ISBN 978-92-64-04991-8
OECD Science, Technology and Industry
Outlook 2008

Chapter 2

Main Trends in Science, Technology and Innovation Policy

This chapter presents the main trends in national science, technology and innovation policies, focusing in particular on policies and programmes introduced between 2006 and 2008. It discusses developments related to public-sector research, government support for business R&D and innovation, collaboration and networking among innovating organisations, globalisation of R&D and open innovation, human resources for S&T, and the evaluation of research and innovation policies.

Introduction

Since the 2006 edition of the *OECD Science, Technology and Industry Outlook*, science, technology and innovation policies have continued to evolve.[1] In some cases, there have been gradual changes in the mix of policies and instruments to support research and innovation (*e.g.* a shift towards indirect measures and a growing interest in demand-side policies). In other cases, there have been significant changes in line with broader policy reforms in framework conditions for economic development. In still others, reform is due to changes in elected governments as well as demand from society to address national concerns (*e.g.* jobs, education, health) and, increasingly, global challenges such as energy security and climate change. Although changes in framework conditions are beyond the scope of this chapter, many of the policy areas covered, from public funding of research and development (R&D), to human resources for science and technology (HRST) to tax incentives for business R&D, are influenced by broader social and economic policies that shape the scope for sustainable growth.

Countries therefore are challenged to develop and implement innovation policies above and beyond those that promote public and private R&D. Yet, many government innovation initiatives remain focused on technology- or science-based innovation rather than on innovation in a broader sense (*i.e.* non-technological innovation) or on sectors that do not do much R&D (*e.g.* resource-based and traditional sectors) or on services. Part of the reason is arguably the fact that much of the policy rationale, as well as the metrics used to measure success, arose from market failure arguments over the inability of firms to fully appropriate returns to investment in R&D due to externalities, which in turn led to underinvestment in R&D. The challenge of supporting innovation in a broader sense is even greater from the operational point of view: while government responsibility for R&D is often the remit of one ministry (*e.g.* research and education ministries) and while a few sectoral ministries may promote mission-oriented research (*e.g.* energy, agriculture and health), a wide variety of public policies support innovation. They range from framework conditions for business in general (*e.g.* labour market policies, competition policy) to areas such as the quality of public research or of education and the development of linkages with the innovation system. The resulting complex environment implies a need for more co-ordinated policy making and implementation across a range of government departments and agencies, as well as at different levels of government.

With this in mind, a broad set of policy trends has emerged or been reinforced since the last edition of the *STI Outlook*:

- *The globalisation of R&D and more open innovation models are challenging national policy making.* The globalisation of R&D and the emergence of open innovation platforms are fast redefining how businesses innovate and are leading governments to enhance framework conditions for research and innovation as well as to adapt their specific policies and supporting instruments to the changing nature of innovation.

OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

- *Medium- and long-term national S&T plans include more quantitative objectives and monitoring elements*. National science and technology (S&T) plans increasingly present quantitative objectives such as R&D investment targets (*e.g.* the EU Lisbon Agenda objectives) as well as qualitative ones. The use of targets can help monitor and assess progress and the achievements or shortcomings of national plans and can also help mobilise political support for specific policy goals. National plans also reflect national priorities articulated or decided at the executive level of government and are being linked more closely to regional strategies and plans.
- *Several countries have strengthened institutional mechanisms for S&T governance,* notably as regards the co-ordination of design and implementation (*e.g.* new inter-ministerial councils) especially in light of the increasing number of actors involved in research and innovation policy. Some countries have reorganised ministerial or departmental functions to strengthen the links between R&D and higher education or between industry and research.
- *Countries continue to focus on key research and technology fields* such as information and communication technologies (ICTs), health, nanotechnologies and energy, but social issues are increasingly a focus of science, technology and innovation policies. They include ageing, social cohesion and, in the case of catching-up economies, alleviation of poverty and increased access to higher education.
- *Reform of funding mechanisms for research institutions* to link budget allocations to performance evaluation is becoming more widespread.
- *Efforts are made to reduce fragmentation and create critical mass and excellence in the public research sector.* Initiatives in this area include ensuring or strengthening block grant funding mechanisms to support longer-term research, especially in catching-up economies, or renewing support for infrastructure and research equipment in more advanced countries.
- *Support for business R&D and innovation continues to increase* and is characterised by focusing or streamlining of programmes and improving ease of access and use, especially for small and medium-sized enterprises (SMEs). Indirect support, such as R&D tax credits, continues to evolve as countries revise various schemes in order to improve uptake in firms, increase business R&D spending and meet other policy goals. Some of the interest in R&D tax credits may also reflect growing tax competition between countries in this area.
- *Networking and cluster initiatives continue to emerge* while various tools (*e.g.* tax credits) are being used to promote collaboration between industry and research. Support for clusters is also evolving from geographically bound clusters towards a focus on creating world-class "nodes" to link to global innovation value chains. In this context, linkages and co-operation between regions both within and between countries is becoming more important.
- *Support for non-technological and user-driven innovation, including in services, is receiving growing emphasis*. Recognising that non-technological and other forms of innovation (*e.g.* design, branding) are important to competitiveness, especially in services firms, OECD countries are trying to raise awareness and encourage non-technological innovation alongside technological innovation. Policies in this area have not yet fully developed, however.

- *Human resource development is an area of continuous policy focus and action.* Many OECD countries have implemented a variety of policies to improve the development of human resources in science and technology ranging from initiatives to raise interest in and awareness of science among youth, to reduce gender gaps in science and technology education, to improve funding opportunities for PhD study and post-doctoral training. In addition to increasing the supply of new S&T graduates, there is a strong focus on better linking education with industry skills needs to reduce dropout rates and to better match demand. In this context, there is a renewed focus on university reform as well as on training of vocational and technical personnel. The international mobility of students and young researchers and other highly skilled expatriates also remains a high priority in many countries.
- *Evaluation mechanisms and tools are increasing in importance as countries seek to monitor progress in policy making and to assess socio-economic impacts. Ex ante* evaluation is becoming more widespread, but countries still encounter difficulties in using evaluation to guide policy making at various levels of government and institutions.
- *Policies to foster demand for innovation, such as the development of lead markets, innovation-friendly procurement and standards, are receiving growing emphasis, in particular in the European Union (EU).* These policies reflect the awareness that some of the key problems in certain countries are linked to the lack of markets for innovative products and services. In spite of the growing attention to this area, questions on the focus, design and implementation of demand-side policies remain.

While OECD and non-member economies face common challenges, such as improving national competitiveness in the face of globalisation, differences in terms of economic development and S&T capacity and innovation performance result in differences in priorities but also in their policy responses. As many advanced OECD countries face growing global competition, the contribution of innovation to fostering economic growth and future competitiveness becomes a key issue. For catching-up economies in the EU, participation in the European Research Area and the use of structural and regional funds to boost domestic capacity for research and innovation will be both a challenge and an opportunity in the coming years. For non-OECD economies, especially the less advanced, the key challenge ahead remains building the framework conditions and infrastructure – institutional, physical and intellectual – to use science, technology and innovation as a source of future economic growth.

National strategies for science, technology and innovation

National plans or strategies for S&T and innovation continue to evolve. In some cases, past strategies remain in place but countries are fine-tuning or modifying the mix of policy instruments they use to implement the strategies. The fine tuning of policy is also taking place in response to recommendations from international peer review of countries by the OECD and the European Commission. In other cases, recent changes in government have led to the development of new plans, new strategies and new institutions as well as changes in the level of funding or in the financing channels or mechanisms used to support research and innovation. New rules on reducing red tape or administrative reform based on new public management models are also driving changes to national plans or in their implementation. In still other cases, the arrival of new governments with new political priorities (*e.g.* labour, fiscal or welfare reform) has lowered the visibility of existing

S&T strategies. Nevertheless, for many countries, there is a degree of continuity. Many plans have five-to-ten-year horizons and many of the instruments used require considerable time, often exceeding electoral mandates, to bear fruit. A noteworthy recent trend is the development of national innovation strategies that encompass all or most government ministries.

National strategies also include more quantitative objectives and monitoring elements. They are also being linked more closely to regional strategies and plans. More countries select and focus S&T policies on strategic priorities. Moreover, more attention is paid to social issues and to demand-side measures. Some recent updates to national plans and strategies include:

- The Danish government has launched an ambitious and pro-active strategy to prepare Denmark for the future. The strategy, published in April 2006, contains 350 specific initiatives and entails extensive reforms in education and training programmes, research and entrepreneurship. It also provides for substantial improvements in the framework conditions for growth and innovation in all areas of society. The strategy focuses specifically on helping Danish enterprises become more innovative, including new innovation-promoting instruments for SMEs. It provides more opportunity for initiatives based on enterprise demand, plans technological services for SMEs, and promotes the employment of more highly educated staff in SMEs. It deals with the services sector's need for user-driven innovation. More generally, it aims to streamline knowledge dissemination and innovation by making the system more demand-oriented and improve access to information on initiatives for promoting innovation. The plan also seeks to strengthen interaction between research and industry, in part by co-financing Danish enterprises' participation in international research and innovation programmes.
- France's research and innovation system has evolved significantly since the mid-2000s. Funding has increased since 2004 and the 2006 research programme law (*loi de programme pour la recherche*) has launched several reforms regarding the organisation and programming of research (including the creation of new funding agencies for research and for innovation – *Agence nationale de la recherche* and the *Agence de l'innovation industrielle*). These were recently strengthened by the 2007 university reform act which aims to increase the financial and administrative autonomy of universities, helping them develop the tools to define a true research policy.
- Finland launched an innovation strategy in 2008 (*www.innovaatiostrategia.fi*) which aims to create a broad-based and multifaceted innovation policy to help the country face the challenges of globalisation, sustainable development, the emergence and convergence of new technologies and an ageing population. Key elements of the strategy include a focus enabling Finland to engage in innovation in a globalised context; to help steer innovation by demand, focusing on the role of users, consumers and citizens in the private and public sector; to enhance the contributions of individuals, entrepreneurs and communities to innovation; and to develop a broad-based and comprehensive innovation policy by strengthening the administrative structures for policy design and implementation. The strategy presents ten key sets of measures ranging from changes to the governance structures for S&T policy making, updating the set of public financing and expert services to meet the needs of demand and user-oriented innovation, to innovation-friendly procurement.

- Germany has launched several major funding initiatives in order to boost research expenditure to 3% of gross domestic product (GDP) by 2010. In 2005, the federal and *Länder* governments adopted the Pact for Research and Innovation which calls for increased joint funding of the major German research organisations by approximately EUR 150 million a year. For higher education institutions the Initiative for Excellence aims to promote top-level research and improve the quality of German universities; EUR 1.9 billion will be made available to support graduate schools, "excellence clusters" and the development of institutional strategies for leading university research. The federal government's High-Tech Strategy of August 2006 is the first comprehensive national innovation strategy. Its aim is to boost German competitiveness in the most important future markets. For 2006-09, approximately EUR 15 billion will be made available, of which EUR 12 billion for research and the dissemination of new technologies in leading fields (*e.g.* health research and medical, security, energy, environment, services, nanotechnologies and biotechnology) and EUR 2.7 billion for cross-cutting measures.
- In 2007, the Japanese government formulated a long-term strategic plan, Innovation 25, for the next two decades, to be implemented in line with the third S&T basic plan. Innovation 25 encompasses renewal of technology and the reform of social systems. It includes nearly 150 urgent and 30 medium- to long-term measures for social system reform. The aim is to eliminate institutional bottlenecks so that achievements of science and technology can be put into practice and to develop a new framework to accelerate the process. Innovation 25 focuses on: *i)* a pioneering project for accelerating social returns; *ii)* promotion of strategic R&D in individual fields; *iii)* diversification of basic research; and *iv)* strengthening the R&D system.
- In 2007, the Korean National Science and Technology Council approved its second five-year S&T basic plan (2008-12) which aims to help Korea become one of top five countries by 2012 in terms of S&T competitiveness. To this end, the plan sets major policy directions: to move from the existing follower/imitative innovation system to a creative/pioneering innovation system; to target 100 strategic technologies for the creation of future growth and the improvement of quality of life; to facilitate innovation in the services industry; and to expand the ratio of government R&D investment to GDP from 0.86% in 2006 to 1% in 2012.
- In 2007, the Hungarian government adopted its mid-term (2007-13) Science, Technology and Innovation Policy Strategy, which focuses on the following issues: *i)* a culture of acceptance and use of scientific research results; *ii)* an efficient national innovation system based on quality, performance and use; *iii)* a creative and innovative workforce able to meet the demands of a knowledge-based economy and society; *iv)* an economic and legal environment that encourages the creation and use of knowledge; *v)* domestic companies, products and services that are competitive in the global market.
- In 2007, the Slovak government introduced the Innovation Strategy 2007-13 and the Long-term Objective of the State S&T Policy for 2015. The former aims to increase innovation and support its transfer into practice. The latter, prepared by Ministry of Education, has three broad objectives: *i)* greater involvement of S&T in the country's development and more intensive use of S&T in solving economic and social problems; *ii)* better conditions for developing S&T in the Slovak Republic and through participation in the European Research Area; and *iii)* setting targets for S&T development in a number of areas (*e.g.* S&T policy co-ordination, systemic R&D priorities, thematic priorities).

- In 2007, Spain's national and regional governments jointly adopted the National Strategy for Science and Technology as the guide for S&T policies until 2015. Its objectives are: *i)* to place Spain at the frontier of knowledge; *ii)* to foster a highly competitive business sector; *iii)* to integrate regions in the S&T system; *iv)* to boost the S&T system's international dimension; *v)* to facilitate a favourable environment for investment in R&D and innovation; and *vi)* to ensure appropriate conditions for the diffusion of science and technology.
- Switzerland's Federal Council's policy paper, "ERI Dispatch", promotes education, research and innovation for 2008-11. It contains policy objectives as well as a detailed account of the proposed measures (legal changes, credit requests, etc.). To co-ordinate the planned measures, the Federal Council has established two policy guidelines: the education guideline for securing and improving sustainability and quality and the research and innovation guideline for increasing competitiveness and growth. In autumn 2007 the Federal Parliament approved a budget of CHF 20.1 billion for 2008-11.
- In the United Kingdom, government published a White Paper, *Innovation Nation*, in March 2008, which sets out a new vision for strengthening innovation performance economy-wide. It includes new proposals in a range of areas including on using procurement and regulation to promote innovation in business as well what it can do to make the public sector and public services more innovative.
- The Russian Federation developed the Strategy for Developing Science and Innovation for the period to 2015. The main target indicators and milestones are: *i)* to raise domestic R&D spending to 2% of GDP by 2010 and to 2.5% by 2015; *ii)* to enhance the prestige of Russian science by attracting young people to science and technology and raising the share of researchers under 39 years of age to 36% by 2016; *iii)* to increase innovation so that the share of enterprises introducing technological innovations reaches 15% by 2011 and 20% by 2016; and to see business expenditure for R&D reach 10% a year.

S&T governance and reform

A key element in the changes to national strategies or the launching of new ones has been modifications of the governance structures for S&T and innovation policy making. In most OECD countries, but also in non-member countries, the governance of S&T is organised as a multi-layered matrix in which ministerial bodies, advisory bodies and a range of different actors are involved in the making and steering of policy and its implementation. This matrix has bottom-up and top-down flows in the advisory and decision making processes. As in previous years, some countries have created new inter-ministerial committees or co-ordinating councils which often operate at the top or highest levels of government. Some countries are also making changes at the operational level, such as merging the functions of various agencies, in order to improve co-ordination and implementation as well as to provide greater visibility to higher level instances.

Advisory councils, co-ordination and implementation

In 2006, France established a new High-level Council for Science and Technology (*Haut Conseil de la science et de la technologie* – HCST) to give more coherence to national research policy making and improve the functioning of the overall research system. The HCST answers to the President of the Republic and is composed of 20 members designated on the basis of their scientific and technological competence. Its mandate is to advise the president on all issues of national importance related to S&T, technology transfer and innovation. It thus helps strengthen the legitimacy of the government's strategic choices.

Table 2.1. **Revised or new national plans for science, technology and innovation policy in OECD countries and selected non-member economies 2008**

	National plan	Period covered	Main objectives
Australia	Backing Australia's Ability – Building Our Future through Science and Innovation	2004-10	Strengthen Australia's ability to generate ideas and undertake research; accelerate the commercialisation of ideas, and develop and maintain skills. Provides approximately AUD 1 billion a year through 2010.
Austria	Strategie 2010: National Action Plan for Innovation	2005-10	Improvement of networking and co-operation between science and industry; strengthen framework conditions; public infrastructure; financing innovation; human resources for innovation.
Belgium	Strategic Plans for Each Belgian Entity	From 2006	Federal Belgian policy focuses on reducing costs of R&D employment and attracting foreign talent. Flemish policy focuses on R&D goals and "integrating" innovation policy making; Wallonia's strategy focuses on boosting business R&D and linking universities to industry; Brussels Region focuses on regional clusters and the French Community aims to strengthen basic research and research careers as well as industry-science links.
Canada	Mobilizing Science and Technology to Canada's Advantage	2007 onwards	The actions Canada will take will be based on four guiding principles: promoting world-class excellence; focusing on priorities; fostering partnerships; and enhancing accountability.
Czech Republic	The National Research and Development Policy of the Czech Republic	2004-08	The systemic priority areas are the following: human resources; international co-operation in R&D; regional aspects of R&D; exploitation of research results in practice; research evaluation. Thematic priority areas: safe, reliable and ecological power engineering for the future; information- and knowledge-based society; quality of life and safety; new materials and technologies; economic and social needs.
Denmark	Progress, Innovation and Cohesion	2007-10	Strengthen Denmark's competitiveness in the global economy; more public investments in R&D; improve the efficiency of public spending on R&D and education, in particular by allocating more public funds through open competition and internationalisation of R&D; long-term research projects and strategic research projects; human resources for innovation. The government has announced its intention to invest an additional EUR 1.5 billion in R&D for 2007-10.
Finland	Science, Technology, Innovation	2007-11	Raise R&D from 3.5 to 4% of GDP by the end of the decade; promote the innovation system and its ability to renew itself; enhance the competence base; improve quality and focus of research; promote introduction and commercialisation of research results; secure economic "prerequisites", including human resources.
France	*La loi de programme pour la recherche* (new law on research)	From 2006	Improve the strategic vision and coherence of the research system; develop interfaces and co-operation between public research actors and between them and the business sector.
Germany	High-tech Strategy	2006-09	As the first comprehensive national innovation strategy, about EUR 14.7 billion will be invested in 2006-09. EUR 12 billion will be earmarked for research and the dissemination of new technologies in 17 fields. In addition, five key cross-cutting fields (*e.g.* strategic partnerships; internationalisation of R&D and innovation; fostering the advancement of talented young scientists, etc.) were identified for the successful implementation of this strategy.
Greece	Strategic Plan for the Development of Research, Technology and Innovation	2007-13	Meet the challenge of globalisation by shifting the Greek economy towards higher value added and more user-friendly sectors; more emphasis on innovation support measures, in particular in a regional context; creation of internationally competitive poles/centres of excellence in high-technology sectors.
Hungary	S&T Innovation Strategy	2006-13	Increase total R&D expenditure to 2.1% of GDP by 2013 while doubling the ratio of business to public R&D performance (business at 1.4% of GDP; government at 0.7%). Strong focus on key technology areas, commercialisation and regional innovation systems.

OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

Table 2.1. **Revised or new national plans for science, technology and innovation policy in OECD countries and selected non-member economies 2008** *(cont.)*

	National plan	Period covered	Main objectives
Iceland	Policy Statement of the Science and Technology Policy Council	2006-09	Foster an education and research system of high international quality in close contact with the economy; strengthen competitive funding for research and innovation; strengthen university research; re-organise public research labs and link them to higher education; enhance public/private sector co-operation for increased international competitiveness; and review the role of the state in supporting long-term research and monitoring in the public interest.
Ireland	Building Ireland's Knowledge Economy: The Irish Action Plan for Promoting Investment in R&D to 2010	2006-10	Promote R&D to become an innovation-driven economy; improve competitiveness; remain attractive for FDI; and maximise social cohesion.
Italy	The National Programme for Science and Technology	2005-07	Support basic and mission-oriented research; increase the technological level of the production system. *e.g.* through the creation of high-technology spin-offs; develop human capital for science; intensify collaboration among public research institutes, universities and enterprises. A new National Research Programme for 2008-10 to be issued in 2008.
Japan	A Long-term Strategic Guideline: Innovation 25	2007-25	Short- and longer-term strategies to create the future prosperity of Japan through investment in R&D, social reform and development of human resources.
Korea	2nd S&T Basic Plan	2008-12	Become one of top five countries in terms of S&T competitiveness by 2012 with highly advanced S&T.
Luxembourg	National Plan for Innovation and Full Employment	2006-10	Support innovation in all its forms to improve productivity. Raise R&D as a share of GDP to 2.4% in 2008 and to 3% in 2010, and raise the number of researchers to 10 per thousand employment by 2010.
Mexico	Programa Especial en Ciencia, Tecnología e Innovación (PECiTI)	2007-12	Apply short-, medium- and long-term state policy to strengthen education, basic and applied science, technology and innovation; decentralise scientific, technological and innovation activities; promote greater funding for basic and applied science, technology and innovation; increase investment in infrastructure for science, technology and innovation; evaluate public investment in development of human resources in S&T and scientific research, innovation and technology.
Netherlands	Innovative, Competitive and Enterprising	2007-11	Promote higher education and improve quality of research; stimulate innovation in SMEs; support business R&D through tax incentives.
New Zealand	Picking up the Pace – Economic Transformation Agenda	From 2006	Plan for the Ministry of Research, Science and Technology to set clearer directions for research, creating a more stable funding environment, accelerate commercialisation of research; support long-term sustainable investment in research, science and technology; support high performers; support engagement of New Zealanders in research, science and technology; and skills for the future.
Norway	White Paper on Commitment to Research	2005-10	Increase total R&D spending to 3% of GDP by 2010; raise Norway's international position in terms of new technology skills and knowledge. Three structural areas will have priority. Internationalisation is to constitute an overall perspective in research policy and basic research will remain a priority area. Emphasis will be given to quality rather than capacity building. Research in the field of mathematics, science and technology will be especially strengthened. The government will invest in research-based innovation and business development.
Poland	Strategy for increasing the innovativeness of the Polish Economy	2007-13	Develop human resources to build the knowledge-based economy; link public R&D activities to the needs of the enterprise sector; improve intellectual property rights; mobilise private capital to create and develop innovative companies; build the infrastructure for innovation.
Portugal	Technological Plan of the New Government Programme	From 2006	Encourage innovation; raise the number of researchers; increase investment in R&D in the public and private sectors, stimulate scientific employment in both sectors; strengthen S&T culture.

Table 2.1. **Revised or new national plans for science, technology and innovation policy in OECD countries and selected non-member economies 2008** *(cont.)*

	National plan	Period covered	Main objectives
Slovak Republic	Long term Objective of the State S&T Policy of the Slovak Republic to 2015	2008-15	Higher involvement of S&T in development and more intensive use of S&T in solving economic and social problems. Better conditions for developing S&T in the Slovak Republic and through participation in the European Research Area. Setting targets for S&T development in ten focus areas.
Spain	National Strategy for Science and Technology	2007-15	Put Spain at the frontier of knowledge; foster a highly competitive business sector; integrate regions in the S&T system; boost the S&T system's international dimension; facilitate a favourable environment for investment in R&D and innovation; ensure appropriate conditions for the diffusion of science and technology.
Sweden	Innovation Sweden	From 2005	Make Sweden competitive through renewal by boosting the knowledge base for innovation; develop innovative trade and industry; support innovative public investment and innovative people.
Switzerland	Education, Research and Innovation (ERI) Dispatch	2008-11	The goal of all planned measures is to enable the players and institutions of the ERI sector to extend Switzerland's capacities as a location for thought and work. Education is guided by the principle of securing and improving quality, and the goal in research and innovation is increased competitiveness and growth.
Turkey	National Science and Research Strategy	2005-10	Basic objectives are improving quality of life, solving social problems, increasing competitiveness and raising awareness of S&T by the public. Main targets are increasing the demand for R&D, enhancing the quality and quantity of scientists, professionals and technical personnel and increasing the share of R&D expenditures in GDP.
United Kingdom	Science and Innovation Investment Framework	2004-14	Retain and build world-class centres of excellence; improve the responsiveness of publicly funded research; increase business investment in R&D; strengthen supplies of scientists, engineers and technologists; ensure sustainable and financially robust universities and public laboratories; boost public confidence in and awareness of scientific research.
United States	American Competitiveness Initiative	From 2006	Boost funding for innovation and competitiveness; foster development of human resources for S&T.
Brazil	Action Plan in Science, Technology and Innovation for National Development	2007-10	The plan's main priorities are enlargement of business innovation and consolidation of the national innovation system. To this end, the plan establishes four strategic priorities with 21 action lines and 88 programmes and policy initiatives.
Chile	National Innovation Strategy for Competitiveness	From 2006	Build the institutional framework for the innovation strategy in order to improve medium-term competitiveness and, in the longer term, double GDP per capita; improve technology absorption; increase critical mass in scientific capacity; build human resources in S&T.
China	National Guidelines on a Medium- and Long-term Programme for Science and Technology Development	2006-20	Enhance China's S&T and innovation capabilities; use innovation as a tool for restructuring Chinese industry; shift growth modes from investment-driven to innovation-driven; build a conservation-minded and environmentally friendly society; and enhance independent innovation capabilities as a national priority.
India	Science and Technology Plan in the Tenth Five-year Plan	2002-07	Main focus areas are interface between industry, R&D institutions and academia; application of S&T for society; international co-operation in S&T; development of human resources in S&T.
Russian Federation	Strategy for Developing Science and Innovation	To 2015	Raise domestic R&D spending to 2% of GDP by 2010 and to 2.5% by 2015; enhance the prestige of Russian science; increase level of patent activity and capitalisation of R&D; raise the number of small innovative enterprises; and increase innovation activity.
South Africa	National Research and Development Strategy	2002-06	Further the implementation of the principles contained in the *White Paper on S&T*; promote innovation and new national technology missions (biotechnology, information technology, technology for advanced manufacturing, technology for and from natural resource sectors and technology for poverty reduction); improve and diversify human resources; promote a new set of science missions; and create an effective government S&T system.

Source: Responses to the STI Outlook 2008 policy questionnaire and national sources.

The Council can be summoned by both the president and the prime minister and can also be called upon to respond to urgent issues on which society requires a public policy response. Since its establishment in September 2006, the president has called upon the Council three times to advise on national research strategies in energy, health and the environment; to give scientific advice on social, economic and cultural changes in France and in the world; and to consider issues relating to human resources, including the attractiveness of research careers and large scientific equipment.

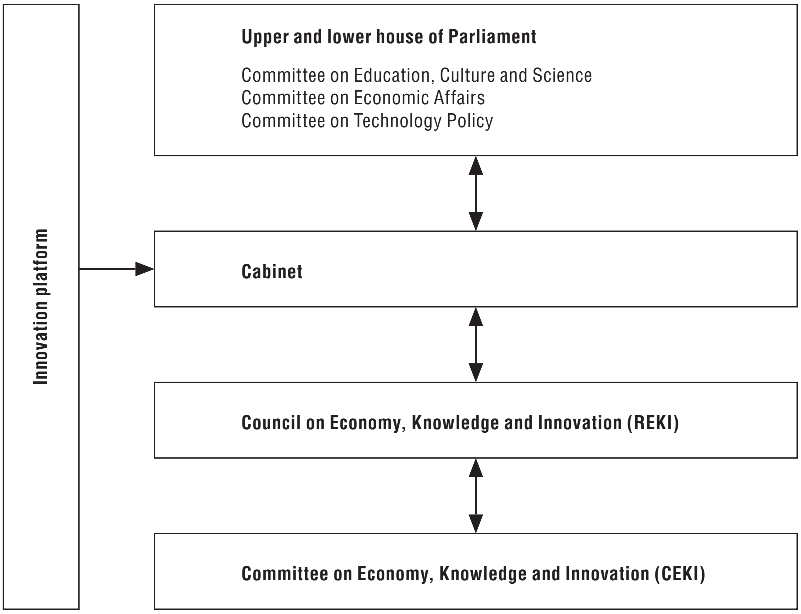
In April 2005, the Danish government set up a Globalisation Council with representatives of all sectors of society to advise the government on Denmark's strategy for the global economy. Those in the Council cross traditional divides: employers with trade unions and representatives of the major educational and research areas with those of companies. In a total of 14 meetings, the Council has heard contributions from 48 international and Danish speakers and held discussions with 111 representatives of organisations and other individuals specially invited to the meetings.

With the emergence in Japan of new stakeholders (*e.g.* industry, civil society) in policy design and implementation as well as new players (regions, localities, funding agencies), co-ordination of science and innovation policy has become more important. Japan has created a Headquarters for Innovation Promotion which is chaired by the prime minister in order to promote the new measures outlined in the national strategy. An Innovation Office was recently established within the Cabinet Office to implement the policies of Innovation 25.

In Chile, progress is being made on the institutional framework for S&T. Under the draft law under parliamentary debate, the President of the Republic is responsible for drawing up the long-term strategy that serves as a road map for innovation initiatives and for ensuring co-ordination and consistency in plans and programmes financed by the government. In drawing up the strategy, the president will be advised by the National Innovation Council for Competitiveness, which is comprised of experts in various areas related to innovation. The Council will also draw up policy proposals and will establish the resource allocation criteria and will evaluate the policies implemented by the government in the area. A new Committee of Ministers for Innovation will act as the link between the Council's proposals and the government's decisions. It will also serve as co-ordinator between public policies and the institutions responsible for implementation.

The Netherlands has established a dual co-ordination mechanism at the Cabinet and ministerial levels for governing the S&T system. Specific committees correspond to the six pillars of the current policy programme and are responsible to both levels. The interface for policies for knowledge and innovation takes place at the Cabinet level through the Council on Economy, Knowledge and Innovation (REKI), and at interdepartmental level through the Committee on Economy, Knowledge and Innovation (CEKI). The REKI is headed by the Prime Minister and is composed of the Minister of Economic Affairs (co-ordinating), the Minister of Education, Culture and Science, the Minister of Interior and Kingdom Relations, the Minister of Finance, the Minister of Justice, the Minister of Agriculture and Fisheries, the Minister of Social Affairs and Employment and the Minister of Health, Welfare and Sports. It prepares decisions to be taken by the plenary Cabinet. The CEKI consists of high-level civil servants of all relevant ministries and chooses the proposals to be presented to the REKI (Figure 2.1).

Figure 2.1. **Governance of S&T Policy in the Netherlands**



Source: Response to the STI Outlook 2008 policy questionnaire.

In Sweden, overall co-ordination of research was previously the responsibility of the Minister of Research. Since late 2006 responsibility for industrial and innovation-related R&D has been transferred to the Ministry of Enterprise, Energy and Communications. One of the reasons was to achieve more transparency and better distinguish between primarily industrial and primarily academic R&D. Another change has been the creation of a Globalisation Council headed by the Minister of Research. The council is a forum to discuss competitiveness and develop a global competitiveness strategy. A new research and innovation bill will probably be released in 2008 and it may spur the creation of new structures for governance of S&T policies. The current government's desire to cut business red tape by 25% creates additional pressure on public actors to change their ways of operating.

New institutions and institutional structures

Changes in institutional structures for science, technology and innovation policy have sometimes resulted from efforts to consolidate responsibility for related policy areas under a single institutional umbrella in order to improve co-ordination or to reflect the higher priority of these fields. In other cases, they reflect changes in government and a reshuffling of responsibilities. Some countries have reorganised ministerial or departmental functions to strengthen the links between R&D and higher education.

- The Australian government created the Department of Innovation, Industry, Science and Research (DIISR) and the Department of Education, Employment and Workplace Relations in 2007 by restructuring the former Department of Education, Science and Training and the Department of Industry, Tourism and Resources.
- The Finnish government launched a new Ministry of Employment and the Economy in January 2008 by merging the Ministry of Trade and Industry, the Ministry of Labour and regional departments of the Ministry of the Interior. The new innovation department is larger and more comprehensive than the former department of the Ministry of Trade and Industry.

- In Hungary, the Ministry of Education was responsible for science, technology and innovation policy until August 2006. Since then, the Ministry of Economy and Transport is responsible for R&D and technology policy and the Ministry of Education and Culture for science policy.
- The Italian Ministry of Education, Universities and Research was again divided into two ministries. To highlight the strategic role of research for Italy's economic development, the Minister of Universities and Research became, for the first time, a member of the Interdepartmental Committee for Economic Planning (*Comitato Interministeriale per la Programmazione Economica* – CIPE).
- The new Korean government established the Ministry of Education, Science and Technology by merging the Ministry of Science and Technology and the Ministry of Education and Human Resources in February 2008.
- The Norwegian Ministry for Education and Research appointed two ministers in October 2007; a Minister for Research and Higher Education and a Minister for Education. The appointment of a minister responsible for research and higher education emphasises the increased importance of this area.
- The new Spanish government created the Ministry of Science and Innovation in April 2008 by merging some functions of the former Ministry of Education and Science (MEC) and the former Ministry of Industry, Tourism and Trade (MITYC). The new ministry is responsible for higher education, public research organisations, funding of academic, basic, biomedical and industrial R&D and the promotion of innovation. It has jurisdiction over all government budgets for R&D and innovation (3% of the national government budget).
- Responsibility for innovation policy in the Slovak Republic was detached from R&D policy and shifted from the Ministry of Education to the Ministry of Economy in 2006.
- The UK government created the Department of Innovation, University and Skills (DIUS) in 2007 by bringing together functions from two former departments: the Higher Education, Further Education and Skills directorates of the former Department of Education and Skills (DfES) and the Science and Innovation directorates of the former Department of Trade and Industry (DTI).

In Switzerland, a new constitutional framework for the education system was introduced in May 2006. Its aim is better co-ordination among the cantons and between the cantons and the federal government. The new structures envisaged by the reform of the Swiss higher education landscape also aim to strengthen this co-ordination. The Federal Council has begun to restructure the seven departments that make up the federal government. It is envisaged that only one body will be responsible for education and science policy at the federal level (office or department).

In France, the *Loi de programme pour la recherche* of April 2006 established new tools to improve the overall effectiveness of the system, notably by clarifying the role of institutions. For the steering of research, the ministerial reorganisation included the creation of the Department for Research and Innovation (*Direction générale de la recherche et de l'innovation*) with a strategy department (*Direction de la stratégie* – DS). The reorganisation reaffirms the leading role of the Research Ministry in the design and steering of research. At the operational level, the creation of three new financing agencies – the National Agency for Research (*Agence nationale de la recherche* – ANR), the Agency for Industrial Innovation (*Agence de l'innovation industrielle* – AII), the National Cancer Institute (*Institut national du cancer* – INCA) – is intended to clarify research planning and has already resulted in a net increase in funding for research projects. However, the main responsibility for steering research continues to be in the hands of the large national research centres. To ensure coherence at national level and to allow for better alignment of national, regional and EU framework policies, the DGRI established in 2007 sectoral consultation groups (*groupes de concertation sectoriels* – GCS) to enhance the capacity for research steering and planning, increase transparency and take account of stakeholders and the national priorities expressed by the President of France. For the future, research will concentrate on major sectors, notably health, ICTs, nanotechnology, energy, and sustainable development.

Poland's National Centre for Research and Development (NCRD) was established in 2007. It is a central governmental agency responsible for implementing R&D and innovation policy, managing strategic R&D programmes, facilitating technology transfer to the economy and business, and enhancing scientists' career development, in particular by supporting the involvement of young scientists in the research programmes and implementing international mobility programmes for scientists. The centre will also represent Poland in international R&D activities.

Selecting and focusing S&T policies on priority areas

National plans need to prioritise research and innovation policies and instruments. While countries continue to focus on key research and technology fields, such as ICTs, health, nanotechnologies and energy, social issues increasingly gain attention. These include climate change, energy, ageing, water management, public safety and, in catching-up countries, poverty alleviation and higher education.

The Netherlands has designated six target areas for support to innovation: high-technology systems and materials, flowers and food, water, creative industries, chemicals industry, and pensions and social insurance services. In 2008, innovation programmes to address social challenges will be launched in the areas of care, water and energy to be followed later by safety and security and agro-innovation. In addition, the Innovation Platform has designated The Hague: Residence of Peace and Justice as an emerging key area and ICTs and energy transition as an innovation axis for all sectors of the economy. It is in these areas that the Netherlands aims to achieve and maintain a standard of international excellence, boost private R&D and persuade foreign companies to invest in knowledge. In the Peaks in the Delta policy framework, regional economic policy dovetails with this approach by increasing the accessibility and availability of industrial parks in regions with clusters that are among the world leaders.

In Canada, the government established four priority areas for research in the national interest: environmental science and technologies; natural resources and energy; health and related life sciences and technologies; and information and telecommunications technologies.

In Poland, the government defined nine strategic R&D areas which will be subject to screening and possible revision: health, environment, agriculture and food, state and society, security, new materials and technologies, information technologies, energy and its resources, and transport infrastructure.

In 2006, the Korean government formulated the R&D Total Road Map as a blueprint for national R&D investments. Pursuant to the road map, 90 priority technologies were selected of which 33 were chosen for accelerated development. The list of selected technologies will be used as a basic guideline for comprehensive planning, evaluation and budget allocation under the National R&D Programme. R&D investments for technologies such as biotechnology, energy technology, environmental technology and basic sciences will increase, and investments for technologies such as machinery, manufacturing process, information and electronics technologies will decrease. The roadmap is reflected in the 2nd Basic Plan of S&T (2008-12).

For the Swiss government, new technology fields with high priority include life sciences, nanotechnology and ICT. One of the most important initiatives is SystemsX, a co-operative project in system biology officially launched in 2007. Eight universities (ETH Zurich, EPF Lausanne and the universities of Basel, Berne, Fribourg, Geneva, Lausanne and Zurich) and three other research institutions and partners from industry are involved. For 2008-11, SystemsX is funded by the government at CHF 200 million.

In Spain, five strategic actions are included in the National R&D and Innovation Plan (2008-11): health; biotechnology; energy and climate change; telecommunications and information society; and nanoscience, nanotechnology, new materials and processes.

Strengthening public research and public research organisations

In keeping with the strategies outlined in national plans for science, technology and innovation and with the higher profile of innovation policy in many countries, efforts are being made to strengthen public research. These entail increases in public expenditure on R&D and changes in the governance of public research organisations to raise the quality and relevance of their output and boost their efficiency.

Increasing public R&D expenditures

Consistent with the higher priority of science, technology and innovation, OECD countries have substantially increased public funding for R&D, despite persistent budget constraints and overall reductions in government funding in some countries. Data on government budget appropriations or outlays for R&D (GBAORD) show that between 2001 and 2006, government R&D budgets in the OECD area expanded by 6.4% in real terms. While overall growth for the EU27 was modest, Luxembourg, Spain and Ireland experienced double-digit growth rates (see Chapter 1).

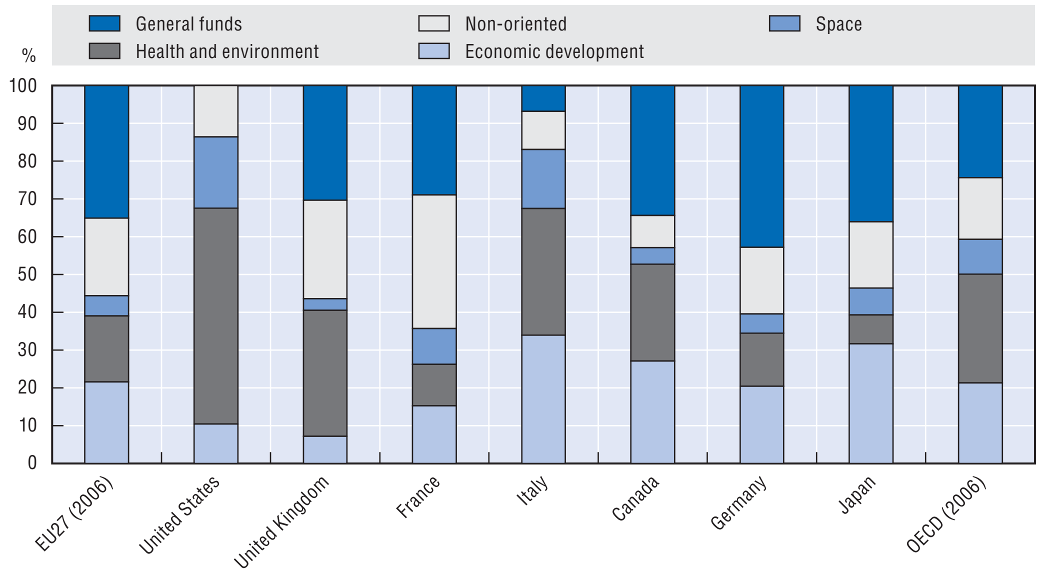
In terms of where countries are devoting civilian R&D spending, in 2007, the main areas were "Research financed from General University Funds (GUF)" followed by "Health and the Environment". At EU27 level GUF represented the main socio-economic objective level followed by "Economic development" objectives and "Non-oriented Research" (Figure 2.2). For the US, "Health and the Environment" and "Space Research" followed by "Non-oriented Research" accounted for most allocations while in Japan most budget outlays were devoted to economic development programmes and general university funds.

In 2002 in Barcelona, the European Council called for R&D investment in the EU to reach 3% of GDP by 2010, of which 2% from the private sector. This set the stage for individual EU countries to establish their own national goals (Table 2.2). While most countries have targeted an increase in the business sector, efforts are also made to boost public R&D investments. It is likely that most EU countries will not attain their goals, but these nevertheless demonstrate political commitment to meeting economic and social objectives by stimulating investment in research and innovation.

- In Austria, the federal government invested EUR 2.13 billion in 2007, a substantial increase over the EUR 1.89 billion in 2006. The public sector (federal, state and other public funding) is expected to invest EUR 2.56 billion in 2007, a 10.5% increase from the level of 2006.

Figure 2.2. **Civilian GBOARD by main socio-economic objectives, selected OECD countries, 2007**

Distribution of government budget appropriations or outlays for R&D by socio-economic objectives, 2007 or closest available years



StatLink http://dx.doi.org/10.1787/451614687830

Source: *OECD Main Science, Technology and Indicators*, 2008.

Table 2.2. **Targets for R&D spending**

Country/region	Target	Target date	Most recent expenditure
Austria	3.0% of GDP	2010	2.45% of GDP (2006)
Belgium	3.0% of GDP	2010	1.83% of GDP (2006)
Czech Republic	2.06% of GDP	2010	1.54% of GDP (2006)
Denmark	3.0% of GDP	2010	2.43% of GDP (2006)
Finland	4.0% of GDP	2011	3.45% of GDP (2006)
France	3.0% of GDP	2012	2.11% of GDP (2006)
Germany	3.0% of GDP	2010	2.53% of GDP (2006)
Greece	1.5% of GDP	2015	0.57% of GDP (2006)
Hungary	1.4% of GDP	2010	1.00% of GDP (2006)
Ireland	2.5% of GNP	2013	1.32% of GDP (2006)
Japan	1% of GDP for the public sector	2010	3.39% of GDP (2006)
Korea	5.0% of GDP	2012	3.23% of GDP (2006)
Netherlands	3.0% of GDP	2010	1.67% of GDP (2006)
Norway	3.0% of GDP	2010	1.52% of GDP (2006)
Poland	2.2-3.0% of GDP	2010	0.56% of GDP (2006)
Portugal	1.8% of GDP	2010	0.83% of GDP (2006)
Spain	2.2% of GDP	2011	1.20% of GDP (2006)
Sweden	4.0% of GDP	2010	3.73% of GDP (2006)
United Kingdom	2.5% of GDP	2014	1.78% of GDP (2006)
European Union	3.0% of GDP	2010	1.76% of GDP (2006)
Non-OECD countries			
China	2.0% of GDP	2010	1.42% of GDP (2006)
Russian Federation	2.0% of GDP	2010	1.08% of GDP (2006)

StatLink http://dx.doi.org/10.1787/456208744677

Source: *OECD Main Science and Technology Indicators*, 2008/1; responses to the STI Outlook 2008 policy questionnaire.

- In France, the 2008 draft finance law (*projet de loi de finance*) foresees some EUR 26 billion for investing in higher education and research, representing an increase of EUR 1.8 billion in comparison to the 2007 finance law. These additional funds are to accompany the university reform act adopted by Parliament in 2007 with a view to making French universities centres of excellence for students and researchers as well as leading partners for firms.
- In Portugal, the 2008 public S&T budget of the Ministry of Science, Technology and Higher Education increased from the 2007 level by about EUR 50 million in national funds (plus a significant amount of structural EU funds). This follows a significant increase in 2007 in the ministry's national S&T budget, and an overall budget increase of more than 60%. In 2008, the S&T budget will correspond to 1% of GDP. This is one of the government's highest priorities. In 2005, the R&D budget represented only 0.75% of GDP.
- In Spain, the national government budget for R&D and innovation amounted to EUR 9.43 billion in 2008, nearly twice the EUR 4.41 billion in 2004. The government aims to increase national R&D investment to 2.2% of GDP in 2011.

Reforming the governance of public research

In addition to changes in the level of funding, many countries have initiatives to reform the governance of universities and public research organisations to increase their efficiency and responsiveness to social needs.

- Italy's 2007 Budget Law included measures to better co-ordinate the management of funds for research and innovation which are the responsibility of the Ministry of Universities and Research, of Economic Development, and of Innovation and Reforms in the Public Administration. In July 2007, the three ministers signed a joint statement, undertaking to support Italian participation in European R&D initiatives, in particular joint technology initiatives and joint research programmes pursuant to Art. 169 of the EC Treaty and to prepare specific national plans involving all relevant national public and private stakeholders.
- In Poland, the government has consolidated and transformed branch R&D units into commercial companies capable of managing large and complex R&D projects and competing and co-operating with foreign partners. The restructuring will be accelerated in accordance with the provisions of the amended act on branch R&D units.
- In Spain, a Universities Act approved in 2007 aims to give universities more autonomy in terms of their governance models and recruitment systems and to establish better conditions for technology transfer and promotion of technology-based firms. Also, the transformation of the CSIC (the national research centre) into a public agency was approved in 2007 in order to increase its autonomy and long-term responsiveness to public objectives.
- In the United Kingdom, the government merged the Particle Physics and Astronomy Research Council (PPARC) with the Council for the Central Laboratory of the Research Councils (CCLRC) to form the Large Facilities Research Council. The new council supports the research councils' investments in large research facilities with capital funding that could not be accommodated within research council baselines.

Some countries reformed funding mechanism to universities by linking funding allocation to performance evaluation.

- In Austria, as of 2007, the provision of funds to each university is tied to a performance contract between the Federal Ministry of Education, Science and Culture and the university.
- In 2006, the Polish government revised the rules governing the allocation of block grants (institutional subsidy) to scientific units in order to concentrate institutional financing on the best research institutes, facilitate consolidation and strengthen the institutes with greater R&D potential. The allocation of block grant is closely linked to an assessment carried out every four years. In 2007, institutional subsidies were concentrated on the best-performing units.

In 2007, Germany's federal government and the *Länder* agreed on a Higher Education Pact 2020 to maintain the performance of higher education institutions and allow them to accept a larger number of new entrants. Under the Pact, higher education institutions will be able to accept 91 370 more new entrants in 2010 than in 2005. The federal government will make EUR 565 million available for new entrants by 2010; the rest will be provided by the *Länder*. In addition, the Pact addresses important structural policy issues. In using the funds, the *Länder* must focus on creating additional jobs at institutions of higher education, on increasing the number of places for new entrants at universities of applied sciences, and on increasing the number of women appointed to professorships and other positions.

The New Zealand government wants to ensure that tertiary education produces the skilled graduates needed to help transform New Zealand into a high-wage knowledge-based economy and society. To this end, tertiary education institutions are to identify, plan for and meet the needs of students, employers, industry, Māori and Pasifika community groups, and other stakeholders. From January 2008, a new investment system for tertiary education will support the shift in focus to achievement and meeting the long-term needs of stakeholders. Under the new investment system the Tertiary Education Commission (TEC) will engage with individual institutions to approve an investment plan of up to three years' duration. The plans will set out what education, research and other services tertiary education institutions will be funded to deliver in accordance with their distinctive contributions, priorities of the TEC and identified educational needs. The major funding components of this system will be the student achievement component to support teaching and learning and the tertiary education organisation component to develop capability. The Performance-based Research Fund (PBRF) will be included in this component.

Strengthening critical mass and reducing fragmentation

In many OECD countries, centres of excellence play an important role in efforts to achieve critical mass in research. Sweden currently has some 120 of these in operation. The basic rationale is that co-operation on R&D by universities, institutes and industry can generate the resources needed to create a centre of excellence in a specific field or a distinctive profile. With this as a basis, the ambition is to attract the actors, resources and attention necessary to become an internationally recognised research and innovation environment that creates added value for the participating parties. Most centres are organised in accordance with the following overall principles: competition; industrial participation; long-term financial commitment; contribution to national sustainable growth; and ambition to be part of a larger research and innovation environment.

Chile's efforts to increase critical mass rely on a new funding scheme. The goal of the Basal Funding Programme, under the National Commission for Scientific and Technological Research (CONICYT) (funded at around USD 18 million for the first year) is to fund selected centres for a five-year period, extendable once for up to another five years if the half-term evaluation is positive. The beneficiaries will be national not-for-profit entities constituted as scientific and technological centres of excellence and national not-for-profit entities that sponsor a team of researchers in order to establish scientific and technological centres of excellence. The main impact expected from this programme is to establish the conditions for forming critical masses of top-level scientists and improve the capacities of scientific and technological centres with proven track records in specific areas. The objective is to raise their productivity and their relationship with the productive sector significantly.

In Italy, the 2007 Budget Law approved the creation of a new fund for investment in S&T research (*Fondo per gli Investimenti nella Ricerca Scientifica e Tecnologica* – FIRST). The FIRST will allow for better management of resources according to the guidelines of the National Research Programme 2008-10 and will support academic and industry-driven proposals. It pools the resources of previous funds managed by the Ministry of Universities and Research. The 2006 Budget Law earmarked additional resources for the fund, in the amount of EUR 960 million for 2007-09. Implementation criteria are currently being defined but EUR 150 million was allocated in 2007 to research programmes of significant national interest (*Progetti di Ricerca di Interesse Nazionale* – PRIN), which are funded every year by the Ministry of Universities and Research.

Box 2.1. **Recent research and innovation policy developments at European Union level***

In 2000, the Lisbon Strategy for Jobs and Growth set the stage for European Commission policies and action in the area of science, research and innovation under the banner of a European Research Area (ERA) with three key objectives: *i)* to create an internal market of European research for researchers and research goods; *ii)* to improve co-ordination of national and regional policies; and *iii)* to play a leading role through EU-funded programmes and initiatives. To carry out the Lisbon Strategy, the European Commission has launched a range of policy initiatives to boost research and innovation.

Strengthening public research, reducing fragmentation and improving co-ordination

EU 7th Framework Programme for Research and Technological Development: With more than EUR 50 billion allocated over the next seven years, FP7 funding grants co-finance research, technological development and demonstration projects throughout Europe and beyond. Grants are determined on the basis of calls for proposals and a highly competitive peer review process. FP7 not only represents one of the largest international efforts to support applied research but also basic research funded by the European Research Council. Furthermore, FP7 is fully open to co-operation to third-country participants (*e.g.* the United States but also countries such as China and India).

European Research Council (ERC): The ERC funds top-quality research by providing competitive grants for both individual researchers and teams of researchers. Since its launch in 2007, 78 grants valued at EUR 20 million have been allocated.

European Strategic Forum on Research Infrastructures (ESFRI): The forum, established in 2006, performs an incubator function for new research infrastructure at European level.

Structural Funds for Research and Development: The funds are used to accelerate the integration of new member states into the European Research Area by strengthening research capacity and innovation.

Box 2.1. **Recent research and innovation policy developments at European Union level*** *(cont.)*

Supporting public-private partnerships, networks and co-operation

European Technology Platforms: These group the main stakeholders in the areas concerned. They develop medium- to long-term research agendas to address strategic technological challenges. In so doing, the platforms are invited to identify issues related to the regulatory framework for the technologies concerned. This can enable early identification of issues that might hamper the development of new technologies and facilitates early adaptation of regulations and standards. Some 25 industry-led European technology platforms have been launched since 2003 in areas such as innovative medicines, aeronautics, hydrogen and fuel cells, textiles and manufacturing technologies.

Joint Technology Initiatives (JTI): These are initiatives emerging from European technology platforms and are financed partly by FP7 funds and by industry. Once agreed upon and established under Article 171 of the EC Treaty that allows the European Community to set up any structure necessary for the efficient execution of research, technological development and demonstration programmes, the JTIs can launch calls relating to topics in their domains. These calls are to be open to stakeholders from public bodies, academia and industry (EU and associated countries). Six areas in which a JTI might be particularly relevant have been identified: hydrogen and fuel cells, aeronautics and air transport, innovative medicines, nano-electronics (ENIAC), embedded computing systems (ARTEMIS) and global monitoring for environment and security.

European Strategic Energy Technology Plan (SET) which aims to strengthen industrial research and innovation, by aligning European, national and industrial activities; it also proposes the creation of a European Energy Research Alliance to ensure much greater co-operation among energy research organisations as well as improved planning and foresight at European level for energy infrastructure and systems.

European Institute of Technology (EIT): The EIT will function as a hub in a broader network linking business and public research. The EIT has two levels: a governance structure that is based on its Governing Board (GB) and knowledge and innovation communities (KICs) which are autonomous partnerships of universities, research organisations, companies and other stakeholders. The GB will be responsible for steering the activities of the EIT and will also take charge of selection, designation and evaluation of the KICs and all other strategic decisions. It will be composed of a balanced, representative group of high-profile people from business and academia, supported by a small number of administrative staff. The KICs will undertake innovation activities, cutting-edge innovative research in areas of key economic and societal interest, education and training activities at master's and doctoral levels, and dissemination of best practices in innovation.

Stimulating demand for innovation

Lead Markets Initiative: The Lead Markets Initiative (LMI) has identified promising emerging markets in which the EU has the potential to become a world leader and which urgently needs co-ordinated action. The six markets are e-health, protective textiles, sustainable construction, recycling, bio-based products and renewable energies.

Community Framework for State Aid Initiatives: Under this new framework, support for R&D and for innovation will be authorised on the basis of new guidelines. The framework outlines the main market failures hampering R&D and innovation: knowledge spillovers, imperfect and asymmetric information, co-ordination and network failures. It also gives guidance on state aid measures that can address these market failures without excessively distorting competition and trade.

* For a discussion of European Commission initiatives in the area of human resources and S&T, see Box 2.6.

Support for business R&D and innovation

Business enterprises are the main source of innovation. They play the primary role in funding and performing R&D in most OECD countries, and, more than ever, governments wish to increase business investment in R&D and innovation. Global competition and the emergence of new players such as China and India have led countries to seek to boost the innovative capacity of the business sector. In the EU, another catalyst has been the EU's target of raising R&D spending to 3% of GDP by 2010, primarily by increasing business investments in R&D. The integration of new members into the EU and slow economic growth among the larger members have served as additional drivers of investment in business innovation, as firms and governments seek to accelerate economic growth.

A wide range of policy instruments can affect business innovation, ranging from improvements in framework conditions and other measures to strengthen incentives for innovation, to direct support measures such as grants and loans, to indirect measures such as fiscal incentives and changes to intellectual property rights (IPR) regimes.[2] Competitive and merit-based grant programmes continue to be the main mechanisms for supporting business innovation in most OECD countries. However, fiscal incentives such as tax credits and support for firm creation and start-ups and other programmes that focus on co-operation, networking and technology commercialisation are rapidly gaining ground. International experiences with tax incentives for R&D show that they can, if well designed, induce additional private R&D efforts. Direct support is also important to foster innovation, but needs to be based on a competitive and merit-based selection of deserving projects that can provide high social returns. In both cases, a careful evaluation of policies to support business innovation is needed to ensure that the policies are effective and achieve their goals.

Trends in direct funding

Direct support to business innovation in the form of competitive grants or subsidised or guaranteed loans remains important even if use of indirect schemes such as tax credits has tended to rise. Some existing programmes have been extended and upgraded and new initiatives have launched:

- In the 2007 budget, the Canadian government committed CAD 500 million over seven years to Sustainable Development Technology Canada to invest with the private sector in establishing large-scale facilities for production of next-generation renewable fuels; CAD 350 million over three years to support leading centres of excellence in commercialisation and research; and CAD 11 million in 2008-09 to create research networks proposed and led by the private sector.
- In 2005 in the Flemish community of Belgium, three financing instruments were created: The Innovation Fund (VINNOF), the NRC fund and ARKimedes. VINNOF supports investments in innovative or high-technology start-ups. EUR 150 million is available, of which one-third is allocated to the Non-recurring Costs (NRC) fund, which provides long-term financing for innovation projects of high-technology companies on market-related terms. ARKimedes is a fund that doubles the risk capital available for SMEs. It offers EUR 1 for every EUR 1 invested in a Flemish SME by private risk capital funds (ARKIVs).
- In Ireland, the Business Expansion Scheme and the Seed Capital Scheme help bridge the financial gap for businesses in the pre- and early start-up phases of new enterprises. The schemes were extended in 2006 for seven years.

Box 2.2. **Recent research and innovation policy developments in the United States**

Amid concerns of growing international competition, including from emerging economies, the United States Congress passed the Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act (America Competes Act) which was signed into law on 9 August 2007 by President Bush. The act aims to address issues raised in the 2005 National Academy of Sciences (NAS) report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, which underlined a number of areas in which the United States was seen as losing ground. The act follows other wide-ranging legislation in recent years to boost America's competitiveness, including A New Generation of American Innovation of 2004, the American Competitiveness Initiative of 2006, and the No Child Left Behind Act of 2001. In the president's 2008 budget submission, the federal government is slated to invest USD 138 billion in R&D (NSB, 2008).

- **Support to basic research.** US federal government support to basic research remains strong, representing 59% of US basic research funding in 2006, although recent funding increases for the main performing and funding agencies (*e.g.* National Science Foundation, Department of Energy, National Institutes of Health) have been less than expected. Greater attention is being given to the physical sciences following earlier increases in funding for the life sciences. The government has established a national co-ordination office to identify and prioritise research infrastructure needs at universities and national laboratories and to help guide the investment of new infrastructure funds authorised for the National Science Foundation and the Department of Energy.
- **Business R&D and innovation.** In addition to programmes such as Small Business Innovation Research (SBIR), the government maintains an R&D tax credit which provided more than USD 5 billion in relief in 2005. The tax credit is currently the subject of legislative proposals to improve its functioning and to make it permanent. The government has also expanded funding for the Manufacturing Extension Program (MEP) with a view to doubling funding over the next decade (funding for fiscal 2008 is set at USD 110 million). In addition, the government has established a presidential innovation award to stimulate scientific and engineering advances and authorise the National Science Foundation (NSF) to support research on innovation, including ways to measure it and assess its broader impact.
- **Linking research and industry.** The government has replaced the Advanced Technology Program (ATP) with a new initiative, the Technology Innovation Program (TIP) which funds high-risk, high-reward, pre-competitive technology development with a focus on small- and medium-sized companies. The TIP allows for greater industry input in the operation of the programme, allows university participation for the first time, and firmly focuses on small and medium-sized high-technology firms. Funding is expected to reach USD 100 million in fiscal 2008, USD 131.5 million in fiscal 2009 and USD 140.5 million in fiscal 2010. These funding levels will allow for a viable programme, with approximately USD 40 million a year for new awards.
- **Human capital and research workforce issues.** The America Competes Act provides USD 150 million for K-12 science, technology, engineering and mathematics (STEM) education programmes that link secondary education and national labs. It has also increased funding for NSF STEM education programmes, including the Noyce Teacher Scholarship programme and the Math and Science Partnerships programme. The government has also taken steps to reduce delays in processing entry visas for foreign students and researchers. It has boosted grant funding for outstanding early-stage researchers by expanding graduate research fellowships (GRF) and integrative graduate education and research traineeship (IGERT) programmes, by strengthening the early career grants (CAREER) programme, and by creating a new pilot programme of seed grants for outstanding new investigators.

Box 2.3. Recent research and innovation policy developments in China

The Chinese government adopted the Medium- and Long-term National Plan (MLP) for Science and Technology Development (2006-20) in January 2006, which aims to make China an innovation-oriented society by the year 2020 and, in the longer term, a leading science and technology power and innovation economy. To implement the 15-year plan, the government also issued the 11th Five-year National S&T Plan (2006-10) in October 2006. To encourage enterprises to undertake indigenous innovation, the State Council released the Implementing Policies for the Medium- and Long-term National Plans for S&T Development. The main policies implemented or proposed by these plans are:

Key objectives. The MLP aims to increase R&D intensity from 1.23% in 2004 to 2% of GDP in 2010 and to 2.5% by 2020. By then, the contribution of science and technology to economic growth will be more than 60%. Dependence on foreign technology will be reduced to less than 30% (in the ratio of expenditure on technology import to R&D expenditure, estimated at 56% in 2004). China aims to be among the top five countries worldwide in terms of the number of domestic invention patents granted and the number of international citations of scientific papers.

Prioritisation. The plan identifies 11 priority research fields: energy, water and mineral resources, environment, agriculture, manufacturing technologies, transport, information technology, population and health, urbanisation, public security and national defence. In addition, eight frontier technologies have been chosen as priorities for funding; biotechnology, information technology, new materials and nanotechnology, advanced manufacturing technologies, advanced energy technologies, ocean technology, laser technology and aeronautics and astronautics. Moreover, 16 "megaprojects" in engineering and science fields, conceived, directed and funded by the government, will be implemented soon.

Tax incentives. To facilitate business R&D, the implementing policies proposed a number of new tax incentives. These include:

- Allowing 150% deduction for R&D expenditure by enterprises in all categories of enterprise ownership.
- Investment in some categories of R&D equipment with a value of less than RMB 300 000 can be excluded from income tax. Accelerated depreciation is applied to R&D equipment with a value of more than RMB 300 000.
- Venture capital firms providing capital to high-technology SMEs can receive a bonus tax deduction from their taxable income on qualifying investment. Firms can carry forward and deduct the unused bonus deduction for the following five years, if their taxable income for the current year is less than the bonus deduction.
- Tax-free policy for importation of some categories of R&D equipment for use in universities and research institutions.

Public procurement. The implementing policies proposed that indigenous innovative products take priority in public procurement and should receive a price advantage and that no less than 60% of the cost of purchasing technology and equipment should be spent on domestic firms.

Industrial research alliances. In June 2007, four industry-research strategic alliances, concerning steel, coal, chemistry and agricultural equipment, were set up with government support. They aim to address long-standing problems relating to the low level and dispersal of innovation capabilities, the inadequate supply of generic technologies and the lack of core technological competencies in these sectors. They seek to enhance these sectors' technological innovation capability by creating a stable, institutionalised industry-university-research partnership based on market principles. The alliances encompass 26 leading enterprises (with total sales revenue of RMB 900 billion in 2006), 18 leading universities and nine key national research institutions.

Human resources in S&T. In order to promote HRST flows to firms, policies support part-time employment of S&T personnel in universities and research institutes. A number of schemes have been launched linking academic S&T personnel with industry as well as promoting the return of overseas Chinese students.

Popularisation of science. The government aims to popularise science by implementing the National Action Scheme of Scientific Literacy for All Chinese Citizens, enforcing National Popular Science Capacity Building, opening research institutes and universities to the public, encouraging scientists to participate in popular science writing, and building centres and facilities for the promulgation of science and technology.

Several countries have attempted to streamline or simplify support programmes to make it easier for firms to access support programmes. The UK government has implemented the business support simplification programme. In 2008, it will develop a comprehensive portfolio of up to 100 business support schemes, including schemes to support innovation. By 2010, all existing publicly funded business support will be earmarked to close, merge into or be delivered through the new portfolio. In 2006, the Norwegian Research Council merged several smaller industrial R&D programmes into a larger, general programme of user-driven innovation projects (BIA) to reduce administrative costs and make it easier for applicants to apply for R&D grants.

Fiscal incentives for R&D

Recent years have seen a clear shift from direct public funding for business R&D towards indirect funding (see Chapter 1). In 2005, direct government funds financed on average 7% of business R&D, down from 11% in 1995. In 2008, 21 OECD countries offered tax relief for business R&D, up from 12 in 1995 (18 in 2004), and most have tended to make it more generous over the years. The appeal of R&D tax credits stems from their non-discriminatory nature in terms of research and technology fields or industrial sectors. Several OECD and non-member economies have recently introduced new tax incentive schemes and made changes in existing schemes to make them more generous (Table 2.3). While many tax incentive programmes reward incremental increases in R&D investment (based on various formulas), a number of new incentives are based on the level of R&D spending in a given year. Some countries are finding uptake by companies to be quite low and are adjusting their schemes to improve ease of use or to clarify eligible expenses. Special tax incentives have also been introduced for SMEs. There are concerns, however, that the expansion of R&D tax credits is being driven by growing tax competition as countries seek to enhance their attractiveness for R&D-related foreign direct investment. These concerns reinforce the need for evaluating the effectiveness of existing schemes as well as their interaction with other forms of support (*e.g.* subsidies) and the general tax system.

Although Spain currently has one of the most generous programmes for R&D tax incentives (Figure 2.3) only 40 to 50% of innovative Spanish firms performing R&D benefit from tax incentives. To raise the efficiency of tax instruments, the government has changed fiscal incentives for R&D: the general corporate tax has been reduced by 15% for all companies; the rate for the main R&D tax credit is set to become proportional to the general corporate tax levels until it is phased out completely by 2011 subject to an evaluation of the scheme; and a new complementary R&D tax credit has been created which offsets 40% of labour and social charges of R&D workers. New Zealand, following OECD recommendations, has introduced a scheme that would give a 15% tax credit for private-sector R&D expenditures with effect from the 2008-09 fiscal year. While Mexico, Norway, Portugal and New Zealand have expanded the level of support via R&D tax incentives, other countries spend more on R&D tax incentives in terms of foregone revenue: from USD 800 million in the United Kingdom and France to USD 2.2 billion in Canada and USD 5.1 billion in the United States in 2005.

A number of OECD countries do not have R&D tax credits but nevertheless try to encourage business R&D investment or to attract foreign R&D through the general fiscal framework. In Switzerland, the 26 cantons have their own tax policies and may use them to attract national and foreign R&D. To promote Switzerland more effectively as a location for R&D, several cantons have set up networks (*e.g.* Greater Zurich Area). Germany, Finland, Iceland and Sweden also do not have R&D tax incentives but some of these countries have

 OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

Table 2.3. **Recent or proposed changes in R&D tax incentives in OECD and selected non-member economies, 2008**

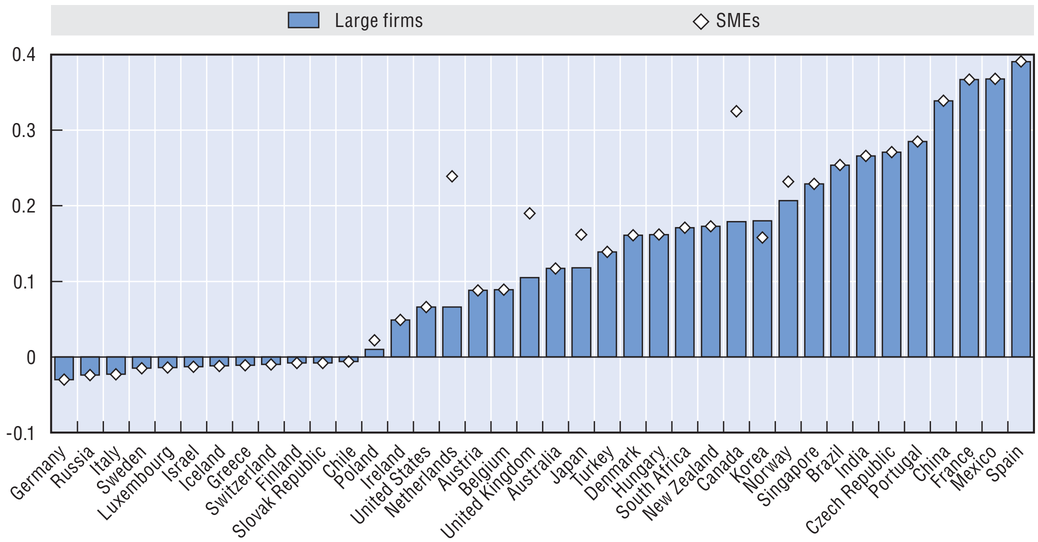
	Recent or proposed changes
Australia	From 1 July 2007, the beneficial ownership provisions for the 175% Premium R&D Tax Concession programme have been amended to allow claims for R&D projects undertaken in Australia, regardless of where the intellectual property is held. The international premium attracts investment by the growing number of multinational enterprises in Australia that hold their intellectual property overseas and had been excluded from access to the Australian R&D Tax Concession. Firms that boost their long-term investment in Australian innovation will be rewarded with a subsidy on their additional R&D activity performed in Australia. This will enable multinationals to have access to similar concessionary deductions while retaining strong integration with global supply chains. Firms of all sizes can access the R&D tax concession. The aim was to make "Australia a more attractive place for world class innovation (that) will boost investment, expand our skills base and help anchor the local arms of leading multinationals in Australia". An evaluation of the Tax Offset and 175% Premium was completed in 2007 by comparing the three years prior to and after they were introduced. The report concluded that both elements stimulated businesses to increase their R&D expenditure.
Belgium	Belgium has introduced a series of measures to diminish salary costs of researchers and give firms an immediate reduction in research costs. Since 1 October 2005, all companies collaborating with a European university or with one of the Belgian research institutes are entitled to keep 50% of the withholding tax the researchers are supposed to pay. There are two conditions: *i)* the researchers need to have a degree at a level higher than secondary school; and *ii)* the tax credit can apply only to taxes due for researchers involved in and working on the collaborative project. Furthermore, since 1 January 2006, companies can in addition keep 50% of the withholding tax of all PhDs in science or medical sciences and civil engineers involved in company research. A third measure grants all personnel involved in research a 50% reduction in the withholding tax. Researchers must be young and participating firms must be small. The basic difference among these three measures is the category of people for whom the company can claim the share of the withholding tax.
Canada	The taxable income limits on Small Canadian-controlled Private Corporations (CCPCs) eligible for the enhanced Scientific Research and Experimental Development (SR&ED) provisions for small CCPCs have been increased, in line with the increases to the limits for eligibility for small business tax rates. The changes to the eligibility criteria have been: Budget 2003 increased the range of prior-year taxable income over which the enhanced credits for small CCPCs are phased out from USD 200 000-400 000 to USD 300 000-500 000, generally for taxation years ending after 2003. Budget 2006 increased the range of prior-year taxable income over which the enhanced credits for small CCPCs are phased out from USD 300 000-500 000 to USD 400 000-600 000, generally for taxation years ending after 2006. In addition, there have been a few revisions to the SR&ED tax legislation over the last five years. In Budget 2005, the geographical area in which expenditures are eligible for the SR&ED tax credit was extended from the boundaries of Canada (*i.e.* areas within the 12-nautical-mile territorial sea) to include Canada's Exclusive Economic Zone (*i.e.* areas within 200 nautical miles from the Canadian coastline). Budget 2006 extended the carry-forward period for unused SR&ED tax credits from ten to 20 years.
France	The new government reformed its tax credit at the beginning of 2008. Henceforth, the tax credit will be volume-based only and set at 30% for the first EUR 100 million with a preferential rate of 50% for first-time users which is targeted towards new innovative firms.
Greece	Law 3296/2004 provides tax incentives to businesses for the deduction of expenditures for scientific and technological research from taxable profits. It is open to all businesses, regardless of size and sector of economic activity.
Hungary	Since 1 January 2005, SMEs and individual entrepreneurs with up to 250 employees may decrease their incomes by the costs of acquiring and maintaining domestic patenting, utility models, industrial designs, and plant variety protection. The VAT regulation for enterprises changed on 1 January 2006 to make purchases under funded project eligible for refund of VAT. There has been no change in the rule on the mandatory innovation contribution payable to the Research and Technological Innovation Fund for medium and large enterprises registered in Hungary (0.3% of their adjusted net turnover). Micro and small enterprises are exempt.
Ireland	In 2004, a tax credit for incremental R&D spending was introduced and 2003 was set as the base year for the first three years. A tax credit of 20% of R&D expenditure can be taken against corporate tax. Under the 2007 Finance Act, 2003 is maintained as the base year for a further three years (*i.e.* until end 2009). Also, payments to subcontractors for R&D activity are now allowed subject to certain limitations and conditions.
Italy	The government approved new tax incentives for firms that invest in R&D for the years 2007-09 which gives them a tax credit of 10% of the expense of research and pre-competitive development. It is raised to 15% if the R&D costs are related to contracts with universities and public research institutions. The ceiling is EUR 15 million a year per company. The Finance Law 2008 has increased the tax credit to 40% and raised the ceiling to EUR 50 million.
Japan	In FY 2003 the government modified its tax incentive system to establish a permanent credit of 8-10% for total R&D expenditures. At the same time, it created an additional 2% temporary credit owing to the depressed economic situation. In FY 2005, the government decided to abolish the additional 2% credit, but in order to maintain companies' incentive to increase R&D, the current tax credit for R&D expenditures (which varies according to whether companies choose to apply it to their total R&D expenditures or only to the increase in those expenditures) will be integrated into a single credit based on total R&D expenditures. Moreover, as a temporary measure, for the next two years an additional credit equivalent to 5% of the amount exceeding "comparable R&D expenses", defined as the average of R&D expenditures over the past three years, will be implemented.
Mexico	The government allows a 30% tax credit for annual expenditure on R&D carried out by firms.

Table 2.3. **Recent or proposed changes in R&D tax incentives in OECD and selected non-member economies, 2008** *(cont.)*

	Recent or proposed changes
Netherlands	With some 15 000 applications and a total budget of EUR 425 million in 2007, the Research and Development (Promotion) Act (WBSO) is the country's largest technology incentive scheme. A recent evaluation (April 2007) concluded that the WBSO works properly and provides a high level of added value, in particular for SMEs. It was therefore decided to increase structural funding for this instrument by up to EUR 115 million by 2011, for example by broadening the definition of R&D to include process innovation and ICT R&D. In addition, an extra deduction will be created for existing companies (not start-ups) embarking on R&D for the first time. Finally, consideration is being given to raising the limit up to which companies may profit from the high rate.
New Zealand	A new tax scheme to take effect from the 2008-09 income year will give a 15% tax credit for private-sector R&D expenditures. It is estimated at NZD 630 million over the next four years.
Norway	The government introduced an R&D tax incentive in 2002, which originally applied only to SMEs but was extended from 2003 to all enterprises with activity in Norway. The scheme, Skattefunn, is a tax credit scheme and is operated jointly by the Tax Administration and the Research Council of Norway (RCN). It applies to expenses for R&D projects approved by the RCN. The scheme offers a rebate of 20% of expenses for SMEs and 18% for large enterprises. Both have a cap on expenses per enterprise of NOK 4 million for intramural R&D projects and NOK 8 million for projects conducted at an R&D institution. If the calculated rebate exceeds the assessed taxes of the enterprise, the difference is refunded as part of the assessment. About three-quarters of the total tax expenditure under the Skattefunn scheme has been such cash refunds. The total R&D tax rebate for 2007 is estimated at approximately NOK 1.0 billion, a reduction from 2006 owing partly to less R&D activity under the scheme and partly to caps on personnel and indirect expenses. In a recent evaluation, carried out by Statistics Norway, it was found that firms that receive support through Skattefunn have stronger growth in their R&D investments than other firms, that firms that previously invested less than the cap (NOK 4 million) have increased their R&D investments more than those previously above the ceiling, and that firms that previously did not invest in R&D are more likely to start doing so since Skattefunn was introduced. Estimates of how much additional R&D Skattefunn triggers per NOK in lost tax revenue (input additionality) vary between 1.3 and 2.9 with a preferred point estimate of 2, which is high compared to results for other countries.
Poland	The act on some forms of support for innovation was modified as of 1 January 2006 to enable all enterprises to deduct from their tax base no more than 50% of their expenditures on purchase of new technologies (including patents and know-how).
Spain	Following the tax reform approved in November 2006, a new scheme was introduced for corporate tax reductions of up to 40% of the Social Security cost of personnel working in R&D, and corporate tax rates were reduced by 15% for all companies (for SMEs from 30% to 25% by 2007 and for the rest of firms from 35% to 32.5% by 2007 and to 30% by 2008). Also, to compensate for the general decrease in corporate taxes, R&D and innovation corporate tax credits were reduced (8% by 2007 and 15% by 2008) and are to be phased out completely by 2011. The government envisages evaluating the relative effectiveness of the reduction in social charges for R&D staff and the R&D and innovation corporate tax credits before the end of 2011 to decide which is better adapted to the needs of the Spanish economy.
United Kingdom	At the end of 2005, the government published a series of proposals to improve the R&D tax credit. Among these are: *i)* the creation of a dedicated R&D unit within HM Revenue and Customs, which administers the credits, to ensure that all SME tax credit claims are dealt with by specialist staff; *ii)* an R&D tax credit statement of practice for SMEs, detailing how SMEs can expect staff to deal with their claims; and *iii)* a package of legislative and operational simplifications, including expanding qualifying costs to include payments to clinical trial volunteers. There is also a proposal to extend the SME scheme to mid-size companies and increase the enhanced relief to 175 and 130% in 2008.
United States	The federal research and experimentation (R&E) tax credit was established by the Economic Recovery Tax Act of 1981. Given its temporary status, it is subject to periodic extensions and was last renewed by the Tax Relief and Health Care Act of 2006 (Public Law 109-432) through 31 December 2007. However, the 2006 Act not only extended the credit for two years (2006 [retroactively] and 2007) but also increased the rates for the alternative credit for 2007. It also created a new simplified alternative credit from 2007. A few bills to extend it permanently are being considered in the current Congress.
Chile	A draft law is currently under discussion to establish a tax incentive to foster R&D spending in the private sector when it is undertaken jointly with accredited research centres. Companies cannot have any ownership relationship with the research centres. Contributors that fulfil the requirements can deduct the first category tax, 35% of total payments related to R&D through contracts subscribed between businesses and the accredited research centres. The part of R&D spending that is not subject to deduction will still be recognised as spending for calculating the first category tax. Accreditation of the research centres and verification of research capacity is the responsibility of the Chilean Economic Development Agency (CORFO). This will require metrics to measure the fulfilment of the contract commitments. Supervision will be carried out *ex post* and randomly. This procedure results in a register of centres which companies can consider for carrying out R&D and receiving the tax credits.

Source: Responses to the STI Outlook 2008 policy questionnaire; Colecchia (2007); and results of the TIP Workshop on R&D tax credits, 10 December 2007.

Figure 2.3. **Tax treatment of R&D in OECD and non-member countries, 2008**[1]



StatLink http://dx.doi.org/10.1787/451653862465

1. Tax subsidy to R&D calculated as 1 minus the b-index, defined as the present value of before tax income necessary to cover the initial cost of R&D investment and to pay corporate income tax.

Source: Warda, 2008, based on national sources.

a growing interest in using these to meet certain S&T policy goals such as stimulating R&D in SMEs or fostering co-operation between public research and industry. Again, some of the growing interest in R&D tax credits may also reflect concerns about tax competition between countries.

Introduction of fiscal incentives for labour and social charges of R&D personnel

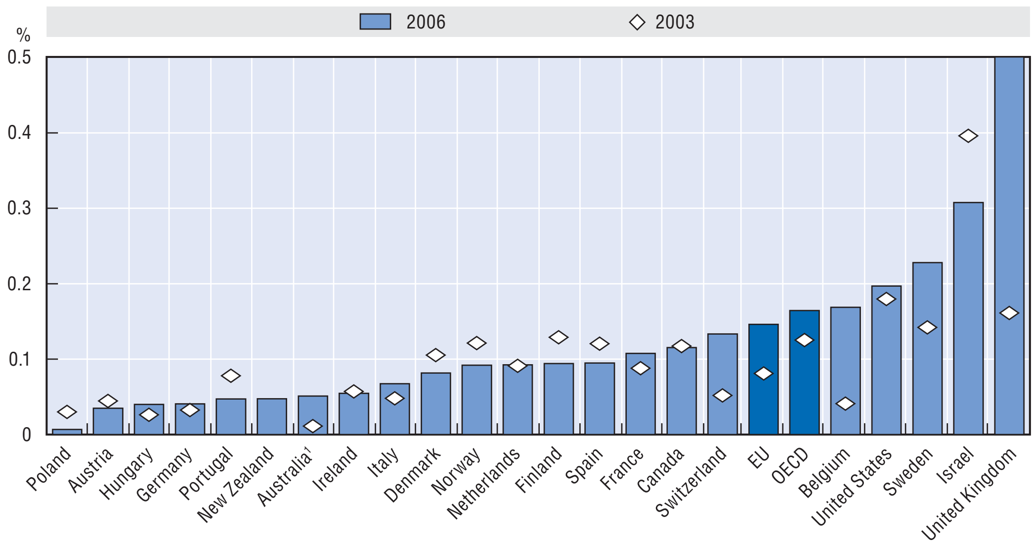
A recent trend in OECD countries has been to employ fiscal R&D incentives for social charges (*i.e.* social security and other social taxes on labour). The rationale is that by reducing social charges, companies can reduce monthly operating costs and therefore increase their cash flow. The tax credits on social charges act as a subsidy to early-stage costs while tax credits for R&D expenditures generally subsidise later-stage profits. Another argument for fiscal incentives for labour charges is that they may be easier for governments to control (depending on the design of the programme) and that they may be less subject to manipulation than company profits. Furthermore, by subsiding human capital, they may help to retain human talent. This is especially important for small firms that do not yet make a profit and whose principal assets are the knowledge embodied in people.

France's Young Innovative Company scheme exempts research staff at young SMEs from social charges if they spend up to 50% of their time on R&D projects. The scheme currently costs the government approximately EUR 100 million. In 2004 1 640 firms took part and claimed exemptions for 8 200 employees. Belgium allows an exemption of EUR 11 510 for staff conducting scientific research, which is raised to EUR 23 590 for highly qualified staff. In the Netherlands, the WBSO (Research and Development [Promotion] Act) tax scheme reduces the wage tax and social security contributions of companies with R&D personnel. From 2006, 42% of the first EUR 110 000 of R&D wage costs can be deducted from the wage tax and national insurance contributions. Recently, Spain also introduced a new discount of 40% on the social charges corresponding to R&D staff which cannot be combined with the use of R&D tax credits on corporate taxes.

Funding for new ventures and small firms

Dedicated support for start-ups and new ventures recovered in many countries in line with the rebound in venture capital markets in the mid-2000s (Figure 2.4). However, much of the funding concerns expansionary capital in higher-technology industries. Consequently, governments continue to support funds for early-stage and seed financing, often along the "fund of funds" model. Public support to early stage venture capital may become more important as the cooling of venture capital markets in 2008 dampen prospects for further financing for innovative ventures (see Chapter 1). Following an independent study of the seed and venture capital market in Ireland, the Irish government launched a new round of venture capital funding for 2007-13, for a total of EUR 175 million. This investment will leverage an estimated EUR 1 billion for investments in start-up, early stage and development-stage businesses. The AIB Seed Capital fund was launched in July 2007 under the scheme and seven more are expected to be launched in the coming months. Enterprise Ireland approved support of over EUR 7 million for 14 new community enterprise centres (CECs) and the expansion of ten existing centres. In recent years 168 CEC projects have been supported with a total investment in excess of EUR 1 million and they have made a significant impact on regional economies.

Figure 2.4. **Venture capital investment as a percentage of GDP, 2003 and 2006**



StatLink http://dx.doi.org/10.1787/451670250314

Source: Thomson Financial, PwC, EVCA, NVCA, AVCAL, NZVCA and OECD calculation, 2007.

The Italian government has earmarked EUR 86 million for the subscription of shares in closed-end funds (*Fondi mobiliari chiusi*) promoted and managed by specific asset management companies (*Società di Gestione del Risparmio* – SGR) in order to finance the creation, development and innovation of SMEs located in the south of Italy and operating in the field of process or product innovation with digital technologies. The aim is to promote venture capital investments in the initial phase of the company's activity, including the funding of the study and the assessment and development of the entrepreneurial idea that precedes the company start-up. Investments can also be directed to the development and initial marketing of the product. Public intervention in each closed-end fund will not exceed 50% of the total capital. The duration of the investment is not to exceed ten years (in addition to the time strictly required for disinvestment). In Spain, the NEOTEC venture capital fund (managed by the Centre for Technological Innovation and Development) was launched in February 2006 to increase early-stage investment in Spanish technology-based companies. The fund was provided with EUR 176 million, of which EUR 66 million was contributed by a large number of private companies and EUR 50 million by the European Investment Fund, which participates in managing the fund.

Since 1 January 2006, Hungary has had a new legal act on capital markets whose main objective is to promote venture capital activity by institutional investors in Hungary. This act only allows for the establishment of closed and exclusive risk capital funds. However, the effective operation of these funds requires further legal changes regarding capital markets. In accordance with the Joint European Resources for Micro to Medium Enterprises (JEREMIE) initiative of the European Commission, the fourth priority axis of the Economic Development Operational Programme (EDOP) plans to improve the access of SMEs to external resources through various financial instruments and related advisory assistance. To tackle Hungarian financial market failures, interventions are planned to enhance enterprises' access to financing: micro-financing, guarantees and development of the capital market (venture capital, seed capital).

Russia's state-owned Russian Venture Co. was founded to develop innovative sectors of the economy and to promote Russia's high-technology products on the international market. It is a "fund of funds" which invests its resources in innovative companies via private venture funds. The Russian government approved investing RUR 15 billion from the Stabilisation Fund in the fund.

In Australia, the Commercial Ready programme has been reinforced with an additional scheme (Commercial Ready Plus) which offers grants of AUD 50 000 to AUD 250 000 for innovation projects of up to 18 months duration to SMEs and to companies controlled by Australian universities and public-sector research organisations. The application process is faster and simpler than for large grants.

Supporting non-technological and service innovation

In Switzerland, the *Innovation Promotion Agency (CTI)* funds projects in the fields of finance, company management, tourism, ICT, logistics, e-business and architecture through its Enabling Sciences programme. In addition, the Innovation for Successful Ageing (ISA) programme, launched in 2004, targets R&D projects that lead to innovative solutions in the market and take into account the specific needs of elderly persons, including new technologies, products and services. In 2008-11, CTI wants to increase its funding for non-technological R&D projects. Non-technological innovation is also supported by DoRe projects. Furthermore, CTI has increased funding for projects in arts, social sciences and health-care sciences.

In Germany the Innovation with Services programme is a source of high-technology funding in the services sector. International monitoring allows the results and development lines of international service research to be made available for domestic funding. Consequently, topics and trends in service research and practice are identified early and prepared systematically. The results flow into discussions between science and industry aimed at shaping the service economy. A total of EUR 70 million will be made available for the programme by 2009.

Box 2.4. **The SME offensive in the Netherlands**

The new government has introduced a number of new initiatives to support innovation in SMEs and has increased existing programmes:

- The Innovation Vouchers (IV) scheme provides a subsidy to increase interaction between SMEs and public knowledge institutes, *e.g.* universities and technology transfer institutes. The scheme is being expanded following a recent evaluation. Vouchers will be available for all SMEs in industry, agriculture and the services sector.
- Innovation Performance Contracts (IPC) aim to provide assistance to groups of SMEs to execute collectively their multi-annual innovation plan. The 15 to 35 companies that form a group within an IPC are substantively connected, *e.g.* they are all located in a particular geographical area, they all work in a particular sector, or they are all links in a product or service chain. A budget of EUR 17 million has been earmarked for the IPC grant scheme in 2007.
- The R&D tax incentives under the Research and Development (Promotion) Act (WBSO) tailored to SMEs will include broadening the target group (services will be included), expanding the definition of the term "start-up" and extending the first tax bracket.
- The Cabinet intends to examine closely the question of whether it is necessary for small companies always to be bound by the same rules as large companies.

In addition, the following instruments are available to innovative SMEs:

- The Challenger Facility provides credit to SMEs for innovative but risky projects that do not fit any of the themes of the innovation programmes. Its 2007 budget is EUR 12.2 million. It will be expanded in 2008 to include innovation credits to stimulate development projects (products, processes and services) that entail substantial technical and, consequently, financial risks and which are unable to attract sufficient (if any) funding on the capital market.
- There are currently six Small Business Innovation Research (SBIR) pilot projects in progress. The Ministry of Economic Affairs is running a test project in the field of energy, and the Ministries of Transport, Public Works and Water Management, Defence, and Agriculture, Nature and Food Quality are also running pilot projects in their areas. The SBIR will be fully implemented in 2008.
- A total of 113 technology start-ups have been launched or are about to be launched with funding from the Knowledge Exploitation Subsidy (SKE) programme which has contributed to 54 patent applications. An annual budget of EUR 10 million is available. In 2007 an additional EUR 5 million in SKE funding was provided to finance SKE proposals from the creative sectors and will facilitate pilot projects in three different creative sectors: ICT and new media, fashion, and design.

Source: Responses to the STI Outlook 2008 policy questionnaire.

Promoting non-technological and user innovation is not just an objective of advanced OECD countries. The Polish government encourages non-technological innovation by supporting innovative projects that introduce new or significantly improved solutions for processes, marketing or organisational innovations. In Chile, INNOVA Chile launched the Design on Business Platforms for Innovation contest in 2007 based on recommendations of the National Innovation Council for Competitiveness for business associations and companies that provide business services (consultancy). The available funds are around USD 500 000 with a subsidy of 70% of the cost of the project (with a cap of USD 60 000 per project).

OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

Leveraging public procurement for innovation

Many EU countries, supported by policy developments at the European Commission such as the Lead Markets Initiative (Box 2.1), focus on boosting demand for innovation through public procurement. The Dutch 2006 Launching Customer (LC) plan of action aims to increase government awareness of how it can support innovation in the private sector through its procurement and tendering policy. The plan, implemented in 2007 and 2008, has four main themes: *i) awareness:* raising awareness of the advantages of participation in the scheme among policy makers and government procurement officials; *ii) knowledge and information:* the website *www.launchingcustomer.ez.nl* provides information about such matters as the advantages, costs and risks of LC and the connection between LC and the tendering guidelines; *iii) organisation and co-ordination:* a chief procurement officer has been appointed to shape co-operation within central government; *iv) implementation:* the Association of Netherlands Municipalities (VNG) has completed a project aimed at raising awareness at municipal level. The agency SenterNovem will put together knowledge teams to advise municipalities and other agencies on promoting innovation through tendering.

Changes in IPR regimes

Some countries have made changes to rules and laws governing IPR in an effort to improve consistency with international laws or the ability of firms to manage and exploit intellectual assets (Table 2.4).

Enhancing collaboration and networking among innovators

It is widely recognised that the effectiveness and efficiency of innovation systems are determined to a considerable extent by the degree and quality of linkages and interactions among various actors, including firms, universities, research institutes and government agencies. Throughout the OECD area, networking and collaboration among innovation actors are intensifying. Some programmes focus more on inter-firm networking, others aim at boosting public-private co-operation, and some focus on regional clusters.

Public-private co-operation

Efforts are being made to strengthen linkages between researchers in the public and private sectors. Some countries have developed new programmes, sometimes based on the results of an evaluation of existing programmes. In Austria, the government launched a new programme, COMET (Competence Centres for Excellent Technologies), in 2007. The existing K_{plus} and K_{ind}/K_{net} centres will be integrated into COMET. COMET is financed by the Ministry for Transport, Innovation and Technology and the Ministry of Economic Affairs and Labour. It addresses existing competence centres and networks as well as new consortia with participants from science and industry. It has three programme lines (K2 centres, K1 centres, K projects) which differ in their objectives, funding volumes and duration. Another initiative is the Christian Doppler programme which establishes research centres (CD labs) in universities or non-university research institutes. The labs should be financed equally by public authorities and industrial partners. As of 2007 some 52 CD labs operated in Austria and Germany.

The Canadian government increased its focus on public-private partnerships, most notably through the establishment of the new Centres of Excellence in Commercialisation and Research programme to help Canada achieve critical mass in strategic areas of scientific opportunity and competitive advantage. As announced in the 2007 budget, the

Table 2.4. **Recent or proposed changes in IPR-related policies in OECD and selected non-member economies**

	Recent or proposed changes
Canada	The government of Canada passed new amendments to the Patented Medicines (Notice of Compliance) Regulations ("PMNOC Regulations") and to the data protection provisions of the Food and Drug Regulations (F&D Regulations) on 5 October 2006. The primary purpose was to restore balance to the intellectual property regulations affecting the pharmaceutical and biotechnology industries. Under Industry Canada's amendments to the regulations, patentees are no longer able to extend their patent rights through "evergreening" strategies, and generic drug companies can better predict when they can enter the market with a competing version of an innovative drug. Under Health Canada's amendments to the data protection provisions in the F&D Regulations, innovative drug companies benefit from a guaranteed minimum period of market exclusivity for their products that is competitive with practices in Canada's major trading partners.
Denmark	As part of the Globalisation Strategy, the government has launched an initiative to create a transparent and efficient marketplace for trading in knowledge, in effect, in IPR. Furthermore, the Danish Patent and Trademark Office has established guidance based on the new centres for high-growth businesses which gives Danish companies access to information on IPR. Finally, Statistics Denmark and the Danish Patent and Trademark Office have initiated a yearly collection of data on Danish companies that trade in knowledge. For 2007 the numbers indicate that more than one-third of those with IPR have also traded IPR (in all, 3 200 companies have traded IPR).
France	The key development in 2007 was the ratification of the London Accord which removes the obligation to translate patent applications. A key argument in favour of its ratification was the need to reduce the costs for SMEs. Along these lines, the National Institute for Industrial Property (*Institut National de la Propriété Industrielle* – INPI) now offers counselling services to individuals and SMEs that wish to protect an invention. These services are not a substitute for private services, since they focus on the practical steps. The Finance Law of 2008 foresees a tax reduction on revenue generated from the sale or transfer of industrial property.
Hungary	Due to the high cost of foreign IP protection and the generally low financial capacity of domestic SMEs, the government has, since 2003, maintained a programme to promote foreign patent applications and the exploitation of patents. In particular, SMEs, individuals, research and education institutions can obtain funding for up to 90% of the IP protection costs. From 2007 the programme, which is financed from the KTIA (Research and Technology Innovation Fund) requires public research units, public foundations or non-profit companies established using funds linked to the sub-systems of public finances to adopt rules for IPR management.
Ireland	There has been little change in IPR or related policies in recent years. Forfás has prepared codes for managing projects that are either totally publicly funded or collaboratively funded and is awaiting government approval for publication.
Italy	A bill is being finalised to amend the industrial property code and the enforcing regulations. The law covers assignment of ownership of patents deriving from university research, the duration of the protection afforded by copyright in the case of cumulative design, and the reintroduction of ordinary rite. Meanwhile a three-year programme to strengthen the Italian Patent Office (*Ufficio Italiano Brevetti e Marchi* – UIBM) is under way. Other new IP policies include tax breaks for patents, automatic translation of patents, electronic filing and developing and diffusing tools for the economic valuation of patents in the public and private sectors.
Netherlands	The Lower House of the Dutch Parliament has passed a bill amending the Patents Act. The Upper House is currently considering the bill. The changes are mainly intended to provide greater legal certainty by abolishing the entirely untested patent and improving the accessibility of the patent system by lowering threshold costs. Another development is the publication of a small handbook on good practices in the use of IPR by universities and industry. It was developed as part of the Innovation Charter (principles agreed between Dutch universities and industry regarding the transfer of knowledge and technology in 2004) by the Ministry of Economic Affairs and representatives of Dutch universities and industry.
New Zealand	Amendments to the Copyright Act are currently being considered by Parliament, and a new Patents Bill is being prepared for introduction. The prime driver behind the changes is to update New Zealand's IP regime to bring it into line with overseas trends, and, in the case of copyright, to ensure that the regime can cope with new technologies. One objective is to try to ensure that the IP regime does not impede innovation or technology transfer.
Norway	The focus on IPR remains strong after a significant increase in priority during the last two years, a period characterised by rapid development of formal structures such as adhesion to the European Patent Office (EPO) and the establishment of the Nordic Patent Institute.
Poland	There is no specialised court for IPR, but the Patent Office has made efforts to establish one. Specialist training is regularly offered to public prosecutors and judges to increase their knowledge and awareness of IPR.
Sweden	A few measures to address IPR are mentioned in the Swedish National Reform Programme. The government intends to strengthen the legal protection of IPR, perhaps by introducing property protection insurance for patents at the national level, and trials of all civil and criminal intellectual property cases are likely to be held in one court. The rationale is to create a more effective and specialised court system. The government also intends to join two international patent conventions and reduce the fee for patent applications, and it will examine the effects of patents and research in biotechnology. A new Trademark Act was proposed in 2007 in order to improve registration procedures and reduce the administrative burden on companies. A committee of inquiry has presented ways to accelerate the development of consumer-friendly legal alternatives for access to music and films on the Internet.
Switzerland	The revision of the patent law is still under way. During the 2007 summer session, Parliament approved the second part of the revision of the patent law. The focus of the partial revision was to bring the patent law into line with EU guidelines (EU directive) on the legal protection of biotechnological inventions in order to provide uniform and clear principles.
Chile	A draft law to set up the National Institute of Industrial Property (INAPI) is under parliamentary discussion and is expected to enter into operation in 2008 or 2009. It transforms the Department of Industrial Property (DPI) of the Undersecretary of Economy into a decentralised public service institution that will no longer depend directly on the Undersecretary. This will give the INAPI greater freedom, flexibility and independence in its management and will increase its personnel from 100 to 180, and its budget from USD 2 million to USD 8 million. It will strengthen, for example, the patent and brand review area and the juridical area. It will also allow Chile, through the INAPI, to participate more in international discussions on industrial property. Another change relating to industrial property is a new law, which entered into force at the end of January 2007, which incorporates some standards agreed with the United States such as extending the duration of patents in cases of unjustified delay in procedures and includes new brand categories, such as the collective brand and the certification brand. Progress has also been made regarding the Patent Co-operation Treaty, which is being ratified. Universities have developed the capacities for developing patents and therefore have a tax concession rate of over 50%. However individuals, who represent nearly 90% of Chilean applicants, do not. Therefore, the INAPI will carry out more outreach activities, including regional workshops on patent preparation, to raise the competencies of individuals in this area.

Source: Responses to the STI Outlook 2008 policy questionnaire; responses to the policy note on globalisation and open innovation.

government will provide CAD 350 million over three years to support eight large-scale centres of research and commercialisation in areas in which Canada has a comparative advantage and to fund other centres that operate at international standards of excellence, as determined through international peer-reviewed competition.

The Italian government has implemented two initiatives to promote public-private co-operation. One is the creation of joint labs between universities or public research bodies and industry in specific areas (new materials, biotechnology, nanotechnology and others that are crucial for new high-technology industries). The other is the creation of technological districts to favour the penetration and dissemination of technologies capable of enabling innovation in SMEs through their relations with high-technology firms, universities, public research organisations, the world of finance and local communities. So far, 26 technological districts have been created.

The Spanish government has significantly increased its direct funding to business research and technological activities while concentrating the funding on bigger projects involving public-private partnerships. In 2006, for example, the government launched the CENIT (National Strategic Consortia for Technical Research) programme, and more than 30 projects have been approved with public funding of almost EUR 600 million.

To facilitate demand-oriented co-operation, several countries have introduced an innovation voucher programme. The Dutch government has decided to broaden the application of its innovation voucher scheme, which allows SMEs to use innovation vouchers from the government to buy knowledge from public or private knowledge institutes (including large firms). Vouchers will be available for all SMEs in industry, agriculture and the service sector. The Austrian government has introduced a system of innovation vouchers for SMEs as a joint initiative of the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Economics and Labour (BMWA) in order to support co-operation between SMEs (fewer than 250 employees) and public research organisations with EUR 5 000 per voucher. The Danish government will also start an innovation voucher scheme for SMEs from 2008.

The German government introduced the new *Forschungsprämie* (research bonus) programme in 2007 in order to mobilise scientific potential for broad co-operation with industry, particularly SMEs. When universities and research institutions carry out R&D for SMEs, they can obtain a bonus amounting to 25% of the volume of the contract awarded by SMEs.

The Dutch government evaluated its leading technological institutes (LTIs) in 2005. LTIs were considered a successful model for public/private co-operation. Since then, new LTIs have been launched in the fields of pharmaceuticals, flowers and food.

As part of its Globalisation Strategy, the Danish government has launched a Programme for User-driven Innovation to improve the innovative abilities of Danish companies and public institutions by enabling them to work with, and tap into, users' innovation potential. Main criteria for grants under this programme include collaboration between companies and co-operation between companies and public institutions, applicability to other companies and institutions, diffusion of knowledge, etc. The programme runs over four years (2007-10) with a yearly grant of DKK 100 million.

The UK government established the Energy Technologies Institute (ETI) in 2007 to achieve a step change in the funding, strategic direction and outcome of UK energy science and technology. ETI will be a 50:50 public-private partnership and aims to raise

GBP 100 million a year for UK-based energy research, design and development and a total of GBP 1 billion over a ten-year period. BP, Shell, E.ON UK, EDF, Caterpillar and Rolls-Royce have committed to contribute as full members a total of GBP 300 million over ten years. The ETI intends to expand private-sector membership further in light of the government's commitment to provide up to GBP 50 million per year over a ten-year period. It will provide funding for universities, SMEs and other firms and international collaborations to accelerate the development of promising technologies and their movement from the laboratories to commercial application.

France's cluster policy is centred on the *pôles de compétitivité* initiative which aims to bring together, through partnerships, the competencies of public and private research entities, training centres and the know-how of companies in order to realise synergies and promote collaboration on innovative projects. Following the first call for proposals in November 2004, the government identified 66 clusters and set aside EUR 1.5 billion for the 2006-08. In July 2007, five new clusters were selected, increasing the number to 71 of which 17 are labelled "world class".

Tax incentives are also being used to promote collaboration between industry and public research. In Belgium, a company collaborating with a public research institution can obtain a 50% reduction of the advance tax due by the researcher. Similarly, the Chilean system for R&D tax credits focuses on interaction between public research centres and business firms.

Globalisation of research and innovation

Globalisation continues to accelerate and spreads to an increasing number of countries as trade and financial flows increase and technological progress facilitates the exchange of ideas and the development of new markets for goods and services. It includes R&D that extends beyond adapting technology to local conditions. More firms are also embracing "open" innovation approaches and actively co-operate with actors outside the firm to gain access to knowledge and commercialise their own knowledge.

More countries also increasingly take into account the recent trends in the globalisation of R&D when formulating their national strategies. For example, in Greece, globalisation has been one of the main factors affecting the formulation of research, technological development and innovation (RTDI) policies for the programming period 2007-13. The opening up of the Greek RTDI system and enhancing European and international co-operation are the main drivers of the National Strategic Development Plan for RTDI. All national programmes will be open to co-operation with research entities worldwide. Furthermore, the following sets of specific actions are planned to enhance internationalisation of the Greek RTDI system: *i)* a programme for European S&T co-operation to support and accelerate Greece's incorporation in the European Research and Innovation area; *ii)* bilateral co-operation programmes; and *iii)* mobility programmes and initiatives to attract foreign talent (including Greek expatriates). The German federal government launched an internationalisation strategy in 2008 which aims to strengthen research co-operation with global leaders, improve international exploitation of innovation potential, intensify co-operation with developing countries in education, research and development on a long-term basis, and use German research and innovation potential to contribute to the solution of global challenges in the areas of climate, resources, health, security and migration.

OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

Linking domestic firms to foreign sources of research and innovation

With the continuing internationalisation of science and innovation, tapping into foreign sources of knowledge becomes more important. This has led to a range of policy initiatives in various countries and at EU level (*e.g.* third-country participation in EU Framework Programmes, the European Institute of Technology). The Danish Ministry of Foreign Affairs, the Danish Export Council and the Ministry for Science have launched an initiative to create local bridgeheads for Danish companies wanting to tap into global innovation hubs. The first opened in Silicon Valley, United States, in 2007, the second in Shanghai, China, in September 2007 and a third in 2008 in Munich, Germany. For its part, Hungary launched a programme, *Déri Miksa* to help enterprises, especially SMEs, to participate in the European Network for Market-oriented R&D (EUREKA) programme by providing assistance in networking and access to financial resources. Austria also introduced a new programme, CIR-CE (Co-operation in Innovation and Research – Central Eastern Europe and South-Eastern Europe) in 2005 to develop networks of enterprises, research institutions and intermediaries across the Austrian borders with neighbours in Central and South-Eastern Europe.

Promotion of inward R&D and investment in innovation

Many countries have implemented a wide range of investment policies, including direct financial support, fiscal incentives and provision of infrastructure (Table 2.5). The Austrian government recently launched Headquarters Strategy – R&D to stimulate expansion and/or (re-)location of multinational enterprises' R&D headquarters to Austria. The scheme is open to both Austrian and foreign firms and supports R&D activities of internationally oriented enterprises of any size that operate on the Austrian market up to 50% of total costs if the applicants:

- Locate their R&D headquarters or significantly expand their R&D headquarters in Austria in connection with a concrete research project based on an explicitly defined research programme.
- Focus their R&D activities on new research topics that represent a significant extension of their research competence and volume.
- Significantly and sustainably enhance existing R&D activities in a promising thematic area linked to a significant extension of their research competence and volume.

The Hungarian Investment and Trade Development Agency (ITDH) supports investment projects exceeding EUR 10 million with a one-stop-shop service and also offers the following incentives:

- A cash subsidy decided on a case-by-case basis by the Hungarian government. For manufacturing, R&D and regional service centre projects the volume of the investment should be at least EUR 10 million.
- Development tax allowance. The investor may be exempted from 80% of the corporate tax to be payable for ten years after the completion of the project.
- Training subsidy up to 70% of training costs related to the project.
- Deduction of R&D expenses. Hungarian tax rules make it possible to claim a double deduction.

Improving the quality of skilled labour is also a focus of policies to improve the attractiveness of a city, region or country for foreign R&D-related investment. In Chile, for example, a programme co-finances personnel training plans in companies establishing a presence in Chile. The government has also made the National Register of Personnel with English Language Fluency available online. This is a service of the Chilean Economic Development Agency (CORFO) for companies recruiting English-speaking staff. It provides access to a database of over 15 000 individuals with a range of profiles and educational levels. All have had their English language level accredited internationally through the TOEIC (Test of English for International Communication) and have the level of English required for the labour market.

Some countries have changed the rules concerning the treatment of foreign firms or foreign institutions in their national R&D programmes or policies. For example, in Australia, foreign firms and other foreign private and public sector organisations are eligible to participate as partner organisations in the Australian Research Council's Linkage Project, Linkage Infrastructure, Equipment and Facilities, and Centres of Excellence schemes under the same conditions as Australia-based firms and organisations. They must make a financial contribution to the research. Linkage Projects proposals involving overseas partner organisations must identify the economic or social benefit of the research to Australia and the intended use of the research outcomes in Australia. In Denmark, foreign companies are allowed to apply for grants under the Programme for User-driven Innovation. Grants are only given when these companies work with Danish partners, when the specific project increases the innovative capabilities of the Danish partners, and when experience and methods are disseminated to Danish society at large.

Table 2.5. **Recent policy changes to promote inward R&D and innovation investments through foreign direct investment**

✓ denotes policy action taken between 2006 and 2008

	Direct financial support	Financial incentives	Provision of infrastructure	Public procurement	IPR framework	Availability of human resources
Austria	✓	✓	–	–	–	–
Belgium	✓	✓	✓	–	–	✓
Canada	–	–	–	–	✓	–
France	–	✓	–	–	–	–
Greece	✓	–	–	–	–	✓
Hungary	✓	✓	✓	–	–	✓
Ireland	✓	✓	✓	✓	✓	✓
Korea	–	–	–	–	–	–
Netherlands	–	✓	✓	✓	–	–
Norway	–	–	✓	–	–	–
Poland	✓	✓	–	–	–	–
Portugal	–	✓	–	✓	–	✓
Slovak Republic	✓	–	✓	–	–	✓
Sweden	✓	–	✓	–	–	–
Switzerland	–	✓	✓	–	–	✓
Russia	–	✓	✓	✓	✓	–

Note: Only those countries responding to the STI Outlook 2008 questionnaire and reporting a change in at least one of these areas are included.
Source: Responses to the STI Outlook 2008 policy questionnaire.

Strengthening international R&D co-operation

Both EU and non-EU countries have developed special programmes to increase the participation of researchers or institutions into EU research programmes:

- The Hungarian government has support programmes such as Déri Miksa for EUREKA and Déri Miksa for consortium building for the 7th Framework Programme.
- The Polish government has introduced a Grant for Grants programme to support scientists and researchers when they prepare project applications for the EU Framework Programme. The programme also disseminates information among the research community.
- The Italian Ministry of Universities and Research set up an observatory to monitor the Italian participation to EU Framework Programmes.
- New Zealand is currently negotiating an S&T agreement with the European Union to facilitate researcher-researcher and institutional collaboration and enhance opportunities for collaboration through the 7th Framework Programme.
- Switzerland is planning to significantly increase its participation in EU research programmes.

In Asia, the first trilateral Korea-Japan-China ministerial meeting on S&T co-operation was held in January 2007.

Globalisation of public research institutions

In 2005, Japan launched a project to establish international headquarters in universities to support international activities, to create an international strategy in co-operation with various university organisations, and to develop an outstanding strategy for international development. In the first year, 20 universities received support. A mid-term evaluation in 2007 found some positive progress: formulation of international strategies, hiring of staff with international skills and promotion of concrete activities.

During 2006-07 the Portuguese government launched an innovative initiative based on new international partnerships involving Portuguese and foreign universities, research institutions and business-sector companies in specific thematic areas to develop postgraduate and R&D programmes. The first partnerships were established with the Massachusetts Institute of Technology (MIT-Portugal Program) and focus on energy systems, transport systems, advanced manufacturing and bioengineering; with Carnegie Mellon University (CMU-Portugal Program), in ICT; with the University of Texas at Austin (UTAustin-Portugal Program), in digital media, advanced computing, mathematics and technology commercialisation; and with the Fraunhofer Society, with the establishment of the first Fraunhofer institute outside of Germany, in technologies, content and services for ambient assisted living, and co-operation projects in logistics, biotechnology, advanced production systems and nanotechnologies. These partnerships aim to stimulate the international opening of universities in collaboration with the business sector, boost international excellence in R&D, and strengthen training in the most advanced S&T areas. Other partnerships are in the preparation stage (*e.g.* Harvard Medical School, in medical sciences).

Human resources for S&T

Human resources in science and technology (HRST) are essential for advancing science and innovation and generating productivity growth. Over the past decade, employment in HRST occupations has grown much faster than total employment in all countries. In 2006, workers in professional and technical occupations represented more than 30% of total employment in the United States and in the EU25. Some countries with low shares of professionals and technicians have been catching up (*e.g.* Spain, Hungary, Ireland and Greece). Luxembourg and Australia, already with high shares, have maintained strong growth in S&T employment (OECD, 2007).

A number of OECD countries are concerned that the supply of highly skilled workers is diminishing and will not be able to meet demand. Several, including, Germany and Hungary have reported waning interest in science and engineering among youth and declines in science and engineering graduates. Denmark and Korea also experienced a drop in the share of S&T graduates at the beginning of the decade, but policies in both countries contributed to reversing the downward trend in absolute terms. However, with an ageing population in most OECD countries, the current supply of new cohorts of graduates may not be sufficient to replace outgoing cohorts.

Increasing the supply of human resources in science and technology

Many OECD and non-member countries have therefore sought to increase the supply and quality of HRST. The Dutch government has set a goal of increasing the number of highly trained workers in the Netherlands and reducing the number of students dropping out of secondary and tertiary education. By requiring young people under 18 to obtain a qualification and imposing a study/work requirement up to the age of 27, it is encouraging young people to obtain a basic qualification and participate in the labour market. The Irish government wishes to nearly double the annual number of new doctorates in science, engineering and technology from 543 in 2005 to 997 in 2013. The Spanish government has defined targets for increasing the number of R&D personnel by 50 000 in the National R&D and Innovation Plan (2008-11).

As shown in Table 2.6, many countries have implemented policies to increase human resources in science and technology. In order to raise interest in and awareness of science among youth, the UK government piloted after-school science and engineering clubs in March 2007 to offer a programme of activities to stage-three pupils with interest in and potential in science. In 2008, a STEM (Science, Technology, Engineering and Mathematics) Communications Campaign will be launched to raise awareness of STEM careers and the range of career opportunities.

To reduce gender gaps in science and technology education, Germany's federal government and *Länder* announced in March 2008 an initiative to establish by 2011 200 additional professorships for women at German universities. The programme's budget of EUR 150 million is financed partly by the Federal Ministry of Education and Research (BMBF) and partly by the *Länder*. Previous measures have already resulted in an increase in female entrants to engineering and science courses. In Switzerland, the two federal programmes on equal opportunities for men and women at universities and universities of applied sciences have been prolonged and reinforced in 2006-07. Other initiatives seeking to attract more women to science and technology studies and professions also continue.

For PhD study and post-doctoral training, the Canadian government's 2007 budget committed CAD 35 million for two years and CAD 27 million a year thereafter to support an additional 1 000 students through the Canada Graduate Scholarships. In 2007 the Finnish Ministry of Education also launched an action for researcher training and research careers for 2007-10 in collaboration with universities and the Academy of Finland. The Swiss National Science Foundation launched a new programme for PhD studies, Pro*Doc, in 2006.

 OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

Table 2.6. **Recent efforts to improve the development of human resources in science and technology (HRST)**

✓ denotes policy action taken between 2006 and 2008

	Raising interest of science among youth	Revising academic curricula	Improving teaching in mathematics and science	Reducing gaps (gender, minority)	Financing for PhD study and post-doc. training	Improving industry involvement in PhD training	Improving the quality of univ. labs and infrastructure	Demand-side policies[1]
Australia	–	–	–	✓	–	–	–	✓
Austria	✓	–	–	✓	✓	–	✓	✓
Belgium	✓	–	–	✓	✓	✓	✓	–
Canada	✓	–	–	–	✓	✓	✓	–
Czech Republic	✓	✓	✓	✓	✓	✓	✓	–
Denmark	✓	✓	✓	–	✓	–	–	–
Finland	–	–	–	–	–	✓	✓	–
France	✓	–	–	✓	✓	–	✓	✓
Germany	–	✓	–	✓	–	–	–	–
Greece	–	–	–	✓	–	–	–	✓
Hungary	✓	✓	✓	✓	✓	✓	✓	✓
Ireland	✓	✓	✓	✓	✓	✓	✓	✓
Japan	✓	✓	✓	–	✓	✓	–	–
Italy	–	–	–	–	✓	–	–	✓
Korea	✓	–	✓	✓	✓	–	–	✓
Netherlands	✓	✓	✓	✓	✓	✓	✓	–
New Zealand	✓	✓	✓	–	✓	–	✓	✓
Norway	✓	–	✓	✓	✓	✓	✓	–
Poland	✓	✓	✓	–	–	–	✓	–
Portugal	✓	✓	–	–	✓	✓	✓	✓
Slovak Republic	✓	–	–	–	✓	✓	✓	✓
Spain	✓	✓	✓	–	✓	✓	–	✓
Sweden	✓	✓	✓	–	–	✓	–	–
Switzerland	✓	–	–	✓	✓	✓	–	–
Turkey	–	–	–	–	✓	–	–	–
United Kingdom	✓	✓	✓	✓	✓	✓	✓	✓
Chile	✓	✓	✓	–	✓	–	–	–
Russia	✓	✓	✓	–	✓	✓	✓	✓

Note: Only those countries responding to the STI Questionnaire and reporting a change in at least one of these areas are included.

1. Demand policies to increase the attractiveness of employment in public research organisations, make public sector employment more flexible, or improve provision of information to students regarding job opportunities in the public and private sectors.

Source: Responses to the STI Outlook 2008 policy questionnaire.

In Portugal, *Agência Ciência Viva* has approved about 1 100 new projects to reinforce experimental teaching of sciences in primary and secondary schools and to promote scientific and technological culture. With approximately EUR 14 million of public funding in 2007 and 2008, they are being implemented in close co-operation with schools and research centres. The Korean government attracts young students into S&T-related careers by providing life-cycle support (Box 2.5), and the Hungarian government introduced the Hungarian Genius Programme, a comprehensive assistance system that encourages the development of talent and enables the exploitation of the results of excellent performance.

Countries are also trying to improve the attractiveness of research careers by boosting public employment, increasing graduate stipends or enhancing PhD job skills. In France, 6 200 positions have been created in higher education and research since 2005 in order to improve the environment for students and the quality of public research. In parallel,

Box 2.5. **Life-cycle support of human resources in S&T (HRST) in Korea**

The Korean government has sought to build a solid foundation for systematically fostering and utilising HRST. A special law on the support of science and engineering fields was enacted in 2004. On that basis, the government implemented the first basic plan to nurture and support human resources in science and engineering fields (2006-10). In 2007, it announced the scheme for life-cycle support of HRST, covering education, employment and retirement. The main policies and achievements of each stage are:

- **Education stage:** The government has established an education programme from elementary school to graduate school designed to attract talented young people to science and engineering (S&E) careers and develop HRST. The number of centres for the gifted and talented in science increased from 171 in 2003 to 231 in 2006. The number of students awarded presidential scholarships in science also increased from 110 in 2003 to 535 in 2006. The number of S&E majors who received national scholarships also increased from 5 872 in 2003 to 16 213 in 2006. The percentage of students majoring in S&E at universities after graduating from science high schools also rose from 74.3% in 2003 to 83.3% in 2006.
- **Recruiting stage:** The government has worked to create jobs for S&E majors and to attract highly talented HRST through various supportive measures. For example, it has implemented policies to increase the number of HRST, especially women, recruited in government agencies or public organisations. In addition, the mandatory public service term for researchers has been reduced from five years to three.
- **Employment stage:** The government is committed to creating a more stable research environment and encouraging the HRST spirit. It has increased the percentage of gross royalty revenue offered to researchers from 35% in 2003 to 50% in 2006. Since 2004, a mutual benefit pension programme has been created to secure post-retirement welfare benefits for scientists and engineers.
- **Retirement stage:** The government has tried to support stable post-retirement while utilising the valuable experience of retired scientists and engineers. For example, retired researchers provide technical support to SMEs through the Techno Doctor Project, under which the government pays KRW 2 million per researcher while the company provides KRW 0.5 million per person as a matching fund. The ReSEAT programme, which aims to put the knowledge of retired scientist and engineers to practical use in their special area, was expanded and in 2006 involved some 236 retirees.

Source: Responses to the STI Outlook 2008 questionnaire.

since 2007, the government has been studying ways to enhance the attractiveness of research careers and has enacted new measures such as a PhD consulting scheme that allows PhD students to carry out missions in companies, government or associations as well as an 8% increase in graduate stipends – as of October 2007, the 12 000 PhD students receiving a research stipend will receive EUR 1 650 per month while those recipients planning to pursue teaching will receive EUR 1 985 per month or 1.5 times the statutory minimum wage.

Fostering the international mobility of scientists and engineers

Most countries view international mobility as important and have implemented a wide range of policies both to retain and attract HRST and to facilitate research abroad:

- The Swiss National Foundation (SNSF) offers a professorships programme to attract young scientists with several years of research experience to resume their careers at a Swiss higher education institution, especially on return from a stay abroad. The SNFS awarded 28 professorships in 2005 and 30 in 2007.
- The Austrian Science Fund offers Erwin Schrödinger Fellowships to encourage highly qualified Austrians to work in foreign research institutions and a Lise Meitner Programme for foreign scientists to conduct research in Austria, irrespective of age.
- Germany's Alexander von Humboldt Foundation can nominate academics from abroad who are internationally recognised as leaders in their field for an Alexander von Humboldt Professorship. This new type of professorship financed by the Federal Ministry of Education and Research enables award winners to carry out long-term and ground-breaking research at universities and research institutions in Germany.
- In 2007, the Polish Science Foundation launched a welcome programme for both Poles abroad and foreigners in order to attract eminent scientist and researchers to conduct research in Poland.
- The Chilean government seeks to train graduates overseas and to attract graduates from other countries. CONICYT's internships programme extends opportunities for postgraduate studies abroad. For example, those who do their PhDs in Chile can leave the country while doing their thesis. In 2007, around 42 internship abroad scholarships and 100 scholarships for short courses were granted. The goal for 2008 is 100 internships abroad. It is hoped that all who study in Chile can have the opportunity to go abroad, through internships, attending congresses, co-tutoring, or any kind of activity that allows them to leave Chile and interact with peers from other countries.

Many OECD member and non-member economies have introduced special fast-track immigration procedures to attract foreign students and researchers and to facilitate their access to the labour market.

- The EU adopted the law on scientific visas in 2005. As of October 2007, Austria, Belgium, Germany, Hungary, Portugal and Romania had fully transposed the EU law on scientific visas into national law and other countries have been undertaking the necessary measures (Box 2.6).
- The Japanese government made some changes in the immigration legislation. Under the e-Japan Priority Policy Programme and the Basic Plan for Immigration Control (2nd edition), the standards for accepting IT engineers from abroad have been relaxed.
- The Canadian government will permit, under certain conditions, foreign students with a Canadian credential and skilled work experience and skilled temporary foreign workers who are already in Canada to apply for permanent residence without leaving the country.
- In April 2008, the Norwegian government proposed changes in the labour migration policy in order to improve skilled foreign workers' access to the Norwegian labour market and to permit foreign students with a Norwegian credential to apply for work in Norway.

Box 2.6. **International mobility policies of the European Commission**

Immigration: The Scientific Visa (European Commission Directive 2005/71) is a fast-track procedure for creating a specific residence permit for third-country researchers outside the EU, independent of their contractual status. Accredited research organisations play a major role, as they certify the status of the researcher in the host country: the existence of a valid research project, the researcher's scientific skills, financial means and health insurance. Once a member state grants the researcher a residence permit, he/she is free to move within all EU member states for the purpose of the scientific project. In addition to the much faster administrative procedure for delivering the residence permit (immigration authorities of member states are required to deliver it in 30 days), researchers can submit applications for residence permits to the authorities of the host member state if they are legal residents in that country.

Mobility incentives: Under the EU's Union's 7th Research Framework Programme (FP7 – 2007-13), two schemes support the mobility of individual researchers: the PEOPLE programme and the IDEA programme. The PEOPLE programme provides support for research mobility and career development for researchers both inside and outside the European Union. It is implemented via a coherent set of "Marie Curie" actions designed to help researchers build their skills and competences throughout their careers. The overall strategic objective is to make Europe more attractive for the best researchers and support the further development and consolidation of the European Research Area. The programme aims to strengthen human potential for research and technology in Europe by encouraging people to become researchers and to stay in Europe and by making Europe more attractive to the best researchers worldwide. Building on experience with the Marie Curie actions under previous framework programmes, the Marie Curie actions will pay particular attention to European added value in terms of their structuring effect on the European Research Area. Entirely dedicated to human resources in research, this programme has an overall budget of more than EUR 4.7 billion over the seven-year period. The IDEA programme seeks to reinforce excellence, dynamism and creativity in European research and improve the attractiveness of Europe for the best researchers from both European and third countries, as well as for industrial research investment, by providing a Europe-wide competitive funding structure, in addition to, and not instead of, national funding, for frontier research by individual teams. The programme is implemented through the European Research Council (ERC) with an overall budget of EUR 7.5 billion over the seven years. Two types of grants are available: the ERC Starting Independent Researcher Grants and the ERC Advanced Investigator Grants.

Social and cultural support: Researchers have free access to a Europe-wide customised assistance service offered by ERA-MORE, the European Network of Mobility Centres. These 200 centres in 32 countries assist researchers in all matters relating to their professional and daily life, including information on legal issues, social security, health and taxes, everyday life as well as family support. A central mobility web portal is at *http://ec.europa.eu/eracareers/index_en.cfm*.

Source: Responses to OECD questionnaire on the international mobility of researchers.

Evaluating innovation policies

Evaluation has become a central part of the management and governance of public support for science and innovation. A combination of factors has led to increased emphasis on the need to evaluate R&D and innovation policy. It is recognised that in a knowledge-driven economy science and innovation are key drivers both of economic competitiveness and of better quality of life for citizens. Publicly supported research and innovation programmes, even for basic science, are now often conceived with such aims in mind. Because governments want their investments to be sensibly allocated and yield the expected return, they use evaluation to analyse the scale, nature and determinants of that return. More generally, evaluation helps policy makers better ascertain the intended and unintended effects of policies and programmes, to learn from past successes and failures, and to inform decisions to continue or to discontinue existing support measures or to introduce new ones.

Many countries also recognise the difficulty of measuring the impacts and benefits of government policy measures. Innovation systems are complex and dynamic, and causality is difficult to establish. In addition, it often takes time for benefits and impacts to appear. Thus, various parameters and a mix of qualitative and quantitative approaches need to be used to determine short-, medium- and long-term outcomes. Evaluation of R&D programmes is widely regarded as particularly challenging owing to the difficulty of gauging the value of immediate outputs and the often long-term outcomes that make research meaningful. In practice, R&D programme goals, priorities and content vary widely across agencies, so that the specific approaches and methods employed for evaluation must be appropriately tailored.

Evaluating the impact of public R&D investments

Many countries and institutions are developing innovative approaches to identify, measure and model the impacts of public R&D investments. For example, the EU 7th Framework Programme uses a broad range of quantitative and qualitative methods. Econometric studies and peer-reviewed *ex post* evaluations were combined during consultations with stakeholders during the programme design period (see Chapter 4 for more on this issue). Meanwhile, the United States launched the Science of Science and Innovation Policy (SciSIP) initiative in the autumn of 2006 to develop the foundations of an evidence-based platform from which policy makers and researchers may assess the country's S&T system, improve their understanding of its dynamics and predict its outcomes. The research, data collection, and community development components of SciSIP's activities will: *i)* develop theories of creative processes and their transformation into social and economic outcomes; *ii)* improve and expand science metrics, datasets, and analytical tools; and *iii)* develop a community of experts on SciSIP (NSB, 2008).

The Netherlands has a long tradition of compulsory periodical *ex post* evaluation. In addition, there is a clear trend towards more emphasis on monitoring and voluntary *ex ante* evaluation which enables policy makers to modify and adapt policy instruments at an earlier stage, if necessary. This requires additional resources and efforts, but allows policies to be made more efficient at an earlier stage.

In December 2006, the Italian government approved the creation of the National Agency for Evaluation of Universities and Research (*Agenzia Nazionale di Valutazione dell'Università e della Ricerca* – ANVUR). Operational since 2008, the ANVUR's main duties are: external assessment of the quality of the activities of universities and public research bodies; direction, co-ordination and supervision of internal evaluation units' activities; assessment of efficacy and efficiency of state funding; and incentive programmes for research and innovation activities. Similarly, the French government established its own national and administratively independent evaluation agency, the AERES, in March 2007. It is responsible for evaluating the higher education and research establishments, research units and assessing graduate degree programmes.

In 2007, the Danish Ministry of Economic and Business Affairs launched the first annual review of public business support programmes. The review assesses business support programmes in general and carries out a critical review of some. The annual review evaluates programmes on the basis of the following criteria: Does the programme meet the legislative objective? Does the programme meet the objective efficiently? How large are its externalities? Is the total gain large enough to account for the cost? The programme on user-driven innovation, for example. will be subject to a mid-term evaluation in 2009, an evaluation in 2011 and a follow-up evaluation in 2015.

Box 2.7. **Evaluation of the impact of S&T and innovation policies in Portugal**

Portugal has three major methods for evaluating the impact of S&T and innovation policies and programmes:

- The first is the 2006 public governmental evaluation framework, based on internationally comparable indicators. These indicators are the product of internationally harmonised surveys, such as the R&D questionnaire IPCTN (census) and the Community Innovation Survey (CIS) (sample) based on a pre-defined periodicity and administrative data.
- The second provides policy makers, analysts and programme managers with constant monitoring of statistical indicators and administrative data through the centralisation in one planning office of the collection process of all data related to the S&T, innovation and higher education systems. This office is responsible for collecting, monitoring and analysing statistical indicators and administrative data, for example on firms with new-to-market product innovations (through the CIS survey), R&D expenditures (through the IPCTN survey), the R&D tax treatment programme (through fiscal data), the number of PhDs (through administrative data) and the annual science and engineering graduation rates (through university administrative data).
- The third is based on the government's decision to introduce foreign and/or independent evaluators. For example, foreign experts were integrated in the evaluation councils of the Portuguese National Science and Technology Foundation, and the OECD and the European Association for Quality Assurance in Higher Education assessed the country's higher education performance before its reform. In some cases, private consultants have been used to evaluate funding programmes.

Source: Responses to the STI Outlook 2008 policy questionnaire.

Feeding evaluation results into policy making

An important objective of evaluation is to improve the design of existing instruments and help better target policy interventions. In practice, the contribution of evaluation to policy making depends on governance of the evaluation process itself, the stakeholders and its relation to budget decisions. Many countries are trying to improve the contribution

 OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

of evaluation to policy making. In New Zealand, for example, evaluation of the recent tax credit for R&D has been given high priority and the evaluation is being designed alongside aspects of the claim process. There is a cross-government steering group to help with the direction and higher-level design aspects. The Ministry of Science, Research and Technology (MoRST) is the lead agency and will commission most evaluation sub-projects, while the Inland Revenue Department will evaluate the effectiveness of the claim application process. MoRST is strengthening approaches to ensure that evaluation results feed back into policy making. The evaluation of the R&D tax credit is specifically designed to inform the implementation of the tax credit and to identify areas for improvement in its administration. Early reports will provide a guide to how the tax credit is understood and taken up by business while the data for large-scale econometric analysis is being gathered. Evaluations of funding programmes include a dissemination phase in which the results are shared with the participant organisations in order to facilitate discussions on and uptake of best practice.

Outlook: future challenges

The contribution of innovation to growth and competitiveness remains a key issue for OECD countries but also for emerging economies. As this chapter shows, OECD countries continue to reform their science, technology and innovation policies to improve the efficiency of their national innovation systems in response to challenges raised by the globalisation process. This particularly concerns R&D and innovation but it also responds to societal challenges such as ageing populations, health or climate change. Changes in the innovation process, not least those driven or amplified by the development of the Internet, the convergence of scientific and technological fields (*e.g.* ICTs and biotechnology), and new business models and markets are also affecting how governments design, develop and implement policies to support scientific and innovation performance. Indeed, the growing complexity of science and innovation means that the policy environment is also becoming more complex. With greater complexity comes the need for better policy co-ordination and coherence at national level. This entails changes in governance structures, which are reflected in the recurrent reforms to the governance structures and institutions in areas such as research and innovation policies. In addition, at the international level there are initiatives such as the European Research Area, which is described above. Indeed, in an environment in which innovation takes place globally, national policies for innovation cannot be designed solely in a national context.

The near-term outlook for public and private investment in research and innovation remains positive but the slowdown in economic growth will affect business investment decisions and choices as well as public tax revenue. This will put pressure on government budgets and require greater efforts to set priorities and to achieve more from limited investments in research. Until recently, public budgets for R&D grew partly in response to national R&D targets and despite fiscal pressure in many countries. This signals a strong political commitment to research and innovation capacity. However, as governments invest more in education and research, society demands proof of performance and accountability for government spending. In the innovation sphere, this is reflected in the ongoing streamlining of government schemes to support business R&D and innovation and in indirect mechanisms such as R&D tax incentives, which are becoming more widespread as countries compete to "attract" foreign R&D investments and increase national business R&D.

Policies to support cluster, network and innovation systems remain important but are evolving. In a globalised world, they may in fact become more relevant given that local conditions for innovation are extremely important for anchoring global phenomena.

In general, however, most policies to support innovation remain focused on the "supply" or capacity building side and on scientific and technological innovation. There is some growing attention to adapting or developing policies to support new or "alternative" forms of innovation, including in the services sectors or user-led (*e.g.* by consumers or suppliers). There is also more attention to the "demand" side of innovation, such as using procurement or standards or lead markets to "pull" innovation. This is reflected in a move away from traditional "supply push" policies to commercialise or transfer public research results to industry towards a model based on joint development, often via public-private partnerships and involving networks of firms even beyond national borders. This trend is also visible in policies to foster human resources for S&T which focus more on strengthening demand signals in order to improve the ability of supply to respond effectively.

As emerging economies slowly alter the global distribution of invention, innovation and wealth creation, a focus on supply-side policies is no longer sufficient. A large share of the future supply of human resources for S&T, for example, lies outside the main OECD countries. Globalisation has made investments in knowledge much more attractive. Developing a policy environment that supports both the supply of and the demand for innovation – and innovation that is more broadly based – will be increasingly important for fostering sustainable growth while addressing broader social challenges.

Notes

1. This chapter is based mainly on the responses from countries to the *STI Outlook 2008* policy questionnaire received as of 31 January 2008. It also draws on responses to related questionnaires or requests for policy information (*e.g.* on R&D tax credits) and the OECD project on Globalisation and Open Innovation.
2. The following does not review all changes in framework conditions that may affect business innovation. Much of this is covered in the OECD's Economic Surveys and in the annual OECD publication *Going for Growth* (OECD, 2008).

References

Colecchia, A. (2007), "R&D Tax Incentives and R&D Statistics: What Next?", internal working document, Economic Analysis and Statistics Division, Directorate for Science, Technology and Industry, OECD.

European Commission (2007), *Green Paper on the European Research Area: New Perspectives* [COM(2007)161 final].

National Science Board (2008), *Science and Engineering Indicators, 2008*, *www.nsf.gov/statistics/indicators*.

OECD (2007), *Science, Technology and Industry Scoreboard*, OECD, Paris.

OECD (2008), *Economic Policy Reforms: Going for Growth 2008*, OECD, Paris.

Warda, J. (2007), "Generosity of Tax Incentives", presentation at the TIP Workshop on R&D Tax Treatment in OECD Countries: Comparisons and Evaluations, Paris, 10 December 2007, *www.oecd.org/dataoecd/40/33/40024456.pdf*.

 OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

Table of Contents

OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

Boxes

Tables

Figures

OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

OECD SCIENCE, TECHNOLOGY AND INDUSTRY OUTLOOK 2008 – ISBN 978-92-64-04991-8 – © OECD 2008

From:
OECD Science, Technology and Industry Outlook 2008

Access the complete publication at:
https://doi.org/10.1787/sti_outlook-2008-en

Please cite this chapter as:

OECD (2008), "Main Trends in Science, Technology and Innovation Policy", in *OECD Science, Technology and Industry Outlook 2008*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/sti_outlook-2008-3-en