006 an agreement to fund the construction of the world's most advanced experimental nuclear fusion reactor in Europe.

The EU will contribute 45% of the construction costs, i.e; an estimated investment of 6.6 billion euro, and the project is anticipated to last for 30 years, 10 years for the construction and 20 of the operation.

The construction of the key components, such as the buildings, vacuum vessel and magnets has already started and the EU is expected to deliver components of the machine in each key technology.

In terms of human resources, during the construction phase, around 500 people will be directly involved in site, while 200 will work at the European Joint Undertaking for ITER and the Development of Fusion Energy. After the construction, around 600 people will work in site.

ITER can be regarded as a leading project for the development of research and innovation in the EU as it is likely to generate important spin offs and will represent a milestone in the production of electricity at a large scale.

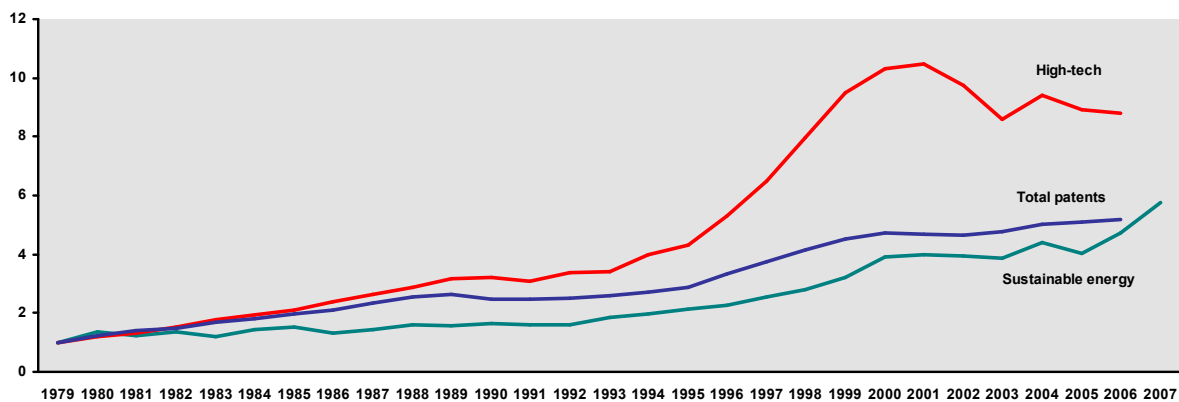
### 5.1.2. Patents for climate-change mitigation and environmental technologies<sup>61</sup>

To a large extent, climate-change mitigation technologies are based on the development of new sources of low-carbon emission energies, such as renewable energies. The next section analyses the recent technological evolution of this sub-section of climate-change technologies which is of particular interest for Europe, as it also reduces energy dependency.

#### *Patents in sustainable energy represent a small but increasing share of overall patents*

Increasing concerns about climate change and the oil crisis of 2003–2008, which saw oil prices going up from USD 25 per barrel to a peak of more than USD 130 in 2008, have clearly intensified interest in the development of new sustainable, in particular renewable-energy technologies. Since the year 2000, the number of EPO patent applications in renewable-energy technologies has increased sharply. As shown below, this growth has been overtaking the average growth of EPO patents or even of high-technology patents since 2005.

Figure III.5.2 Long term growth of EPO patent applications in sustainable energy, high-tech and total patents, 1979-2006 (1979 = 1)

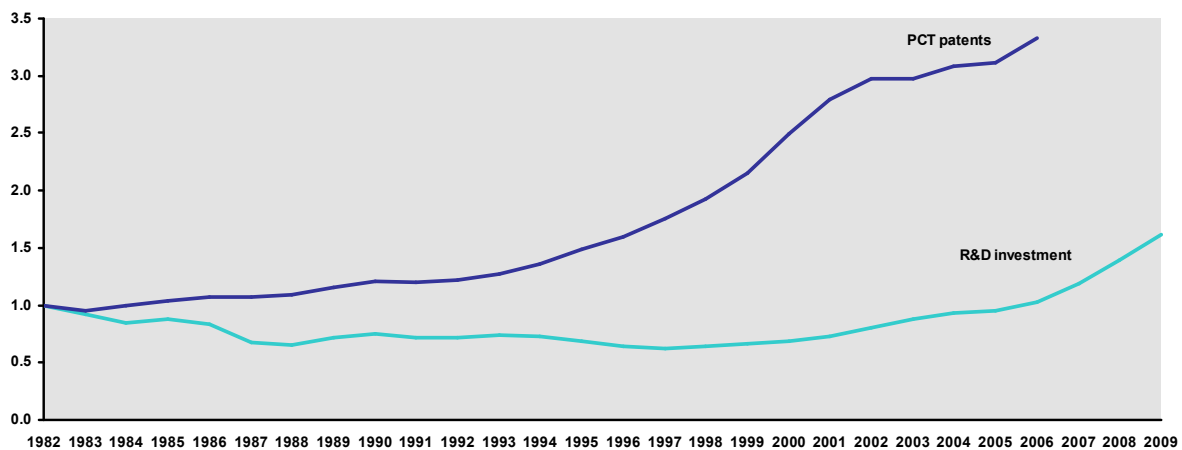


<sup>61</sup> Climate-change mitigation technologies include renewable energy, electric and hybrid vehicles, energy efficient buildings and lighting.

***The rapid growth in sustainable energy patents has occurred despite a slight stagnation of R&D investment***

Public expenditure in sustainable energies decreased from 1982 until the year 2000. Since that year, R&D investments started to increase again, with acceleration from 2006 onwards. On the other hand, despite this negative trend in research investment, patent activity continued to progress, which suggests that there has been a growing interest in the market for new technological applications in the field. In other words, the development of sustainable energies has benefited more from a market *pull*, than a technological *push*.

Figure III.5.3 R&D investment and patent evolution in renewable energy in OECD countries, 1982 =1



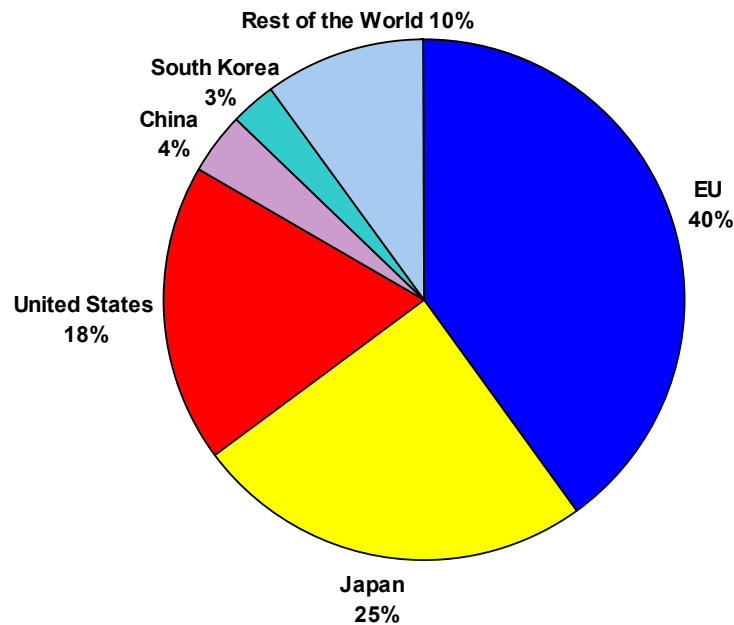
***In addition to renewable energy technologies, the EU plays a leading role in developing other new climate-change mitigation technologies. The EU accounts for 40% of all world patent applications in this field.***

While Japan presents the highest number of climate-change patents relative to the size of the economy<sup>62</sup>, the EU is the world leader in developing new technologies to fight against climate change in absolute terms, accounting for more than 40% of all patent applications addressing this societal challenge.

<sup>62</sup> Please, see part 1 of this report for details.



Figure III.5.4 Climate change mitigation technologies - PCT patent applications - world shares, 2007



Source: DG Research and Innovation  
Data: OECD

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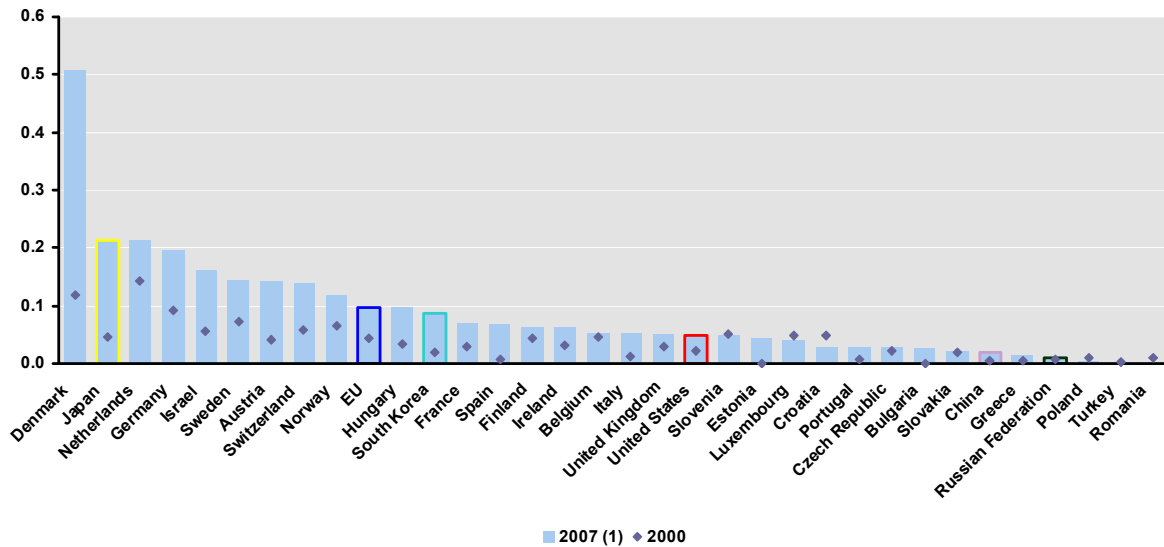
***Denmark, the Netherlands, Sweden and Germany are on the technological frontier for technologies addressing climate change***

Between 2000 and 2007, innovation in climate-change mitigation technologies has been intensifying rapidly. The number of patents which address climate-change challenges has increased considerably in most countries — in Japan more so than in the EU — and represents approximately 2% of total patent applications<sup>63</sup>. Denmark, the Netherlands, Germany and Japan are the countries which patent most in this area relative to their GDP<sup>64</sup>. In volume, Germany and Japan concentrate a large share of these patents in the world, as well as the United States, despite its lower value in relation to GDP (half of the EU). In Europe, although these data do not measure the quality nor the impact of the patents, the high intensity of patenting in Denmark, the Netherlands, Sweden and Germany both in health and climate-change mitigation tends to indicate that these countries are at the technological frontier in both domains.

<sup>63</sup> OECD, *Measuring innovation*, 2010, p 114.

<sup>64</sup> In Figure III.5.5, data for patents related to climate-change mitigation are OECD data concerning PCT (Patent Cooperation Treaty) patent applications by inventor's country of residence and priority year; climate-change mitigation covers the following fields: renewable energy, electric and hybrid vehicles, energy efficiency in building and lighting.

Figure III.5.5 Climate change mitigation technologies - PCT patent applications per billion GDP (PPS€), 2000 and 2007<sup>(1)</sup>



Source: DG Research and Innovation

Data: OECD

Notes: (1) SI: 2006.

(2) CY, LV, LT, MT, IS, MK: Zero or data not available.

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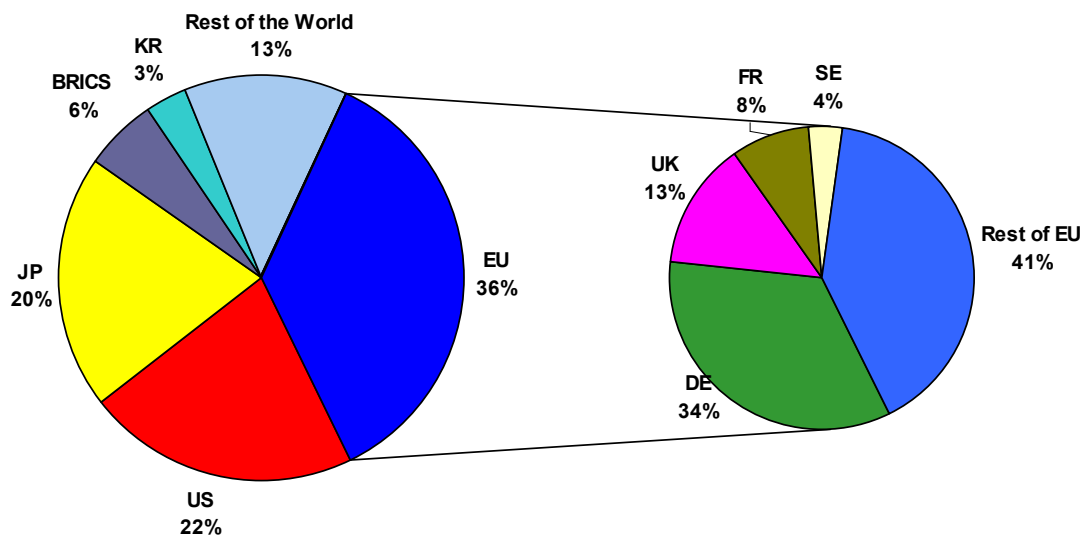
***More generally, the EU is the world leader in environmental technology patents<sup>65</sup>, headed by Germany***

Higher public-research budgets in environmental sciences have allowed the EU to lead the race in the development of environmental technologies. As Figure X<sup>66</sup> below shows, 35% of all patents related to air- and water-pollution control, solid waste management or renewable energies have their origin in the EU. Behind the European Union, the United States and Japan account for 21% and 20% of all these patents respectively. In the EU, Germany is the largest R&D investor, representing 34% of all EU's patents. The United Kingdom and France follow with 13% and 8%, while the rest of the EU countries account for 40.5% of all EU's patents, i.e. 14% of the world total.

<sup>65</sup> Environmental technologies include air-pollution control, water-pollution control, solid waste management and renewable energy as calculated by the OECD (2009): 'Science, technology and Industry Scoreboard 2009', p.52 ([http://www.oecd-ilibrary.org/content/book/sti\\_scoreboard-2009-en](http://www.oecd-ilibrary.org/content/book/sti_scoreboard-2009-en)).

<sup>66</sup> Note: Values are calculated based on an arithmetic average of the percentage of patents of each country in four environmental technology fields: (1) air-pollution control, (2) water-pollution control, (3) solid waste management and (4) renewable energies. As a result, these values assume an equal distribution of patents across four fields.

Figure III.5.6 PCT patent applications in environmental technologies - world shares, 2004-2006



Source: DG Research and Innovation  
Data: OECD

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### 5.1.3. Markets demand measures to enhance technologies in climate-change mitigation and other environmental technologies

*Despite substantial technological development, the use of renewable energies or other environmental technologies still require some market ‘pull’ measures. Smart regulation and public procurement can accelerate the creation of a full, effective market.*

Despite technological advances, renewable energies are currently still more expensive than traditional energy and, therefore, they require market ‘pull’ measures in order to fully deploy and further enhance technological advances and reductions in costs. The same is valid for many environmental technologies, for which a market needs to be developed in order to take into account the full costs of production, i.e. including pollution effects. Smart regulation and policy initiatives such as the Lead Market Initiative<sup>67</sup> on recycling or renewable energies can become important means to achieve this goal. In general, these measures to develop markets have yielded excellent results when coordinated with research efforts to bring the costs of production down.

Denmark represents an excellent example where wind industry has successfully developed.

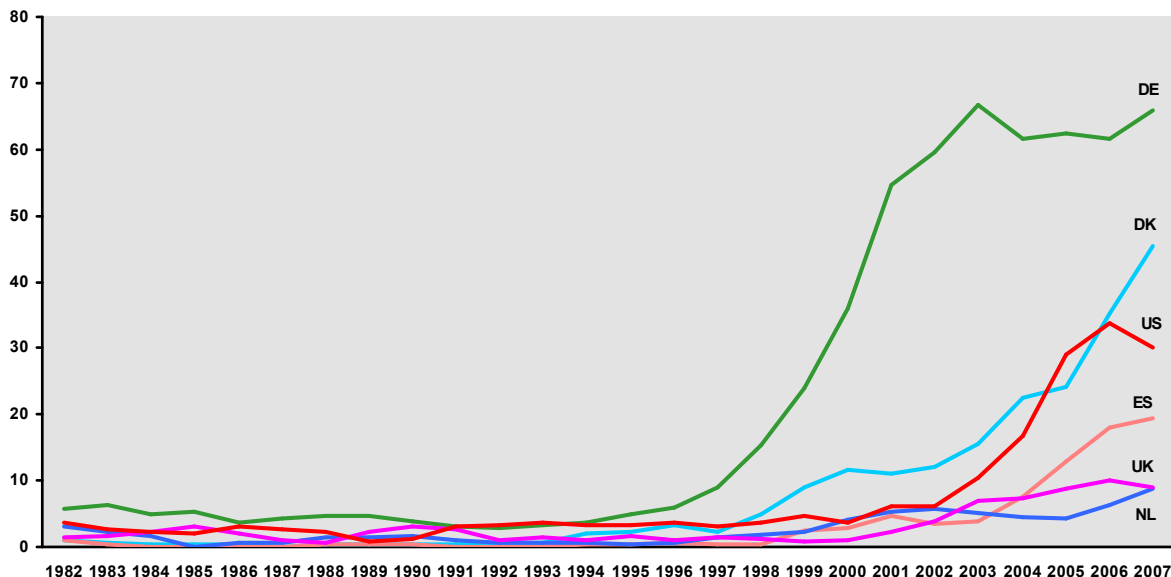
<sup>67</sup> Please refer to the section of Framework Condition for more ample information on the role of lead markets and innovation-friendly regulations.

**Box: The role of demand policies in Europe and the development of wind and photovoltaic industries**

Germany, Denmark and Spain have been the three EU countries with the strongest market-pull policies in Europe. The emergence of Spain as an industrial player is all the more remarkable since it started from a very low base before 1995.

This has led Europe to develop a strong world presence in the wind industry. These three countries accounted for nearly half of world production in 2009. Of special interest is Denmark, which now produces 20% of its electricity through wind power. In the same country more than 28 000 people are employed in the wind industry. Moreover, the interest of United States firms in patenting in the EU is also to be noted in the dynamic European wind-energy market

Figure III.5.7 EPO patent applications in wind energy - three year moving average, 1982-2007



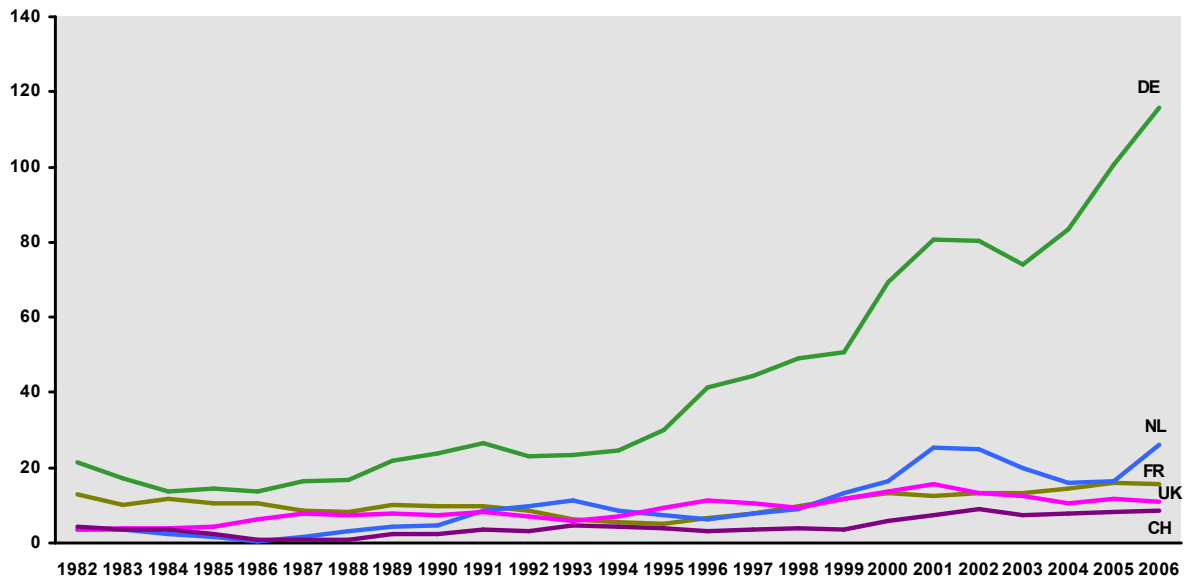
Source: DG Research and Innovation  
 Data: OECD

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The photovoltaic (PV) industry, on the other hand, represents a source of renewable energy where Europe has been less successful as other countries play an important part in the European Market. Japanese, American and, recently, South Korean firms have been active in patent applications in Europe. This reflects the importance of Asia in the domain of PV, as 7 out of the 10 largest companies in the world come from Asia, 2 from the United States and 2 from Europe (Germany).

In Europe, thanks to Germany, the production of solar energy exploded in 1995. Demand-side policies were implemented earlier here than in any other European country, and in the most active manner. The Renewable Energy Sources Act (2004) fixed very favourable tariffs that allowed Germany to have the highest annual rate of PV installation worldwide. It is estimated that 48 000 people are employed in the PV industry alone.

Figure III.5.8 EPO patents in solar energy (3 year moving average), 1982-2006



Source: DG Research and Innovation  
Data: IEA

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*To reap the fruits of the new technologies oriented towards mitigating climate change, lead markets need to be developed and better regulation enforcing their use is needed in order to achieve the full benefits.*

While new technologies are being developed and their benefits in reducing CO<sub>2</sub> emissions or abating pollution are proven, it is still difficult to estimate the full benefits accruing from them. New innovative products and processes will have to be embedded in these upcoming 'breakthrough' technologies, so that the full benefits can be reaped.

This will also require further policy developments to ensure that these new technologies are developed into new products that are then adopted into the market. Regulations, policies on the demand side and the setting of a price on carbon will also be required in addition to technological developments.

## 5.2. What contribution is science and technology making to healthy ageing?

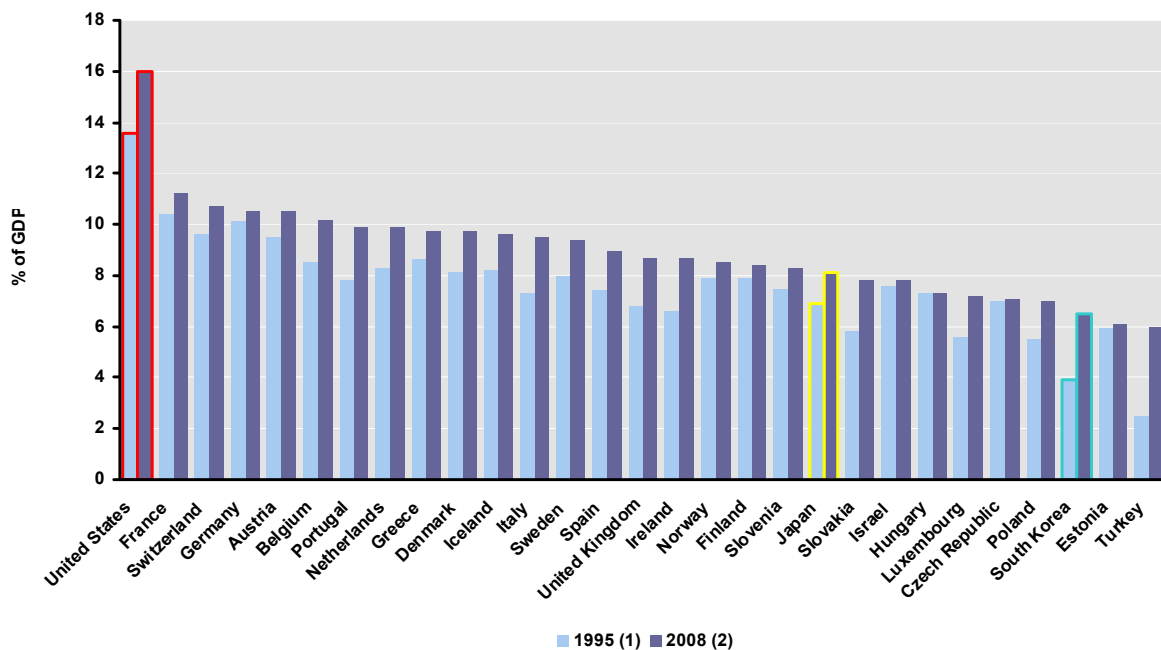
Europe has become an aging society, and will increasingly be so. The improvements in life expectancy coupled with a fall on the fertility rates have brought about a progressive aging of European society. It is expected that in the future, this aging phenomenon will accelerate<sup>68</sup>. An aging population in need of more and better healthcare will pose important challenges to existing healthcare systems as public budgets come under stress. The increase in health costs coupled with the desire to improve the quality of health and long-term care for older citizens

<sup>68</sup> See Part I, chapter 4 for a thorough description of the demographic change in Europe.

will require further investments in health. At present, many developed economies, including EU countries such as Belgium, France, Austria and Germany, devote more than 10% of the national wealth to these activities. Many of these countries have sharply increased the resources devoted to these activities in the last fifteen years or so, and this trend is likely to continue as the cohorts of baby boomers grow older and require more medical assistance.

In order to sustain the system, new medical technologies capable of maintaining health in old age and bringing medical costs down, are regarded as one of the main solutions — if not the only one — to sustain Europe’s quality of life.

Figure III.5.9 Total expenditure on health as % of GDP, 1995<sup>(1)</sup> and 2008<sup>(2)</sup>



Source: DG Research and Innovation  
Data: OECD

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Notes: (1) SK: 1997; EE: 1999.

(2) LU, PT: 2006; DK, EL, TR, JP: 2007; IT, IS: 2009.

(3) BE, CZ, DK, EL, ES, LU, HU, NL, PL, PT, SI, SE, UK, IS, NO, TR: Breaks in series occur between 1995 and 2008.

### 5.2.1. Investments in science and technology for healthy ageing

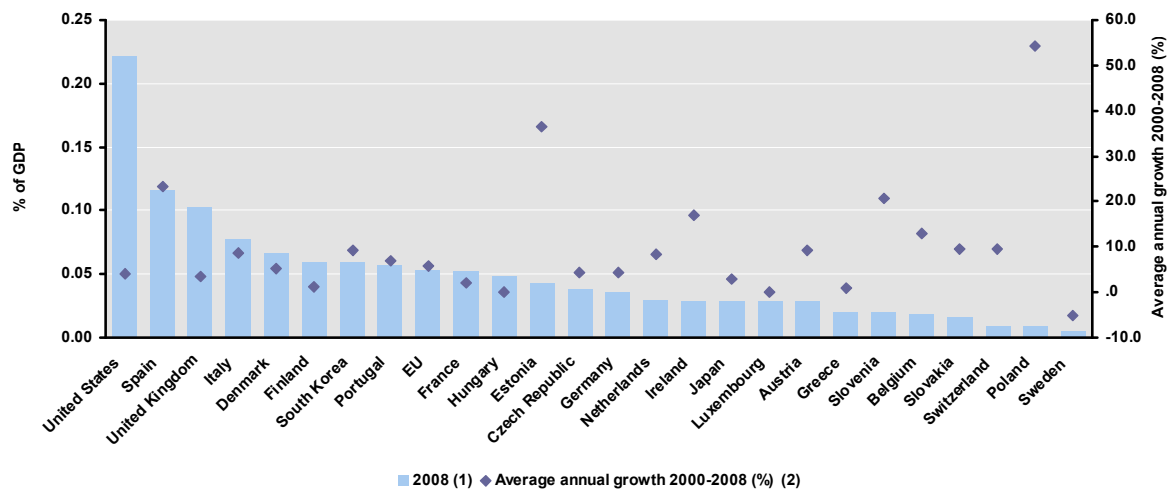
*The United States is by far the absolute and relative largest investor in health research thanks to both public and private sectors*

The United States presents the strongest investment patterns in the world, well ahead the EU. In terms of public budgets, the United States devoted more than 0.2% of the national wealth to health-related R&D, while the EU and South Korea barely invested 0.05%. At this point, it should be noted that for Europe, public R&D investment in health is likely to be higher than the values represented here. Due to the institutional complexity and diversity of centres carrying out health research, many European countries, e.g. Sweden, France, the United Kingdom and Spain, devote significant extra public R&D resources to medical research in other sections of their national budgets that do not fall directly under the ‘improvement of

public health' category, as defined by the Frascati Manual. Therefore, the values are not fully comparable. Unfortunately, no aggregated value is available for the EU<sup>69</sup>.

In recent years however, European governments have increased public budgets related to health research. Since the year 2000, European public budgets grew at an average annual rate of nearly 6%, lower than South Korea, with an average annual growth rate above 9%, but above the United States, with average increases of nearly 4%, and Japan at 3%

Figure III.5.10 GBAORD for R&D in health as % of GDP, 2008<sup>(1)</sup> and average annual growth 2000-2008<sup>(2)</sup>



Source: DG Research and Innovation

Data: OECD

Notes: (1) HU: 2005; EU, UK, CH: 2006; BE, EL, EE, ES, LU, PL, PT, SI, 2007.

(2) EU, UK, CH: 2000-2006; BE, EL, ES, PT, SI: 2000-2007; EE: 2002-2007; PL: 2004-2007; DK: 2001-2008; CZ: 2002-2008.

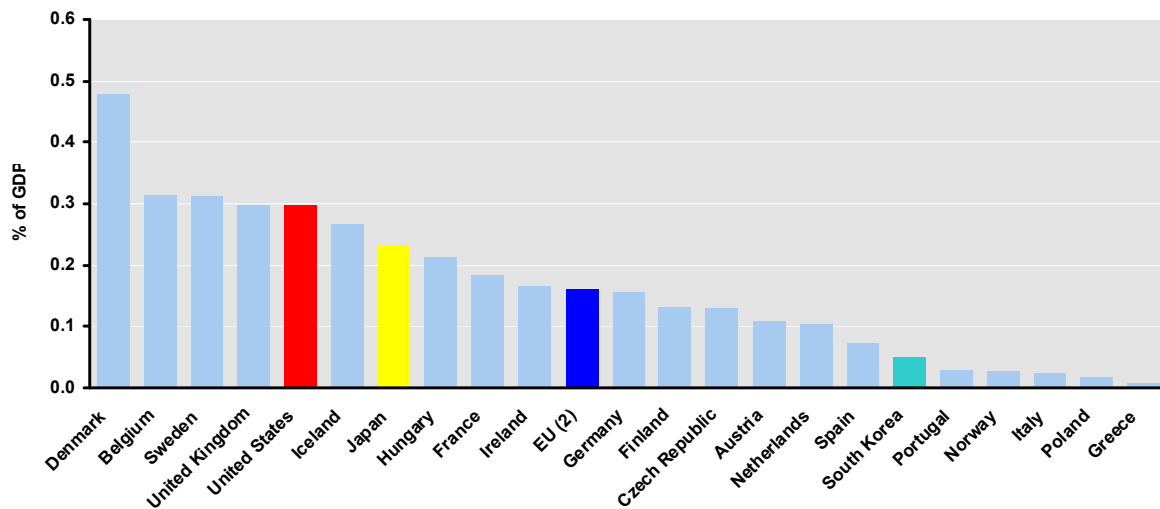
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In terms of private R&D, pharmaceutical companies in the United States also invest more resources than EU companies. Proportionally, companies based in the United States invest almost twice as much in R&D as their European counterparts.

As a result, these high-technology enterprises can benefit both from their own higher R&D investments and the higher public R&D investments that generate a broader knowledge base from which they can capitalise and develop new innovative products and processes.

<sup>69</sup> For a thorough description of the methodology to calculate overall public R&D budget allocations, please consult the OECD 'Science, Technology and Industry Scoreboard, 2009'.

Figure III.5.11 R&D expenditure in the pharmaceutical industry as % of GDP, 2006<sup>(1)</sup>



Source: DG Research and Innovation

Data: OECD

Notes: (1) IE, EL, PT, IS: 2005.

(2) EU does not include BG, EE, CY, LV, LT, LU, MT, RO, SI, SK.

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## 5.2.2. Patents in healthy ageing

Health-related patents have risen in consonance with the increases in R&D investments. For our analysis, health-related technologies include both medical technologies, which are associated with high-technology, and pharmaceutical technologies that mainly refer to an area of application, not a technology *per se*<sup>70</sup>.

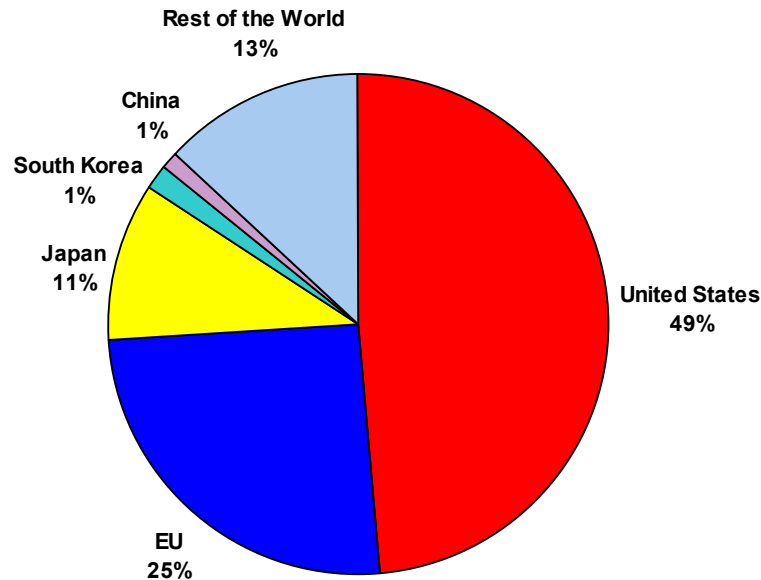
***The United States is the world leader in the development of medical-related technologies, accounting for almost half of all patents. Europe follows***

The United States is the world leader in developing new technologies related to human health. In terms of medical technologies, the United States accounts for almost half of all the world patents, while the EU's share is slightly above a quarter.

<sup>70</sup> For a full description of the fields covered by both medical technologies and pharmaceutical patents, please refer to the OECD (2009): 'Science, Technology and Industry Scoreboard', p. 60 ([http://www.oecd-ilibrary.org/content/book/sti\\_scoreboard-2009-en](http://www.oecd-ilibrary.org/content/book/sti_scoreboard-2009-en)).



**Figure III.5.12 PCT patent applications in medical technologies - world shares, 2004-2006**



Source: DG Research and Innovation  
Data: OECD

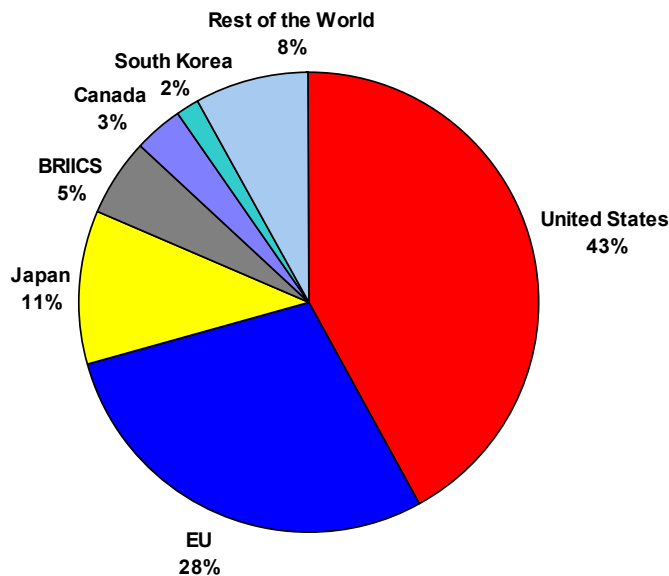
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***The situation in pharmaceutical patents is similar. The United States leads and the EU follows***

Pharmaceutical companies based in the United States filed 43% of all the pharmaceutical patent applications under the PCT in the world in 2004–2006, while companies based in the EU filed 28% of them.

In Europe, countries with strong pharmaceutical sectors such as Germany, with more than 25% of all EU patents, or the United Kingdom, with 20%, filed almost half of all the pharmaceutical patent applications in the EU.

Figure III.5.13 Pharmaceutical PCT patent applications - world shares, 2004-2006



Source: DG Research and Innovation

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Data: OECD

Note: BRIICS: Brazil, Russian Federation, India, Indonesia, China, South Africa.

***Health-related technologies, especially those related to pharmaceutical technologies, can also provide large economic returns and represent an area for future economic growth. Health research is believed to provide ‘exceptional returns’<sup>71</sup>, both in terms of reduction of direct costs of treatments and increase of longevity and quality of life of citizens***

It is not easy to assess the economic impacts of health research in the economy and the well-being of citizens. It is difficult to measure the impacts of improved health, provide an economic value to it and link it back to the original research. However, despite these difficulties, it is broadly accepted that in Europe health research has largely contributed to the increase of life expectancy and quality of life of its citizens. In a context of aging population, health research will become even more important in the future, both from a social and economic perspective.

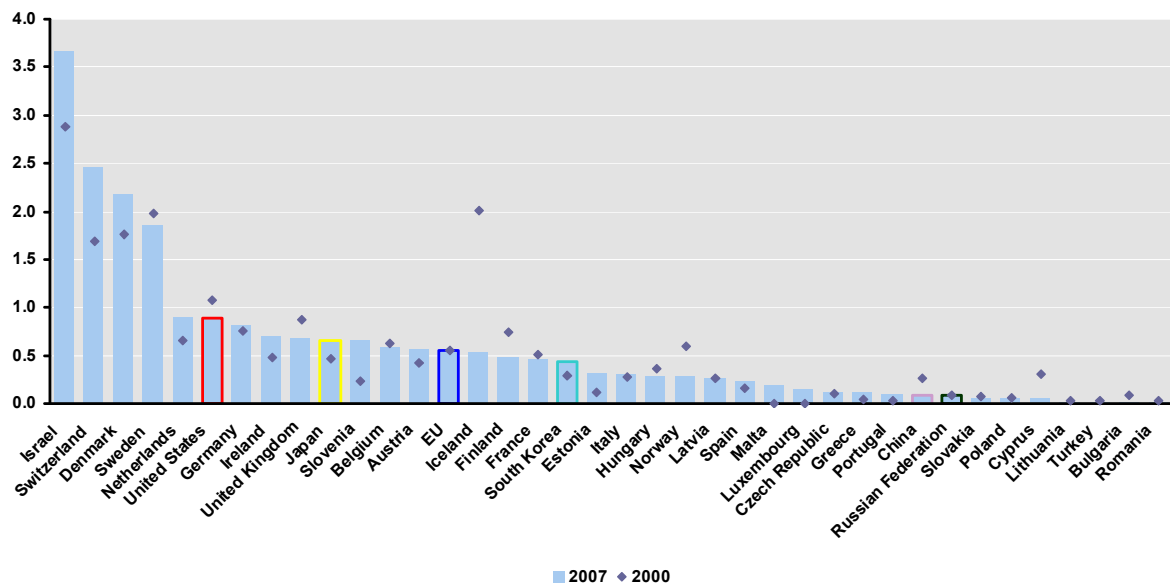
Citizens and governments with limited financial resources will look for an increasing number of medical and pharmaceutical innovations that will contribute to reducing the direct costs of treating illnesses, the indirect costs of employment losses associated with the mortality or morbidity of the labour force and to increasing the longevity and quality of life of the citizens. In the United States, an estimation of the reduction of direct costs in the treatment of illnesses generated by the research funded or conducted by the National Institutes of Health rose to more than USD 1.3 trillion (OECD 2008).

<sup>71</sup> Access Economics Ltd (2003), ‘Exceptional Returns: The value of Investing in Health R&D in Australia’, The Australian Society for Medical Research, Canberra.

***Israel, Switzerland, Denmark and Sweden are leading in Europe in producing technologies for health***

Israel and Switzerland are the countries in the world which produce the most health-related technology patents relative to GDP<sup>72</sup>, well ahead of the United States and Japan in their intensity. Denmark, Sweden and the Netherlands also have a strong technological capacity in this societal field.

**Figure III.5.14 Health technologies - PCT patent applications per billion GDP (PPS€), 2000 and 2007**



Source: DG Research and Innovation  
Data: OECD

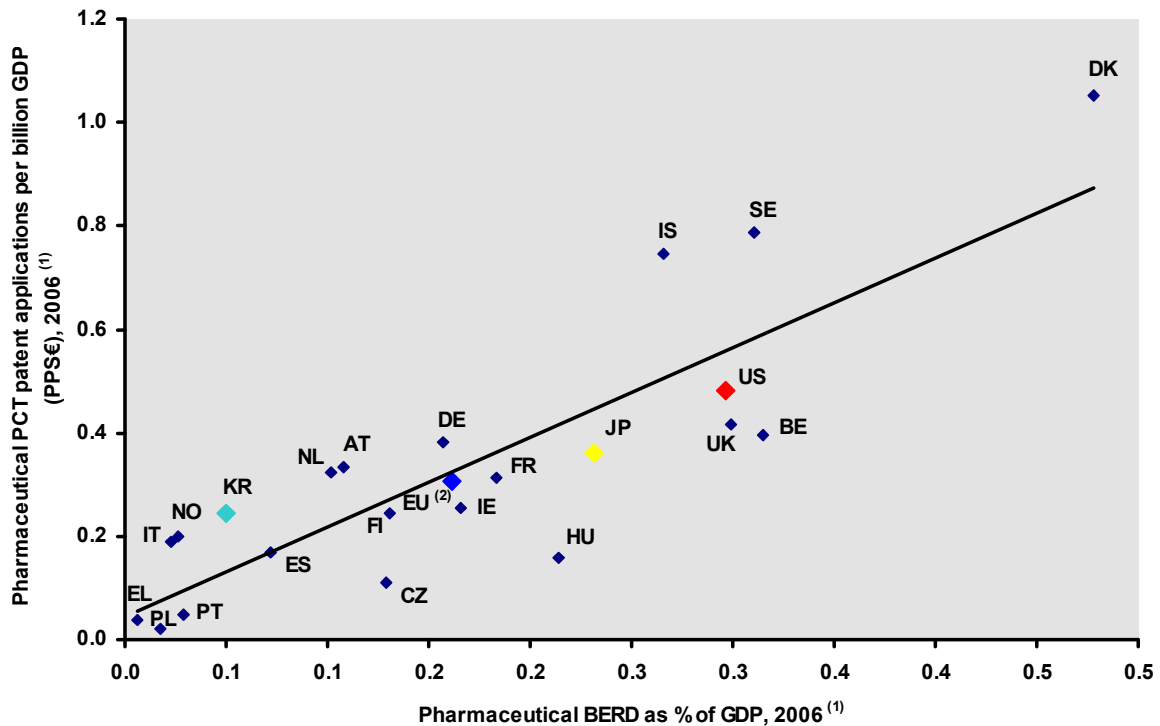
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***As expected, countries benefiting from strong public and private research investment also achieve ample technological returns***

The relationship and synergies between public and private research have a clear impact on the technological production. The correlation between both public and private R&D and pharmaceutical patents is very high. As figure X below shows, and as previously explained in this chapter, the United States is by far the world leader in research investment and in patent productions, followed by the EU.

<sup>72</sup> In Figure III.5.14, patent data for health are OECD data concerning PCT (Patent Cooperation Treaty) patent applications by inventor's country of residence and priority year. Health patents include patent in medical technologies and pharmaceuticals.

Figure III.5.15 Pharmaceuticals - BERD as % of GDP and PCT patent applications per billion PPS€, 2006<sup>(1)</sup>



Source: DG Research and Innovation

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Data: OECD

Notes: (1) IE, EL, PT, IS: 2005.

(2) EU does not include BG, EE, CY, LV, LT, LU, MT, RO, SI, SK.

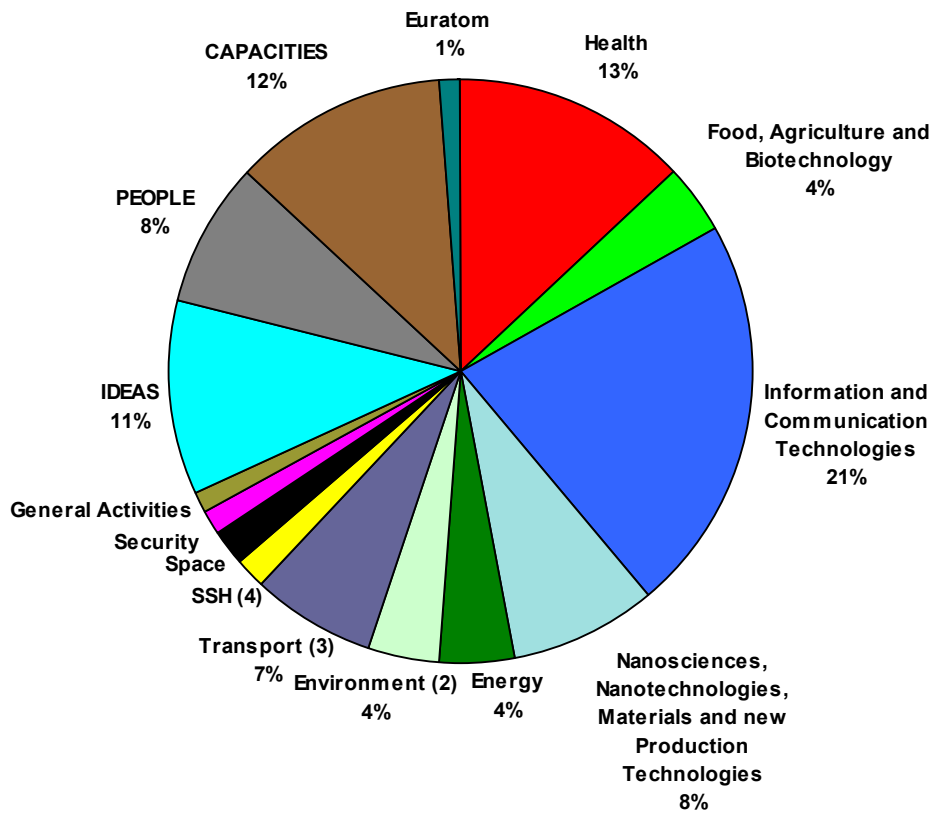
### 5.3. Does the EU Framework Programme address societal challenges?

Most key societal challenges are global in their nature. Given common interests, the internationalisation of science and the fact that over 75% of world knowledge is produced outside the EU, how has European research tackled societal challenges through international cooperation?

#### *The funding of FP7 is largely targeted towards addressing societal challenges*

A large part of FP7 funding supports research in ICT and nanosciences, whose results can be used and exploited in many scientific and technological domains. FP7 funding is also largely funding research addressing the challenges regarding health, food, energy, environment and transport that Europe is facing.

Figure III.5.16 FP7 by thematic priorities, 2007-2009 (9.2 billion euro) <sup>(1)</sup>



Source: DG Research and Innovation

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Data: DG Research and Innovation

Notes: (1) Selections made before 25 October, 2009.

(2) Includes Climate Change.

(3) Includes Aeronautics

(4) Socio-economic Sciences and Humanities

***A large proportion of the FP7 Cooperation programme deals with topics in different fields related to climate change or human health<sup>73</sup>***

A recent review of the monitoring of the Cooperation Programme of the FP reveals that around 1032 topics (i.e. 43% of the total number), deal with research conducive to a low-carbon society. In terms of budget, this amounts to EUR 2.7 billion, i.e. 31.5% of the total allocated budget. In the same line, 771 topics, accounting for EUR 3.34 billion dealt with human health. These topics are not only covered in Health, but in many other areas.

<sup>73</sup> Preliminary data from the monitoring system of the FP7 implementation.