



# ERAWATCH Country Report 2009

Analysis of policy mixes to foster R&D investment  
and to contribute to the ERA

## Luxembourg

Susan Alexander



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# ERAWATCH COUNTRY REPORT 2009: Luxembourg

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investment and to contribute to the ERA

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ERAWATCH Network – Minerva S.à.r.l.

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## Executive Summary

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As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. This report aims at supporting the mutual learning process and the monitoring of Member States efforts. Its main objective is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The report builds on the analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

Luxembourg's national research system (NRS) is young. Its oldest public research centre was barely thirteen years old when the Lisbon Agenda was formulated and the University of Luxembourg did not even exist. Luxembourg embraced the Agenda first because of its long-standing commitment to the European adventure. Second, the government vividly remembered the economic devastation caused by the collapse of the Grand Duchy's steel industry in the 1970's. With the financial services sector having achieved similar dominance, Luxembourg believed that developing an NRS was one way to promote diversification. Policies were put in place to support the Lisbon Agenda and expand Luxembourg's nascent research landscape.

In the period under assessment, 2008-2009, Luxembourg has implemented a range of new policies in response to an OECD review of Luxembourg's national research system (NRS) (OECD 2007), and a Foresight Study of its National Research Fund (FNR) (FNR, 2007). A new programme, CORE, has been launched whose themes capture Luxembourg's social and economic characteristics. Performance contracts have been signed with the Public Research Centres (PRCs), the FNR and Luxinnovation, the national agency responsible for enabling innovation and research in the private sector. Active emphasis has been put on establishing public/private partnerships (PPPs) and the valorisation of research. An external valuation was performed on the University and the Integrated BioBank of Luxembourg was established.

Having reviewed its research institutions, Luxembourg has turned its attention to the researchers themselves. The FNR and PRC Santé became signatories of the Researcher's Code and Charter. The FNR then launched its "Aides à la Formation-Recherche" (AFR) which provides grants to PhDs and post docs. The Ministry of Culture, Higher Education and Research (MCESR) launched its own study of researcher conditions which will result in recommendations for equitable remuneration and career paths to be implemented.

Overall, based on Luxembourg's success in overcoming barriers to R&D to date, the most significant having been the lack of a public research sector until the late 1980's, there can be some confidence in Luxembourg's being able to take advantage of

opportunities and to mitigate risks. The most significant of these are described in the table below.

<b>Barriers to R&amp;D investment</b>	<b>Opportunities and Risks generated by the policy mix</b>
NRS small size and youth	Having time for the NRS to develop, with committed funding, is an opportunity. Having the NRS take too long to develop risks losing opportunities.
Lack of private sector resources, incentives or interest to undertake R&D	Developing culture of private sector R&D through PPPs and SME project participation. Failure of public sector to develop sufficient commercial-mindedness or commitment to research valorisation.
Global economic crisis	Luxembourg's relatively stronger economy means maintaining fiscal commitments to R&D investment. Risks to component suppliers to the automotive sector is a particular vulnerability (03/09)

Due to its small size and location nestled between France, Belgium and Germany, Luxembourg has always been mindful of the broader European context. Until the creation of the University in 2003, all tertiary education occurred outside of the Grand Duchy. Like its workforce overall, Luxembourg's researchers are broadly multinational and closely tied to wider European research networks. In fact, it might be observed that policies are as supportive of developing more native researchers as they are of making Luxembourg attractive to foreign ones.

	<b>Short assessment of its importance in the ERA policy mix</b>	<b>Key characteristics of policies</b>
Labour market for researchers	<ul style="list-style-type: none"> <li>• Luxembourg relies heavily on ERA researchers as staff for its research institutions and as collaborators in projects.</li> </ul>	<ul style="list-style-type: none"> <li>• Easing visa restrictions for foreign researchers; joining of Euraxess network; signing Research Code and Charter<sup>a</sup></li> </ul>
Governance of research infrastructures	<ul style="list-style-type: none"> <li>• Governing boards represent both public and private sectors, and are normally multinational</li> </ul>	<ul style="list-style-type: none"> <li>• University has European governing board; other institutions have international scientific committees and external as well as internal stakeholder representatives</li> </ul>
Autonomy of research institutions	<ul style="list-style-type: none"> <li>• Research priorities are established and thematic; funding arrangements vary by institution</li> </ul>	<ul style="list-style-type: none"> <li>• Foresight Study used to establish FNR thematic programmes; the university's initial research priorities have been preset. Performance contracts tie funding to results.</li> </ul>
Opening up of national research programmes	<ul style="list-style-type: none"> <li>• Participation is open but direct funding is restricted except for funding for PhDs and post-docs.</li> </ul>	<ul style="list-style-type: none"> <li>• Participation in Eurohorcs and the "Money Follows Researcher" initiative.</li> </ul>

<sup>a</sup> Signers are the FNR and PRC Santé.

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## 1 Introduction

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As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs.<sup>2</sup> This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. For the period 2008 to 2010, this focus is confirmed as main policy challenge and the need for more rapid progress towards establishing the European Research Area, including meeting the collective EU target of raising research investment to 3% of GDP, is emphasised.

A central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of Member States' efforts in the context of the Lisbon Strategy and the ambition to develop the European Research Area (ERA). The first series of these reports was produced in 2008 and focused on characterising and assessing the performance of national research systems and related policies in a comparable manner. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures which a research system has to cope with. The analysis of the ERA dimension still remained exploratory.

The country reports 2009 build and extend on this analysis by focusing on policy mixes. Research policies can be a lever for economic growth, if they are tailored to the needs of a knowledge-based economy suited to the country and appropriately coordinated with other knowledge triangle policies. The policy focus is threefold:

- An updated analysis and assessment of recent research policies
- An analysis and assessment of the evolution of national policy mixes towards Lisbon R&D investment goals. Particular attention is paid to policies fostering private R&D and addressing its barriers.
- An analysis and assessment of the contribution of national policies to the realisation of the ERA. Beyond contributing to national policy goals, which remains an important policy context, ERA-related policies can contribute to a better European level performance by fostering, in various ways, efficient resource allocation in Europe.

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<sup>2</sup> COM(2007) 803 final, "INTEGRATED GUIDELINES FOR GROWTH AND JOBS (2008-2010)", [http://ec.europa.eu/growthandjobs/pdf/european-dimension-200712-annual-progress-report/200712-annual-report-integrated-guidelines\\_en.pdf](http://ec.europa.eu/growthandjobs/pdf/european-dimension-200712-annual-progress-report/200712-annual-report-integrated-guidelines_en.pdf)

## 2 Characteristics of the national research system and assessment of recent policy changes

### 2.1 Structure of the national research system and its governance

When undertaking an analysis of Luxembourg in any context, there are several salient factors that must first be noted. The first is Luxembourg's small size. Luxembourg has a population of 486,006, in a land of 2,586 km<sup>2</sup>. The second is Luxembourg's relative wealth and resilient economy. With a GDP per capita (PPP) of \$85,100, it is placed only behind Liechtenstein and Qatar in worldwide rankings.<sup>3</sup> Even with the global recession and the economic dominance of the financial sector, Luxembourg's GDP growth is expected to continue to outpace other eurozone countries.

**Table 1: Annual GDP Growth, Luxembourg vs. eurozone (%)**

Year	2007	2008	2009 (est)	2010 (est)
Luxembourg	5.2	2.5	1.2	2.3
Eurozone	2.6	0.8	0.1	0.95

Source: Eurostat

The third significant feature of Luxembourg is the high percentage of resident foreigners. At 42.6%, Luxembourg has the highest number of non-national residents of any country in the world. Of this group the largest number are Portuguese, followed by the French. In addition, each working day, more than 135,000 "frontaliers" cross the borders of France (68,600), Germany (31,700) and Belgium (35,000) to jobs that range from shop assistants and waiters to university professors and corporate executives.

Finally, the most important factor specifically concerning Luxembourg's national research system (NRS) is its youth. Luxembourg's oldest public research centre has only recently celebrated its twentieth anniversary and its university was established by law only in 2003. Thus Luxembourg's relatively low GERD in the table below reflects the lack of a university for the majority of the years noted as well as its diminutive NRS, as described below. The decrease in GERD in 2004-2005 as well as 2006-2007 is mirrored to some extent in EU27 declines.

**Table 2: GERD as % of GDP: Luxembourg compared to EU27 and eurozone**

Year	2000	2001	2002	2003	2004	2005	2006	2007
Luxembourg	1.65	n.a.	n.a.	1.65	1.63	1.56	1.66	1.63
EU27 (est)	1.86	1.87	1.88	1.87	1.83	1.84	1.84	1.83

Source: Eurostat<sup>4</sup>

<sup>3</sup> Source: CIA World Factbook. <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html>. Note that through most of the 1990s and beyond, Luxembourg ranked first until displaced by Bermuda in 2006.

<sup>4</sup> Source: <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=0&language=en&pcode=tsjir020>

**Table 3: BERD as % of GDP: Luxembourg compared to EU27**

Year	2003	2004	2005	2006	2007
Luxembourg	1.47	1.43	1.35	1.43	1.36
EU27 (est)	1.19	1.16	1.15	1.18	1.17

Source: Eurostat

Comparing GERD with BERD, it becomes obvious that private sector research funding by far overshadows the public sector. This is due both to the presence of some world class research companies which have an R&D presence in Luxembourg, some leading R&D companies which are registered in Luxembourg for its fiscal advantages (although the actual research is done elsewhere), and some “home-grown” companies that undertake innovative research.

### Main actors and institutions in research governance

Luxembourg’s NRS is headed by the Ministry of the Economy and Foreign Trade (ECO) for the private sector and the Ministry of Culture, Higher Education and Research (MCESR) for the public sector. ECO’s portfolio includes supporting private sector research, attracting innovative companies to establish themselves in the Grand Duchy and championing IP by supporting patent registration and sponsoring legislation to make IP revenues tax advantaged. A diagram of Luxembourg’s research system is included on following page.

The MCESR is in charge of the University of Luxembourg, the four public research centres (PRCs Gabriel Lippmann, Henri Tudor, Santé<sup>5</sup> and CEPS/INSTEAD), the National Research Fund (FNR) which provides funding for public sector research and the national funding programmes for undergraduate and graduate studies<sup>6</sup>.

Bridging the private and public sectors is Luxinnovation, the national agency for the promotion of research and innovation, whose work with both new and established companies includes identifying sources of funding and possibilities for public/private partnerships (PPP), organising sectoral clusters and assisting firms with FP7, EUREKA and ESA project participation.

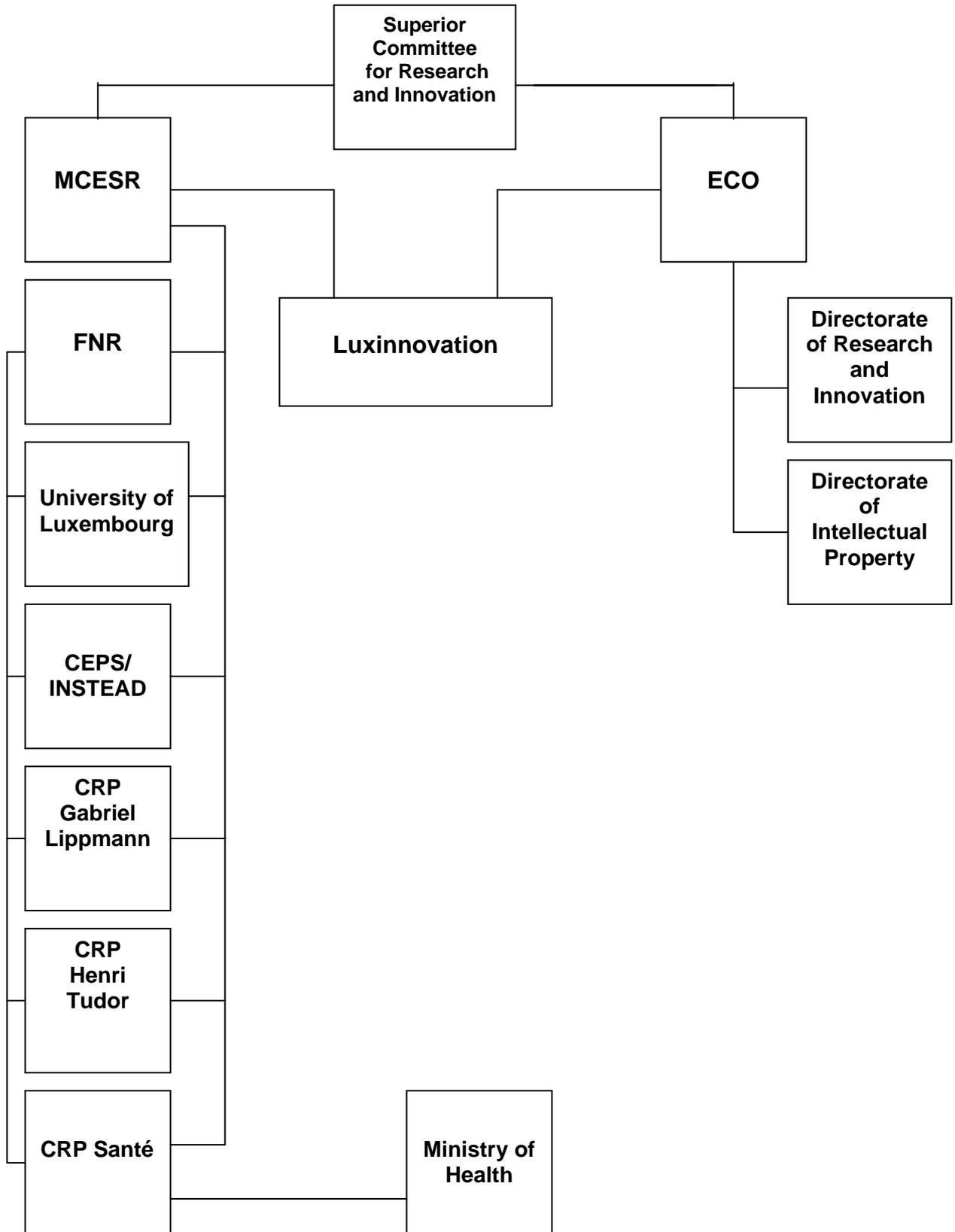
For the private sector there are business incubators supported by ECO and MCESR and funding opportunities, such as innovation loans, for start ups.

In 2008, a Superior Committee for Research and Innovation (Comité Supérieur de la Recherche et de l’Innovation) was created. Its co-chairs are the Ministers of the Economy and Foreign Trade and of Culture, Higher Education and Research, assisted by other members of the government and the business and civic communities. Its mandate is to develop a coherent national approach to research and innovation, with supporting policies, strategic objectives, targeted programmes and plans for implementing the preceding over the long-term. It had its first meeting in July 2008.

<sup>5</sup> CRP Santé is also overseen by the Ministry of Health.

<sup>6</sup> The programme also includes post-doctoral researchers.

**Figure 1: Overview of the governance structure of Luxembourg's research system**



Source: Authors

## Main research performer groups

Luxembourg's main research groups in the public sector are the University, the three PRCs and CEPS/INSTEAD. The University identifies itself as a research rather than merely a teaching university. It has three faculties<sup>7</sup> and has set a series of seven main research priorities.<sup>8</sup> PRC Gabriel Lippmann focuses on the environment, agrobiotechnologies and materials science, PRC Santé focuses on healthcare, public health and biotechnology and CRP Henri Tudor focuses on new technologies, while CEPS/INSTEAD produces and analyses socio-economic statistics.

Private sector companies undertaking R&D include global leaders such as ArcelorMittal, Delphi and Goodyear, "home-grown" companies like Rotarex and Ceratizit and spin-offs like AxoGlia Therapeutics.

## 2.2 Summary of strengths and weaknesses of the research system

The analysis in this section is based on the ERAWATCH Analytical Country Reports 2008 which characterised and assessed the performance of the national research systems. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures a research system has to cope with. The Analytical Country Report for the specific country can be found in the [ERAWATCH web site](#).

Overall, Luxembourg's policies are well co-ordinated. This in large part reflects Luxembourg's commitment to the Lisbon Agenda and genuine efforts on the government's part to formulate policies to realise the Lisbon objectives. The OECD review, the Foresight Study and the concerted follow up to their recommendations indicate Luxembourg's determination to meet the challenges relating to its NRS.

Luxembourg's size is a strength rather than a limitation in this context as it means coherent policies are possible. The Superior Committee for Research and Innovation, launched in 2008, will further ensure policy coherence and increase co-ordination between the private and public sectors.

Achieving greater harmonisation between the PRCs and the University will resolve some remaining issues relating to co-ordination and coherence<sup>9</sup>. This was one of the OECD recommendations and efforts in this regard are underway.

**Table 4: Summary assessment of strengths and weaknesses of the national research system**

Domain	Challenge	Assessment of strengths and weaknesses
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<sup>7</sup> The faculties are of Science, Technology and Communication, of Law, Economics and Finance and of Language and Literature, Humanities, Arts and Education.

<sup>8</sup> The University's research priorities are security and reliability of information technology, material science, life sciences, European and business law, finance, educational science and Luxembourg studies.

<sup>9</sup> These include overlaps in research topics and economies to be achieved by consolidating administrative functions.

Resource mobilisation	Justifying resource provision for research activities	While Luxembourg's relatively low GERD compared to the EU27 may be considered a weakness, this is due mainly to the youth of its NRS and its limited absorptive capacity. Strength comes from a national commitment to the Lisbon agenda that makes raising that level a policy priority.
	Securing long term investment in research	Luxembourg's inaugurating a national university and constructing a "City of Science" reflect the government's long-term perspective. Targeting the logistics and biosciences sectors as new niches for development indicate long-term goals for the private sector. With a research budget in place to realise these objectives, only strengths have been identified.
	Dealing with barriers to private R&D investment	While access to equity venture capital is limited in Luxembourg, and must be considered a weakness, the government has launched several initiatives to promote spin-offs and start-ups including creating business incubators, promoting entrepreneurship and offering innovation loans. Raising awareness of IP and a favourable fiscal environment for IP revenue increases Luxembourg's attractiveness for both new and established companies; these provide strength.
	Providing qualified human resources	Visa restrictions are being eased to support researcher mobility and doctoral and post-doc studies are being funded, strengthening human resources. A dependence on ex-national researchers can result in a brain drain rather than a brain gain if researchers return home and can be viewed as a weakness.
Knowledge demand	Identifying the drivers of knowledge demand	The Foresight Study was a major initiative undertaken to identify up-to-date demand drivers involving all NRS stakeholders and the implementation of its recommendations is a strength. Clusters also provide driver input. The focus on industrial to the neglect of service sector needs remains a weakness, as evidenced by recipients of ECO R&D subsidies.
	Co-ordination and channelling knowledge demands	The specificity of FNR programmes are a system strength, while attention to European programmes such as EURKEA and FP7 also channel efforts. However, such a targeted focus can also mean missed opportunities and could possibly, but not necessarily, result in future weakness.
	Monitoring of demand fulfilment	Tracking the growth of the ECO R&D funding programme indicates private sector demand fulfilment, as well as private sector IP registrations under the new law, and shows system strength. Instituting a Performance Contract culture within the public participants of the NRS will help overcome weaknesses in governance and accountability.

Domain	Challenge	Assessment of strengths and weaknesses
Knowledge production	Ensuring quality and excellence of knowledge production	The quality of Luxembourg's knowledge production is a significant strength. Its targeted approach to research is both a strength and a weakness as it prevents dissipation of resources while limiting exploration of new opportunities.
	Ensuring exploitability of knowledge	Initiatives to actively develop PPPs will enhance knowledge exploitation and strengthen the system. Increased attention to IP and research valorisation will also support exploitation.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Greater harmonisation between the University and the CRPs is needed and will improve knowledge circulation and system strength. The presence of leading international research companies is a strength that will be further leveraged by the initiative to promote PPPs.
	Profiting from international knowledge	FNR programmes like INTER and the Accompanying Measures encourage international participation of Luxembourg researchers, while ATTRACT brings in international expertise. No weaknesses are identified.
	Enhancing absorptive capacity of knowledge users	Absorptive capacity could be strengthened by increasing the participation of the dominant services sector and SMEs in PPPs, as the industrial sector currently dominates, which weakens the system.

Thus the predominant strengths of Luxembourg's NRS on which future developments can build are the government's commitment to the Lisbon goals, its determination to continue improving the quality of the NRS by such undertakings as the OECD review and Foresight Study and its willingness to implement fully the reports' recommendations. NRS development will receive further support from a renewed focus on the valorisation of research, whether through public/private partnerships or the favourable treatment of IP.

While the dominance of the industrial sector in private sector R&D continues, in contrast to the dominance of the services sector in GDP, new research programmes have begun to address this imbalance. There is also a new focus on research as a career choice to develop more native research talent and decrease over-dependence on a foreign researcher presence. At the same time, attention is being given to making Luxembourg an attractive place for all researchers.

Having identified weaknesses in public NRS governance and accountability, performance contracts have been signed with the major actors. These should improve responsiveness to knowledge demand and increase knowledge circulation. Greater transparency will only assist in the justification of research provision and will further co-ordination and coherence. The launch of the Superior Committee for Research and Innovation will further assure policy coherence.

### ***2.3 Analysis of recent policy changes since 2008***

The contribution of research and research policies to Lisbon goals (as well as to other societal objectives) goes beyond the fostering of R&D investment. It is therefore important to also analyse how other remaining shortcomings or weaknesses of the research system are addressed by the research policy mix. The focus of the section is on the analysis of main recent policy changes which may have a relevant impact on the four policy-related domains.

### 2.3.1 Resource mobilisation

Luxembourg's resource mobilisation in the public sector can be seen in new budget commitments as detailed in Table 5 below.

**Table 5: Meeting the Lisbon Goals: Share of government budget appropriations allocated to public R&D**

Year	2004	2005	2006	2007	2008	2009*	2010*
Amount	€72.0m	€94.5m	€113.6m	€142.0m	€175.0m	€215.0m	€250.0m
% GDP	0.27	0.32	0.36	0.42	0.48	0.54	0.58

\*Foreseen. Source: Government of Luxembourg, 2008.

While the allocations fall short of the ultimate goal of 1%, this shortfall reflects issues of absorptive capacity due to the youth of the NRS. The government's commitment is to supporting *good* research, not just any research.

#### **Changes in National Reform Programme regarding the role of research in the broader economic growth strategy**

Luxembourg's NPR for 2008, in its discussion of support and funding for research (LDI 7), again commits to working towards a goal of 1% of GDP invested in public R&D. It describes the formation of the Superior Committee for Research and Innovation and its mission to ensure coherency in the Grand Duchy's R&D policy mix, as well as the implementation of the recommendations of the OECD review of the national innovation system (OECD, 2007) and the FNR Foresight Study (FNR, 2007). In terms of the broader economic growth strategy, the role of R&D as an economic driver for Luxembourg has not changed as a central component in realising the Lisbon Agenda. Policy developments such as the decision to invest in the Integrated Biobank of Luxembourg (IBBL) support this assessment..

**Table 6: Main policy changes in the resource mobilisation domain**

Challenges	Main Policy Changes
Justifying resource provision for research activities	<ul style="list-style-type: none"> <li>• Conducting an external evaluation of University. Completing the signing of Performance Contracts with NRS actors.</li> </ul>
Securing long term investments in research	<ul style="list-style-type: none"> <li>• Launching of the biobank IBBL.</li> </ul>
Dealing with uncertain returns and other barriers	<ul style="list-style-type: none"> <li>• Beginning of legislation giving favourable tax treatment to IP-related revenues.</li> </ul>
Providing qualified human resources	<ul style="list-style-type: none"> <li>• Initiating the programme Aides à la Formation-Recherche (AFR). Undertaking a study of the situation of researchers in Luxembourg in order to develop an HR strategy for researchers.</li> </ul>

As detailed in Table 6, above, some of the most important new policies implemented in 2008-2009 are in mobilisation of resources. The launching of the Integrated BioBank of Luxembourg ([www.ibbl.lu](http://www.ibbl.lu)), with government funding of €140m, is particularly significant. A collaboration between the University of Luxembourg, the three PRCs, and the Institute for Systems Biology, Seattle, the Partnership for Personalized Medicine, Phoenix, and the Translational Genomics Research Institute, Phoenix, the biobank will store, process and distribute biospecimens. These will be used to identify disease mechanisms, develop screening tests for biomarkers associated with sub-types of a disease and group patients with common genetic characteristics for testing new drugs and determining the best treatment.

### 2.3.2 Knowledge demand

Policy changes in knowledge demand are best reflected in the launching of the CORE programme, which is a source of funding for research projects undertaken by Luxembourg’s public research institutions. An outcome of the FNR Foresight Study (FNR, 2007), CORE focuses on themes developed in consultation with both the public and private sectors and international experts. More than previous programmes, it more accurately reflects the contributions of the services sector to the economy, which accounts for 80% of Luxembourg’s GDP. The CORE programme’s themes are: Innovation in Services; Sustainable Resource Management in Luxembourg; New Functional and Intelligent Materials and Surfaces, and New Sensing Applications; Biomedical Sciences/Regulation of Chronic, Degenerative and Infectious Diseases; Labour Market, Educational Requirements and Social Protection; Identities, Diversity and Integration. In 2008, 35 projects out of 97 submitted were funded for €14.7m. Projects are of 2-3 years’ duration. There will be new calls made for project proposals in 2009 and 2010.

**Table 7: Main policy changes in the knowledge demand domain**

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	<ul style="list-style-type: none"> <li>• Issuing first call for new FNR programme CORE.</li> </ul>
Co-ordinating and channelling knowledge demands	<ul style="list-style-type: none"> <li>• Signing of Performance Contract by Luxinnovation. Forming biohealth and automotive clusters.</li> </ul>
Monitoring demand fulfilment	<ul style="list-style-type: none"> <li>• Tracking success of NRS actors in meeting requirements of Performance Contracts.</li> </ul>

### 2.3.3 Knowledge production

The government’s continuing commitment to knowledge production is seen in ongoing increases in its public R&D budget as detailed in Table 5 above and outlined in the NRP. In addition to budget increases, the government has also focussed on research *quality*. To this end, the MCSR reported the results of an evaluation by external experts of the University. Research was regarded as mature; teaching was judged to need improvement and the fragility of the institution due to its extreme youth was highlighted as needing attention. These assessments will be incorporated in the University’s next multi-year plan which runs from 2010-2013 and is being finalised in 2009.

To exploit the legislation that provides favourable tax treatment for IP revenues, the government has sponsored “IP Days” to increase general awareness of corporate intellectual property. The next event is a conference entitled “How to valorise your intangibles” on 27 April 2009, sponsored by ECO and Luxinnovation. It is free and open to the business community. In addition, public NRS actors have put new emphasis on research valorisation. The University has assigned a Vice Rector to focus on valorising the IP resulting from University research while PRC Henri Tudor has valorisation specialists working in its Centre for IT Innovation.

**Table 8: Main policy changes in the knowledge production domain**

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	<ul style="list-style-type: none"> <li>• Undertaking an external evaluation of University.</li> </ul>
Ensuring exploitability of knowledge production	<ul style="list-style-type: none"> <li>• Stressing valorisation of research by IP events and public NRS administrative emphasis</li> <li>• Requiring PRCs secure part of their funding through PPPs.</li> </ul>

Finally, the performance contracts signed by public NRS actors will also address knowledge demand. As detailed in the NRP, the public research centres are expected to contribute €103m of their funding through public/private partnerships for the period 2008-2010. To achieve this goal, the centres must give increased attention to knowledge demands from Luxembourg's private sector.

### 2.3.4 Knowledge circulation

Policies to improve knowledge circulation focused on the requirement that PRCs actively initiate public-private partnerships (PPPs), as described in Section 2.3.4, and ensure greater involvement of SMEs in projects. Performance contracts link government funding with PPPs and participation in European and international projects. The Centre for IT Innovation of PRC Henri Tudor, along with Luxinnovation, is especially focussed on involving SMEs in participating in European projects, such as the Eureka projects MOVIES and CARLINK, described in Section 3.2.

The IBBL, described in Section 3.2.1, is a textbook example of policies put in place to profit from access to international knowledge.

**Table 9: Main policy changes in the knowledge circulation domain**

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	<ul style="list-style-type: none"> <li>• Requiring PPPs as component of Performance Contracts.</li> </ul>
Profiting from access to international knowledge	<ul style="list-style-type: none"> <li>• Launching of biobank IBBL</li> </ul>
Absorptive capacity of knowledge users	<ul style="list-style-type: none"> <li>• Emphasising involvement of SMEs in NRS as part of Performance Contracts.</li> </ul>

## ***2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment***

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths.

Overall, in the period under review, Luxembourg has continued to build on its strengths and address system weaknesses. The launch of the biobank project is an example of building on Luxembourg's strengths of a robust economy and a government responsive to opportunities that support the Lisbon Agenda. A new policy addressing weaknesses is the implementation of performance contracts with the PRCs and other NRS actors that require public/private partnerships to justify funding. An outline detailing opportunities and risks appears in Table 10 below.

**Table 10: Summary of main policy related opportunities and risks**

Domain	Main policy related opportunities	Main policy-related risks
Resource mobilisation	<ul style="list-style-type: none"> <li>• Growing GERD as NRS matures</li> </ul>	<ul style="list-style-type: none"> <li>• Failure to increase absorptive capacity.</li> </ul>
Knowledge demand	<ul style="list-style-type: none"> <li>• Building public/private partnerships</li> </ul>	<ul style="list-style-type: none"> <li>• Inability to generate project proposals to meet new standards and overcome financial constraints</li> </ul>
Knowledge production	<ul style="list-style-type: none"> <li>• Encouraging spin-offs and research valorisation</li> </ul>	<ul style="list-style-type: none"> <li>• Limited venture capital funding for new ventures</li> </ul>
Knowledge circulation	<ul style="list-style-type: none"> <li>• Expanding research community by PPPs and SME involvement</li> </ul>	<ul style="list-style-type: none"> <li>• Failure to attract private sector participation in PPPs.</li> </ul>

### 3 National policy mixes towards R&D investment goals

The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. The Lisbon strategy emphasises an EU overall **resource mobilisation objective** for 2010 of 3% of GDP of which two thirds should come from private investment. R&D investment is seen as important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.

The chapter is structured around five questions:

1. What are the specific barriers in the country that prevent reaching the Lisbon goal? What barriers exist in the country to prevent reaching the specific targets, particularly related to the private sector R&D investments?
2. Given the above, what are the policy objectives and goals of the government that aim to tackle these barriers?
3. What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?
4. What have been the achievements in reaching the above mentioned R&D investment objectives and goals?
5. What are the reasons for not reaching the objectives, adaptation of the goals?

The chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

#### ***3.1 Barriers in the research system for the achievement of R&D investment objectives***

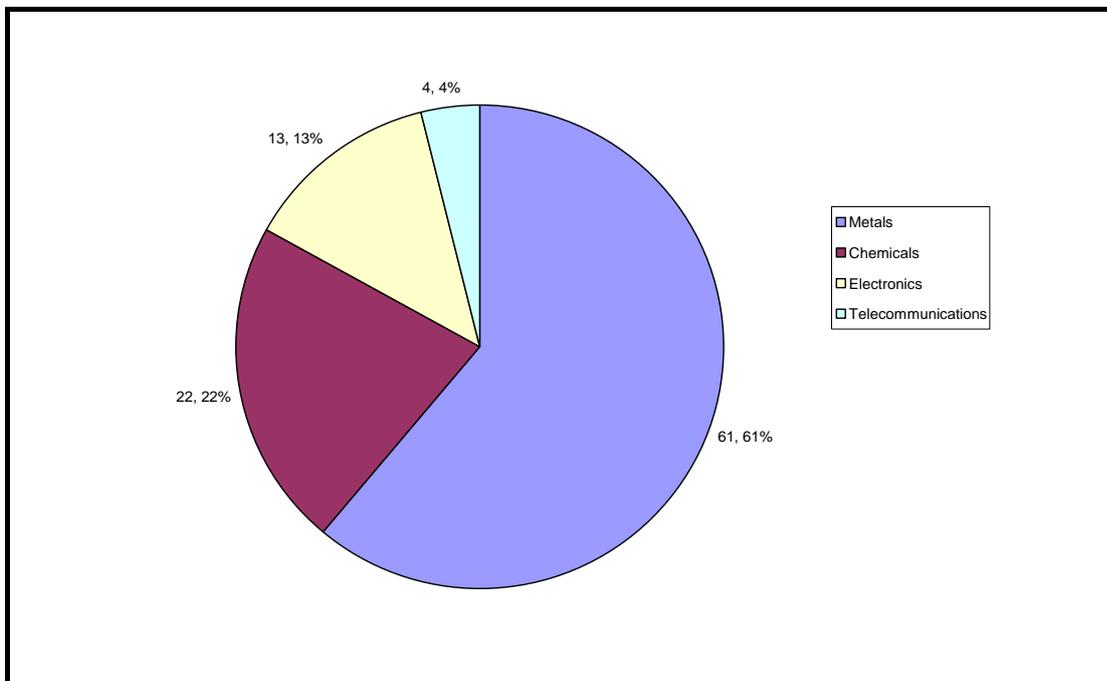
Currently the barriers to achieving public sector R&D investment objectives are, as stated above, the youth and small size of the NRS, which impact its absorptive capacity. However these are barriers that will be resolved more with time than policy.

In terms of the private sector, recent policy changes are designed to overcome other investment barriers. Performance contracts for the PRCs mandate the cultivation of public/private partnerships (PPPs) and the development of greater commercial-mindedness. An increased focus on the valorisation of research and the identification of IP, with a supporting law giving IP revenues favourable tax treatment, also encourage increased private sector investment.

However, the major barriers in 2008-2009<sup>10</sup> to private sector R&D investment are not systemic but rather financial constraints due to the global recession. Luxembourg is home to ArcelorMittal, the world's leading steel producer, and an extensive automotive components sector, both of which have been caught in a precipitous slump in demand. That Luxembourg is a major financial centre whose banks are the focus of the crisis further impacts R&D investments. It should be noted that Luxembourg has no defence industry, which in some countries is a major source of R&D investment. In Luxembourg, this is not considered to be a barrier. A systemic barrier to private R&D investment is the lack, until recently, of active development of public/private partnerships (PPPs) between research institutions and businesses, accompanied by an under-developed commercial-mindedness on the part of the PRCs.

The impact of the economic crisis on private sector R&D investment objectives can be seen in the results of ECO's research grant programme in 2008.<sup>11</sup> Only 28 projects were funded, compared to 32 in 2007, for a total R&D investment of €66.04m, compared to 2007's €90.19m. Finally, only four sectors were represented, compared to seven in 2007. The IT, health technologies, environmental technologies and wood sectors which received grants in 2007 did not participate.

**Figure 2: Sectoral allocation of companies participating in the ECO programme, 2008**



Source: ECO

<sup>10</sup> And also possibly 2010 depending on when the global economy begins to expand again.

<sup>11</sup> ECO grants cover some but not all project costs. In 2008 €22.04m was financed of €66.04 R&D costs overall.

### **3.2 Policy objectives addressing R&D investment and barriers**

In Luxembourg's NRP for 2008, the government committed to increasing budget appropriations allocated to public R&D, as detailed in Table 5. It also referenced additional policies to support R&D investment and overcome R&D barriers. The first is the formation of the Superior Committee for Research and Innovation. Headed by the Ministers of the Economy and of Culture, Higher Education and Research, its purpose is to ensure coherency in the Grand Duchy's R&D policy mix, as well as to oversee the implementation of the recommendations of the OECD review of the national innovation system (OECD, 2007) and the FNR Foresight Study (FNR, 2007).

The next NRP policy focuses on concentrating national efforts on a limited number of prioritised domains. These are the areas identified in the FNR's CORE programme, which was an outcome of the Foresight Study. They are detailed below in Section 3.3.1 and illustrate the thematic orientation of Luxembourg's public sector research.

The transfer of administering the programme that provides financial support to PhD candidates and post-docs from the MCESR to the FNR is significant because the new "aides à la formation-recherche" (AFR) incorporate the Commission's recommendations in the Code of Conduct for the Recruitment of Researchers and the Researcher's Charter. It evidences Luxembourg's commitment to developing researchers and ensuring an attractive environment for their work. A policy easing visa restrictions for researchers is another facet of this initiative.

A policy implementing an OECD recommendation is evidenced in the signing of performance contracts covering 2008-2010 between the government and the entities in Luxembourg's NRS. While the government has budgeted €168m to support its research institutions, for their part the research centres are committed to raising €103m between public-private partnerships and participating in other programmes such as FP7. Other benchmarks include numbers of publications, numbers of doctoral students and numbers of patent applications filed. The FNR and Luxinnovation also signed performance contracts.

Finally the government has committed €140m over a five-year period to develop a centre of excellence in molecular medicine. Included in the initiative are the International BioBank of Luxembourg (IBBL) and a Centre for Systems Biology Luxembourg (CSBL).

Aside from ensuring crucial financial support for Luxembourg's NRS, the policies laid out in the NRP take advantage of some important opportunities, such as the biobank, as well as ameliorate some system barriers. These include creating an attractive environment to fill Luxembourg's need for more researchers and instituting performance contracts to address issues of transparency, governance and accountability.

In terms of private sector R&D, the current ECO research subsidy programme is being continued and no new policies have been foreseen in the NRP, except inasmuch as there are private sector partners in the molecular medicine initiative.

### **3.3 Characteristics of the policy mix to foster R&D investment**

This section is about the characterisation and governance of the national policy and instrument mix chosen to foster public and private R&D investment. While policy goals are often stated at a general level, the policy mix has a focus on how these policy goals are implemented in practice. The question is what tools and instruments

have been set up and are in operation to achieve the policy goals? The following sections will each try to tackle a number of these dimensions.

### 3.3.1 Overall funding mechanisms

Luxembourg's funding mechanisms for R&D are balanced between the private and public sectors, with increasing emphasis given to PPPs. To generalise, private funding mechanisms tend to be generic and without a fixed budget, while public funding tends to be thematic and with fixed programme funding. The reason for the latter is the historic dominance of the PRCs, which undertake applied research, and the youth of the university, which will ultimately undertake more generic research.

The major private sector funding mechanism is ECO's R&D grant programme (see Section 3.1 above). Up to 75% of eligible costs are covered for basic research, up to 50% for industrial research and up to 25% for pre-competitive research. Grants can be increased based on whether the grantee is an SME, is in a cross-border consortium, involves activities prior to basic research activities, or is based in one of Luxembourg's regions considered to be economically less advantaged.<sup>12</sup>

Unlike the recipients of public sector research funding, whose work is made public both online and in various reports, publications and conferences, recipients of ECO grants report their progress only to the ministry, on the basis that it is proprietary information and competitor-sensitive. Even the recipients of these grants are not known publicly.

Additional private sector funding is available from the SNCI and the Ministry of the Middles Classes, Tourism and Lodging (Ministère des Classes Moyennes, du Tourisme et du Logement), which offer innovation loans to start ups. The latter's programme reflects its function as the administration that awards business licenses to new companies. Finally, Luxinnovation actively works with companies to assess which funding mechanisms most suit their needs.

For the public sector, the FNR tends to award funding in response to thematic calls<sup>13</sup>. The themes variously represent existing competencies, such as materials and surfaces, and emerging competencies, such as regenerative medicine. The CORE programme, an outcome of the Foresight Study, has funding of €22m.<sup>14</sup> As a condition of their performance contracts, the PRCs are now required to generate some of their own funding through PPPs or participation in FP7 or EUREKA funded consortia, among others. Consortia participation offers an opportunity to involve SMEs in R&D and Luxinnovation, the national agency for innovation and research, also plays a key role in securing SME funding.

In terms of relative funding budgets, the ECO programme has no set limit; FNR programmes are funded for a total amount per programme; other public sector R&D participation depends on funding awarded by FP7, for instance. In 2008, twelve

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<sup>12</sup> Regions are Southern, Eastern and Northern.

<sup>13</sup> An exception is the INTER programme which is targeted at Luxembourg researcher participation in international projects, regardless of theme.

<sup>14</sup> The CORE programme's thematic areas are: Business service design; Development and performance of the financial systems; Information security and trust management; High performance telecommunication networks; Sustainable management of water resources; Sustainable uses and sources of energy; New functional and intelligent materials and surfaces; Regenerative medicine in age-related diseases; Translational biomedical research; Challenges for the educational system, labour market, social protection including territorial aspects; Identities, diversity and integration.

projects were funded through FP7 calls, for a total of €55.4m. Two of the projects involved SMEs.

### 3.3.2 Policy Mix Routes

The “Policy Mix Project” identified the following six ‘routes’ to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in cooperation with the public sector or other firms;
6. increasing R&D in the public sector.

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one ‘route’, the policy portfolio varies from country to country and region to region depending to policy traditions, specific needs of the system etc.

#### **Route 1: Promoting the establishment of new indigenous R&D performing firms**

At the end of 2007, the government passed legislation creating a more attractive tax environment for IP revenue. The new law provides for an exemption of 80% of the net income deriving from remuneration for the use or the licensing of the use of IP rights on software, patents, marks, trademarks, domain names, drawings or models. As one requirement for the exemption is that the IP right which generates the income must have been created or acquired by the taxpayer after 31 December 2007, the law supports R&D-based innovation and supports the establishment of new indigenous R&D performing firms.

An example of such a firm is AxoGlia Therapeutics, which discovered a molecule with the potential to treat neurodegenerative and neuroinflammatory diseases like Alzheimer’s or multiple sclerosis. Basic research was conducted at the University of Luxembourg, in collaboration with the Louis Pasteur University in Strasbourg and the NCSR in Paris before the spin off was formed. The company’s launch was helped by funding from ECO’s R&D grant programme and co-financing from the National Society for Credit and Investment (SNCI).

More indigenous R&D intensive firms are expected to be spun off from the molecular medicine programme that include the IBBL biobank and the systems biology centre (CSBL)

#### **Route 2: Stimulating greater R&D investment in R&D performing firms**

The ECO R&D grants are designed to encourage the expansion of R&D activities in R&D-performing firms. ECO will actively encourage qualified firms to take advantage of the programme. As mentioned above in Section 3.3.1, only the number of awards

and the sectors of the beneficiaries are made public so a detailed evaluation of the programme is not possible. SME participation is also reported.

### **Route 3: Stimulating firms that do not perform R&D yet**

The ECO R&D grants designed to stimulate more R&D from R&D-performing firms are also meant to stimulate firms that do not yet perform R&D. ECO has launched an initiative called “Fit4Europe” which supports the costs of companies preparing proposals for FP7 calls.

The PPP initiative is also meant to involve non-R&D performing firms in undertaking research. Two examples of the results of promoting PPPs for non-R&D performers are the EUREKA projects MOVIES and CARLINK. Both led by PRC Henri Tudor, MOVIES’ consortium included France’s Alcatel-Lucent and Spain’s Telefonica. The project’s goal was to develop a platform to support mobile video-on-demand. With private sector partner RTL’s Broadcasting Center Europe, which was new to R&D, MOVIES achieved the first-ever broadcast in DVB-H, the new standard for global mobile TV.

With participants from Finland and Spain, and local partner the Automobile Club of Luxembourg (ACL), CARLINK’s objective was to develop a platform to deliver real time information about traffic or weather conditions to drivers’ mobile phones. Having been new to any kind of R&D project the ACL is now continuing to work on further developing of CARLINK. Both projects received silver and bronze Excellence Awards, respectively, from Celtic, the EUREKA telecoms cluster.

Luxinnovation, while offering services to both new and established firms, is especially effective at helping firms determine how to obtain funding for R&D projects, whether via a PPP or an FP7 programme.

Finally, the government sponsors incubators for start-ups. One, the Technoport, is run under the auspices of PRC Henri Tudor and has housed 45 companies since its launch in 1998. It has also arranged ten PPPs between its SMEs and Tudor. ECO has two incubators, while a third is planned for the City Of Science that will eventually house the PRCs laboratories and the University.

### **Route 4: Attracting R&D-performing firms from abroad**

One of ECO’s key missions is to attract firms from abroad to establish subsidiary companies in Luxembourg. In late 2008 ECO launched Focus, a bi-annual magazine reporting on local research developments and initiatives to interest companies in the Grand Duchy. Foreign R&D performing firms are considered particularly attractive. For example, Raval Europe is a new subsidiary of an Israeli firm specialising in R&D for automobile fuel tank venting and control systems. The IBBL, in which the government is investing €140m, is a partnership between the University, the three PRCs, the Translational Genomics Research Institute of Phoenix, Arizona and the Institute for Systems Biology of Seattle, Washington. Finally the Chamber of Commerce organises trade missions abroad to attract foreign firms to the Grand Duchy. In 2009 missions include China, Argentina, Libya, Morocco, Tunisia, Ukraine, Russia, Kazakhstan, Russia, Thailand, Indonesia and the Philippines.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

PPPs are the main policy means of increasing extramural research. To promote more public/private co-operation, Luxinnovation has organised two “Business Meets Research” days where the public actors in the NRS presented their capabilities to private sector participants.

The CARLINK and MOVIES project detailed in Route 3 are also examples of this route.

### **Route 6: Increasing R&D in the public sector**

The decision that the University of Luxembourg should be a research-based institution and then fully funding its establishment is representative of Luxembourg's commitment to increasing research in the public sector. However, the government wants to increase *good* research, not just any research. For the first call for the new FNR CORE programme, out of 97 proposals received, only 35 were funded. However, those projects were awarded a total of €14.7m. Note that CORE covers a number of new themes for the FNR which in themselves will increase the range of public sector research. Already representative of "good" research is the Nanobeams Network of Excellence, headed by PRC Gabriel Lippmann, which also co-ordinates the NoE's PhD school.

### **The importance of education and innovation policies**

As mentioned above, the University of Luxembourg is designed to be primarily a research institution and places significant emphasis on the valorisation of research. In addition, it offers a Master of Science in Entrepreneurship and Innovation in conjunction with the Chamber of Commerce, which also offers services to start-ups.

Another cross-domain policy is the support of several business incubators, one under the auspices of PRC Henri Tudor and two others under ECO.

Finally the Aides à la Formation-Recherche (AFR) programme provides funding to PhDs and post-docs who will form a future cadre of innovators as well as researchers for the Grand Duchy.

### **Assessment of the importance of policy mix routes and their balance**

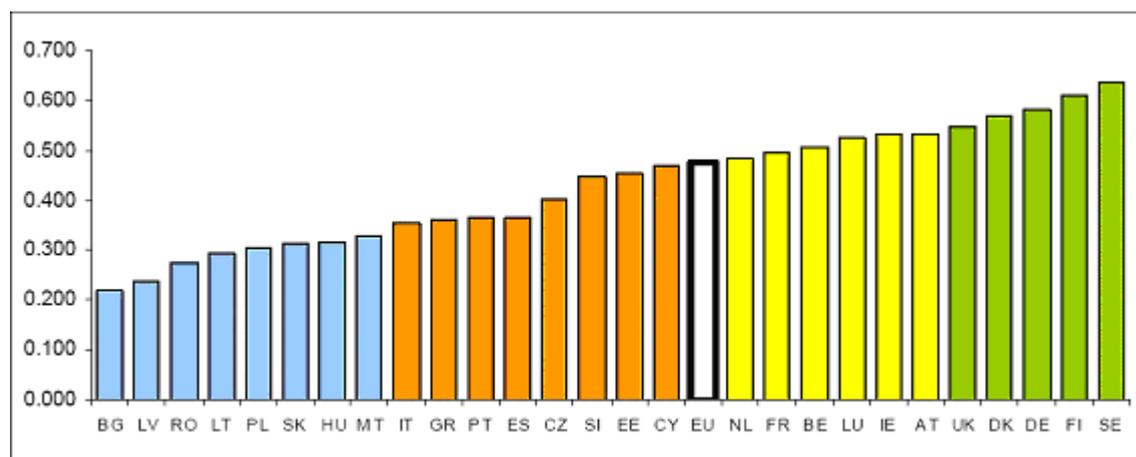
Of the routes detailed above, stimulating R&D investment in R&D performing firms, attracting R&D performing firms from abroad and increasing R&D in the public sector, the second, fourth and sixth routes respectively, are the "traditional" routes along which Luxembourg has previously approached R&D. They continue to be fully supported. New policies resulting from the OECD review of the NRS and the Foresight Study of the FNR, as well as the IP legislation and bio-health cluster funding, seek to more fully open the first, third and fifth routes and effectively widen the older routes. These latter routes are currently policy priorities which are reflected in the PRC performance contracts and the new emphasis on developing public/private partnerships. These policies effectively mandate that the PRCs nurture new private sector research actors as a condition of funding and are highlighted in Luxembourg's NRP.

**Table 11: Importance of routes in the national policy and recent changes**

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	A newer route which is just beginning to show results.	New law on IP tax treatment. Emphasis on valorisation of public research outputs.
2	The ECO R&D grant programme is the most important route for the private sector. It is also the oldest.	PRC Performance Contracts promoting PPPs.
3	Stimulating new R&D-performing firms is a relatively recent initiative; successes will increase its relative importance.	PRC Performance Contracts promoting PPPs. The Fit4Europe programme.
4	Foreign subsidiaries have long been leaders in private sector R&D benefitting from Route 2.	Launching the IBBL and other biohealth initiatives.
5	Encouraging extramural co-operation is also a relatively new initiative (see Route 3).	PRC Performance Contracts promoting PPPs.
6	This is the most important route for the public sector and is especially crucial for the government in meeting its Lisbon goal.	New FNR programme CORE. Launching a biohealth research cluster.

### 3.4 Progress towards national R&D investment targets

As is stated in the [ERAWATCH Research Inventory for Luxembourg](#), “it is just a matter of time for Luxembourg to reach the [Lisbon] objective, not a matter of motivation or financial resources,” (Dussain, 2009). The policy portfolio is inclusive, balanced and designed not just to meet a budgetary target but also to produce an NRS that makes a significant contribution to the economy and ultimately positions Luxembourg as an innovation leader rather than just one of the higher-ranking followers, as per the chart below. Luxembourg is steadily increasing its R&D budget, as per Table 5, and systematically implementing the recommendations made in the OECD report (OECD, 2006) and Foresight Study (FNR, 2007).

**Figure 3: Summary innovation performance EU Member States (2008 SII)**


Source: European Innovation Scoreboard 2008

Not surprisingly, just as Luxembourg’s GERD is lower than the EU27 average (see Table 2), so is GBAORD, as in Table 12 below. The reasons are the same: Luxembourg’s young NRS and consequent lower absorptive capacity. It should be noted, however, that in terms of GBAORD per inhabitant, Luxembourg ranks above the EU27 average, at €209 vs. €166, respectively, in 2005 (Eurostat, 2008).

**Table 12: GBAORD as % of General Government Expenditure**

	2005	2006	2007
Luxembourg	0.75	0.87	1.04
EU-27	-	-	1.55

Source: Eurostat

Since the launch of the University completed Luxembourg's NRS, the Grand Duchy has been increasingly serious about improving its R&D capabilities, from the OECD review in 2006 and the FNR foresight study in 2007 to the external evaluation of the University in 2008 and the human resources study of researchers currently being undertaken as of this writing in 2009 and discussed more fully in Section 4.

Finally, while policies are in place whose purpose is to overcome barriers to R&D investment, as highlighted in Table 13, two of the risks deserve special elaboration.

While encouraging PPPs and mandating that the PRCs take responsibility for generating their own funding via Performance Contracts, the commercial mindedness within the PRCs varies widely. Some departments have worked successfully with the private sector since their inception. Other departments lack such knowledge and some researchers have no experience in the private sector at all. The PRCs have not offered any guidance or training of how suppliers meet private sector expectations and there is anecdotal evidence that some instruction is needed.

In terms of developing an entrepreneurial culture, the government has put policies in place to encourage entrepreneurs. The Chamber of Commerce has a Centre des Entreprises to help start ups with the regulatory paperwork at no charge. An MSc in Entrepreneurship and Innovation is offered jointly by the Chamber and the University. However, the legal environment remains a barrier. Penalties for failure remain punitive and statistics from the US indicate less than half of start ups are still in business after five years (Klein, 1999). In addition, obtaining a business license can be a lengthy and frustrating process, as awards are based on educational credentials rather than experience. A recent example is a director of a European Institution in Luxembourg retired and decided to start his own company. He is a world-recognized authority in his field and consults regularly in Brussels and on European projects. He was denied a business license because his degree was not in economics, a requirement for a consultant. As is said, Bill Gates could not get a business license to launch Microsoft in Luxembourg (he is a Harvard drop out).

**Table 13: Main barriers to R&D investments and respective policy opportunities and risks**

<b>Barriers to R&amp;D investment</b>	<b>Opportunities and Risks generated by the policy mix</b>
Constraints on private sector R&D investment.	Opportunity to develop PPPs; success requires developing PRC commercial-mindedness.
Greater valorisation of public research outputs.	Opportunity for entrepreneurs; success requires developing an entrepreneurial culture. <sup>15</sup>
Limits to public sector R&D capacity.	Opportunity to attract researchers and develop excellence, success requires making Luxembourg an attractive environment for researchers.

<sup>15</sup> Note that policies promoting entrepreneurship are in place as well as the MSc in Entrepreneurship and Innovation.

## 4 Contributions of national policies to the European Research Area

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ERAWATCH country reports 2008 provide a succinct and concise analysis of the ERA dimension in the national R&D system of the country. This Chapter further develops this analysis and provides a more thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA<sup>16</sup> which comprises six policy dimensions, the so-called six pillars of ERA. Based on the Green Paper and complementing other ongoing studies and activities, this chapter investigates the main national policy activities contributing to the following four dimensions/pillars of ERA:

- Developing a European labour market of researchers facilitating mobility and promoting researcher careers
- Building world-class infrastructures accessible to research teams from across Europe and the world
- Modernising research organisations, in particular universities, with the aim to promote scientific excellence and effective knowledge sharing
- Opening up and co-ordination of national research programmes

In the ERA dimension, the *wider context of internationalization of R&D policies* is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

### 4.1 Towards a European labour market for researchers

Luxembourg needs researchers. Demand is evidenced by more than 50 public sector positions open on Luxembourg's Euraxess portal ([www.euraxess.lu](http://www.euraxess.lu))<sup>17</sup> which is the best barometer of the needs of the public sector. With the University such a recent development, and the services sector representing 80% of GDP, Luxembourg lacks sufficient native researchers and relies on its position in the "Grande Région" of France, Belgium and Germany to make up the shortfall.<sup>18</sup>

The private sector has also typically been researcher-hungry, especially in the automotive and aerospace sectors. While the financial crisis may have reduced demand, that is only a temporary slacking until the economy recovers. Both public and private sector researchers are fully protected under Luxembourg's labour laws, just like any other contracted employee.

Given that Luxembourg has a well-rated research system in its chosen niches and that the Grand Duchy offers a high quality of life, it has been competitive in attracting available talent. The table below shows the growth in the numbers of researchers.

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<sup>16</sup> Commission of the European Communities: Green paper: The European Research Area: New perspectives. Brussels 4.4.2007, COM (2007) 161final (see [http://ec.europa.eu/research/era/pdf/era\\_gp\\_final\\_en.pdf](http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf)).

<sup>17</sup> Positions posted as of 15 March 2009.

<sup>18</sup> The government has a programme "Why not a Researcher" to promote research as a career choice among schoolchildren.

**Table 14: Number of R&D Personnel in Luxembourg**

2000	2001	2002	2003	2004	2005	2006
3663	-	-	4010	4318	4392	4586

Source: UNESCO

While statistics of inclusive numbers of PhD and Masters candidates are not available, the numbers of participants in the AFR programme that provides grants to PhD candidates and post-docs is suggestive not only of numbers but of demand (see Section 4.1.1 below). In 2007, the programme predating the AFR, the BFR, received 153 applications, made 129 awards and dispensed €6.3m in fellowships.

In terms of researcher compensation, the study by CARSA undertaken for the EU on that topic found Luxembourg researchers had the second highest average weighed total yearly salary adjusted, surpassed only by Switzerland (EC Enterprise DG, 2007). Luxembourg's rankings broken down by years of experience are shown in Table 9 below.

**Table 15: Luxembourg in Rankings of Research Remuneration Averages<sup>19</sup>**

Years Experience	0-4	5-7	6-10	11-15	>15
Avg. remuneration	€32,247	€43,617	€54,986	€66,356	€77,726
EU-25 average	€20,374	€28,722	€37,240	€46,022	€55,213
EU-25 Ranking	5	2	4	6	8

Source: EC Enterprise DG/CARSA

#### 4.1.1 Policies for opening up the national labour market for researchers

The most significant recent policy for opening Luxembourg for researchers is legislation specifically allowing visas for researchers (NRP, 2008).

In addition, the MCSR has launched a study of Luxembourg's human resource policies regarding researchers, overseen by CARSA, the consultancy that produced the EU Study on Remuneration of Researchers in the Public and Private Sectors. The study will evaluate the current work situation for researchers in Luxembourg and develop a set of recommendations to ensure an attractive environment for researchers and an action plan for research institutions to offer "Careers for Researchers." The study will include a "Gap Analysis" between existing legislation, guidelines and "good practice" and the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers, which Luxembourg already supports and of which the FNR and PRC Santé are signatories. Finally, issues relating to work contracts that are project-based, i.e., they end when the project, and its funding, are completed versus the more desirable open-ended contract will be addressed<sup>20</sup>. Relative compensation scales will also be evaluated.

In 2008, the FNR launched the programme ATTRACT to lure outstanding young researchers to Luxembourg. The first recipient is Dr. Phillip Dale, a UK national and specialist in Photovoltaics. A second recipient will be selected in July 2009. The programme has a budget of €5m for a period of five years.

<sup>19</sup> It should be noted that the CARSA study results for Luxembourg are based on a very small sampling. In fact, the knowledgeable were able to identify specific researchers based on their experience and salary indicated.

<sup>20</sup> At present the public research system tends to award disproportionate numbers of project-based contracts to researchers.

Finally, the AFR programme for PhD and post-doc grants mandates health insurance coverage and promotes work contracts with the NRS institutions. There are no restrictions on applicant nationality or host institution location. The first call resulted in 79 applications of which 46 PhD and 25 post doc candidates were eligible and 40 were finally accepted, with equal numbers of men and women.

Luxembourg's Euraxess portal was cited previously. In addition to listing open positions, it provides interested foreign researchers with extensive information about entry conditions and life in Luxembourg.

#### **4.1.2 Policies enhancing the attractiveness of research careers in Europe**

Although as mentioned above, Luxembourg has accepted the European Charter for Researchers and Code of Conduct, only the FNR and CRP Santé are full signatories of the Charter and Code as of March 2009. The human resources study mentioned above will result in future compliance among NRS actors.

There are no congruent policies concerning researcher remuneration and little public information. While researcher salaries in Luxembourg are some of the highest in Europe,<sup>21</sup> living costs can also be comparably high (She Figures, 2006).

Except for the AFR, there are few figures about the representation of women in public research institutions and direct queries of the institutions resulted in no responses.<sup>22</sup> She Figures reports that overall, Luxembourg has the next lowest percentage of female researchers, at 18%, against an EU average of 29%.<sup>23</sup> The study by CARSA previously cited found salary discrepancies of 23.86% in favour of male researchers.

In terms of women in higher positions in the NRS, the University has one woman vice rector. The FNR has no women on its Board of Administration and one woman member of their Scientific Council (out of 12). PRC Henri Tudor has no women on its Board of Administration, its Scientific Council or its Management Committee. It has one woman department director (out of 10). PRC Gabriel Lippmann has no women on its Board of Administration and no women department heads. Indeed, the Superior Committee for Research and Innovation has only one women member (out of 11). Thus women's representation "at the top" is even lower than their 18% overall presence as researchers in Luxembourg.

Thus while women researchers on employment contracts are protected by the same laws as other female workers in terms of maternity leaves, etc. there are no NRS policies encouraging equal, or even improved, gender representation.

## **4.2 Governing research infrastructures**

Because of its size and youth, Luxembourg's research infrastructure is limited. Its most important recent development in terms of research infrastructure is the biobank (IBBL) initiative which has received €140m of government funding. This project is a result of the government's decision to develop a high tech biohealth sector, along

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<sup>21</sup> Luxembourg is surpassed by Switzerland in researcher compensation.

<sup>22</sup> Thus it can be concluded that although signing Performance Contracts may improve the accountability of public research institutions, there is still work to be done on transparency. See the discussion of governance in the ERAWATCH Country Report Luxembourg 2008.

<sup>23</sup> The Netherlands has the distinction of having the lowest proportion of female researchers, at 16%.

with the further expansion of its logistics sector, to diversify the economy away from a over-reliance on financial services. The construction of the “City of Science” in Belval-Ouest is a massive research infrastructure project launched under an older NRP that will bring together laboratories and researchers from the University and the PRCs—PRC Gabriel Lippmann is already located there. The “City” will also include facilities for start-ups/spin offs and commercial partners. Completion is expected around 2013.

MCESR has representatives to ESFRI and Luxembourg’s national contact point is Luxinnovation. Luxembourg is a full member of the European Space Agency and PRC Gabriel Lippmann’s Earth Observation activities use data from ESA radar satellites to construct geomatic models for water resource management and flood control.

The INTER programme of the FNR supports Luxembourg researchers in international collaborations and has links to France’s CNRS and Belgium’s FNRS as well as the European Science Foundation and the US National Science Foundation.

### **4.3 Research organisations**

Luxembourg’s public research organisations are detailed in the chart of Luxembourg’s NRS in Section 2.1: the University, three public research centres and socio-economic statistical resource CEPS/INSTEAD. With the recent performance contract initiative following the OECD NRS review, all are committed to developing PPPs.

In terms of research autonomy, the University has seven selected research areas as its foci (see Section 2.1), with four areas of medium interest: geodynamics and seismology, environmental resources and technologies; the economy and entrepreneurship; social sciences. At the request of the MCESR, an external evaluation of the University found its research capabilities to be “mature”. The University has Vice Rectors who were recruited through an open tender process, in charge of research and special projects, and who have some autonomy in their appointments and recommendations for new initiatives. Given the youth of the University, however, most issues involve staffing and providing facilities for the research areas already identified. The Vice Rector for Research says the University’s goal is to increase its research faculty by 40-50% by 2012.

The University Board of Governors consists of the head of the Luxembourg Stock Exchange, who is the president, administrators from universities in the UK, France, Switzerland and Slovenia, and two members from the Luxembourg business community. The University supports the Bologna accord and, in fact, all undergraduate students are required to spend a year at a foreign university. Specific alliances with schools whose curricula are complementary, such as the University of Coimbra in Portugal, have been developed.

The University receives “block funding” from the Luxembourg government. It states in the NRP of 2007 that, “In the area of budget... the State agrees to finance the activities of the University through an annual budget allocation that will increase annually, reaching the sum of 72 million euros in 2009.” The University’s Annual Report for 2007 listed operating expenses of €53.5m. It has two funded chairs, one by TDK in Photovoltaics and one by the Ville de Luxembourg in Urbanisme. The University can apply for additional research funding under FNR programmes as well as programmes such as FP7, etc. It won the first ATTRACT programme laureate

(see Section 4.1.1). Of the 35 proposals accepted for the first CORE programme call, 16, or 46%, were awarded to the University. Again, due to its founding only in 2003, funding autonomy is not an issue as of 2009.

#### **4.4 Opening up national research programmes**

In terms of opening up national research programmes, international participation is encouraged but funding only extends to national entities. In FNR programmes, this means funding is limited to public research institutions—no commercial entities are eligible, either Luxembourgish or foreign. In the ECO R&D grant programme, recipients must be Luxembourg companies but additional funding is provided for international projects. Foreign researchers working in Luxembourg are, of course, considered as being Luxembourgish for funding purposes. The one exception to the national rule is the AFR programme of PhD and post doc grants. Recipients can be of any nationality and, in fact, only around 25% of proposals accepted from the first call were Luxembourg nationals.

The FNR INTER programme funds participation of Luxembourg researchers in foreign programmes. An example is the Materials Network Project, which joined researchers from PRC Gabriel Lippmann with counterparts at the University of Texas at Austin (funded by the US National Science Foundation) to work together on boron-based thin films for nano-electronics.

Luxembourg is a member of Eurohorcs and the FNR has joined the “Money Follows Researcher” initiative. The FNR is a member of the ESF, ERCIM, COST and ICSU as well as ERA-NET. However, as Luxembourg research programmes are thematic and designed to suit Luxembourg’s specific research needs and economic concentrations, joint programming is mostly represented by Luxembourg participation in FP7 programmes or EUREKA projects.

#### **4.5 National ERA-related policies - a summary**

Key issues in the ERA Green Paper include an adequate flow of competent researchers with high levels of mobility, world-class research infrastructures, excellent research institutions engaged in effective public-private cooperation, effective knowledge-sharing notably between public research and industry and well-coordinated research programmes and priorities.

Comparing these issues with the Luxembourg policy mix described above, there are obvious congruencies. Luxembourg has always looked beyond its borders for partnerships with neighbouring France, Belgium and Germany; lacking a university until the current decade, all students had to attend foreign institutions.

Luxembourg participates in several ERA-NET projects including CORNET, ERA-NET Matera, ERA-NET Neuron and ERA-NET ERA-AGE. However, again, given the youthfulness of Luxembourg’s NRS, the focus naturally has been on national institutions and programmes.

Luxembourg does fully support researcher mobility and is a member of the Euraxess researcher network.

**Table 16: Importance of the ERA pillars in the ERA policy mix and key characteristics**

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	<ul style="list-style-type: none"> <li>• Luxembourg relies heavily on ERA researchers as staff for its research institutions and as collaborators in projects.</li> </ul>	<ul style="list-style-type: none"> <li>• Easing visa restrictions for foreign researchers; Joining of Euraxess network; signing Researcher Code and Charter<sup>24</sup></li> </ul>
Governance of research infrastructures	<ul style="list-style-type: none"> <li>• Governing boards represent both public and private sectors, and are normally multinational</li> </ul>	<ul style="list-style-type: none"> <li>• University has European governing board; other institutions have international scientific committees and external as well as internal stakeholder representatives</li> </ul>
Autonomy of research institutions	<ul style="list-style-type: none"> <li>• Research priorities are established and thematic; funding arrangements vary by institution</li> </ul>	<ul style="list-style-type: none"> <li>• Foresight Study used to establish FNR thematic programmes; the university's initial research priorities have been preset. Performance contacts tie funding to results.</li> </ul>
Opening up of national research programmes	<ul style="list-style-type: none"> <li>• Participation is open but funding is restricted except for AFR</li> </ul>	<ul style="list-style-type: none"> <li>• Participation in Eurohorcs and the "Money Follows Researcher" initiative.</li> </ul>

## 5 Conclusions and open questions

### 5.1 Policy mix towards national R&D investment goals

Luxembourg has been active in establishing policies to facilitate private sector R&D investment, from the existing ECO grant programme to the recent legislation for favourable IP tax treatment. The new emphasis on public/private partnerships to expand private sector R&D participation and mindfulness about SME inclusion in projects also are intended to expand research activities in the private sector and involve new actors. Consequently, the main barrier to private sector R&D investment as of this writing in 2009 is corporate cost-cutting due to the global economic crisis.

In terms of national R&D investment goals overall, funding has steadily grown with sector and policy development and good progress is being made towards investment targets. "It is just a matter of time for Luxembourg to reach the [Lisbon] objective, not a matter of motivation or financial resources," as noted in Section 3.4.

Taken as a whole, the NRP of course has concerns beyond research that include issues relating to employment and sustainability. Employment issues in Luxembourg concern retraining and joblessness among older workers as well as unemployment among youth who fail to finish their education. One of the themes of the CORE programme, Labour Market, Educational Requirements and Social Protection, funds research dealing with these issues. Another CORE theme, Sustainable Resource Management in Luxembourg, also brings research policy and other national issues together.

<sup>24</sup> Signers are the FNR and PRC Santé.

Implementing the recommendations coming out of the study on equitable conditions for researchers will address a remaining NRS imbalance. As the government has been diligent about realising the recommendations from the OECD and Foresight studies, it is reasonable to expect the HR study suggestions will also be implemented.

## ***5.2 ERA-related policies***

As noted in Section 4.5, the issues identified in the ERA Green Paper are virtually identical to Luxembourg's. In addition, given Luxembourg's size, Luxembourg has always looked beyond its borders to a wider researcher area. This can be seen in projects like the EUREKA CARLINK with ERA participants from Spain and Finland to ERA-NET MATERA projects with partners from Iceland and Slovenia. The biotech spin-off AxoGlia Therapeutics was the result of French-Luxembourg ERA cooperation.

Beyond co-operating in various ERA-NET programmes through the FNR, Luxembourg has programmes such as ATTRACT; INTER and the AFR which support both ERA and broad international participation. The FNR's Accompanying Measures, which are open to both public sector researchers and AFR grantees, promote participation in trainings and conferences in the European Research Area and further abroad. Policies easing visa restrictions to open Luxembourg to researchers as well as promoting the mobility of Luxembourg researchers have also been mentioned.

The majority of broad government policies are focussed inward. The NRS is young and absorptive capacity must be developed, which constitutes the main challenge. That having been noted, policies that promote ERA and related activities include ECO's "Fit4Europe" that helps Luxembourg SMEs participate in European projects and Luxinnovation's activities that focus on participation in FP7 and other ERA funding opportunities. Luxinnovation also runs the Portal for Innovation and Research ([www.innovation.public.lu](http://www.innovation.public.lu)) which has extensive information about how to participate in ERA and ERANET activities and features an index of technological capabilities for R&D trading and transfer. Thus Luxembourg policies promote both public and private sector participation in ERA and back up that with organisational support and funding.

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## List of Abbreviations

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AFR	Aides à la Formation-Recherche / Research Training Grants
BERD	Business Enterprise Expenditure on R&D
BFR	Bourses à la Formation-Recherche / Research Training Scholarships
CEPS/INSTEAD	Centre d'Etudes de Populations, de Pauvreté et de Politiques Socio-Economiques / International Network for Studies in Technology, Environment, Alternatives, Development
PRC	Centre de Recherche Publique / Public Research Centre
FNR	Fonds National de la Recherche / National Research Fund
GBAORD	Government Budget Appropriations or Outlays on R&D
GERD	Gross domestic expenditure for R&D (as a percentage of GDP)
ECO	Ministère de l'Economie et du Commerce extérieur / Ministry of the Economy and Foreign Trade
IBBL	Integrated BioBank of Luxembourg
IP	Intellectual Property
MCESR	Ministère de la Culture, de l'Enseignement supérieur et de la Recherche / Ministry of Culture, High Education and Research
NCSR	National Centre for Scientific Research Paris
NRS	National Research System
NRP	National Plan for Innovation and Full Employment
PPP	Public/Private Partnership
SME	Small or Medium-sized Enterprise
SNCI	Société Nationale de Crédit et d'Investissement / National Society for Credit and Investment

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### **Abstract**

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report encompasses an analysis of the research system and policies in Luxembourg.

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