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Abstract

The report offers an analysis of the R&I system in Luxembourg for 2014, including relevant policies and funding, with particular focus on topics critical for two EU policies: the European Research Area and the Innovation Union. The report was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc. The report identifies the structural challenges of the Luxembourg research and innovation system and assesses the match between the national priorities and those challenges, highlighting the latest policy developments, their dynamics and impact in the overall national context.

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Executive summary

This report was prepared according to a set of guidelines for collecting and analysing a range of material, including policy documents, statistics, evaluation reports, websites, etc. The quantitative and qualitative data is, whenever possible, comparable across all EU Member State reports.

Luxembourg is one of the smallest EU Member States, but also arguably the wealthiest based on GDP per capita. Despite its wealth, Luxembourg's GERD has declined from 1.72% of GDP in 2009 to 1.16% in both 2012 and 2013. While public sector contributions to GERD represented 0.66% of GDP in 2012 and 0.64% in 2013, private sector contributions (BERD) have dropped from 1.22% in 2009 to 0.71% in 2013. The figures mean that Luxembourg is unlikely to meet its intermediate objective for GERD of 2.0% by 2015 (Government of Luxembourg, 2013).

Luxembourg's national research system (NRS) is also small, but it is well-funded and well - defined. It can also be distinguished by its youth. The Grand Duchy's oldest public research institutions were established in the late 1980's and its sole university was launched as recently as 2003. Consequently, the NRS is still developing absorptive capacity and the preponderance of research has historically been undertaken by the private sector.

Also because of its small size—Luxembourg is its own NUTS2 region—the research system is centralised. It is characterised by multi-annual planning and thematic research funding. A change in government in 2013 did not appreciably impact Luxembourg's research and innovation (R&I) strategies or policies.

In 2014, new laws opening National Research Fund (FNR) funding to non-profits and foundations undertaking research and merging the Public Research Centres Henri Tudor and Gabriel Lippmann into a single entity called LIST were finally ratified. The OPEN programme, designed to fund research projects outside of the thematic domains of the CORE programme, was suspended and the Proof of Concept programme, which funds the commercialisation of research projects in the domains of Biomedical Sciences, Advanced Materials, Engineering, and ICT, with a particular emphasis on ICT, was launched.

New performance contracts covering the period 2014-2017 between the Ministry of Higher Education and Research and the University, PROs and the FNR were signed. Of a €183.5m budget for the University, 20.7% is targeted to come from third party funding. For the PROs, out of a €117.1m budget, 37.7% is expected to come from third parties.

After some revisions, Luxembourg has indicated logistics, eco-technologies and health technologies, along with ICT and space technologies, as sectors for Smart Specialisation. It is hoped these sectors can help to diversify the economy which is heavily dependent on the financial services sector.

Luxembourg is making real progress in realising ERA priorities. The FNR has established numerous bi- and multilateral agreements with other research agencies and is a member of seven ERA-Nets to optimise transnational cooperation. The Grand Duchy is a model for Open, Merit-based and Transparent (OTM) recruitment. In fact, most Luxembourg researchers are foreign. Luxembourg has an extensive Euraxess portal and all of its public research institutions are signatories to the Researcher Charter and Code, while two have implemented HRS4R. Research grants are not portable except for the Aid for Research

Training (AFR) programme that funds PhDs and post-docs and embodies the principles of Innovative Doctoral Training.

The university library has electronic resources that give online access to e-books and journals and links to the digital services of the National Library (BnL). The Luxembourg Consortium, made up of the BnL, the University and the three CRPs, offers 50,000 periodicals, 80,000 books and over 350 specialised databases, plus reference books in English, French and German through the findit.lu portal. Beginning in 2013, this content also became available through www.a-z.lu, a unified research portal.

The University has signed a cooperation agreement with the University of Liège (ULg) that includes the establishment of a strategy and a “green” policy on Open Access (OA) and the creation of an Institutional Repository ORBi based on the model developed successfully at ULg.

Luxembourg has a range of measures to support entrepreneurship and performance contracts have targets for spin-offs and patents. Luxembourg has several initiatives that promote intellectual property (IP) awareness and a law that gives preferential tax treatment to IP revenues. It has resources for innovative SMEs and a Cluster initiative run by Luxinnovation, whose role is to offer support to innovative companies. Luxembourg also has an active business angel network.

In the latest Innovation Union Scoreboard for 2014, Luxembourg ranked fifth, the first of the Innovation Followers. Luxembourg’s strengths were in international scientific publications, venture capital investments, community trademarks and community designs. Low performers were non-R&D expenditures and new doctoral graduates. The highest growth was observed in international scientific co-publications, most cited scientific publications and R&D expenditures in the public sector. The indicators non-R&D innovation expenditures, sales share of new innovations and R&D expenditures in the business sector showed significant declines.

Structural challenges facing Luxembourg have been identified as: increasing absorptive capacity; increasing Luxembourg’s research profile through international cooperation; developing human resources in RDI; promoting a culture of entrepreneurship. Although policies are in place for all four challenges, progress is mixed. While Luxembourg is succeeding in increasing its research profile, as shown by growing participation in FP7 compared to FP6, decreasing levels of GERD and BERD indicate more needs to be done to expand absorptive capacity. While there are a range of measures that promote entrepreneurship, a majority of entrepreneurs in Luxembourg, like researchers, are foreign.

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1. Overview of the R&I system

1.1 Luxembourg in the European RDI landscape

With a total area of 2,586 km², Luxembourg is the smallest EU Member State except for Malta. Of its population of 549,680, 248,914, or 45%, are resident foreigners.¹ While Luxembourg's workforce numbers 372,047, 105,024 are foreign residents and an additional 165,341 are "frontaliers", who cross their national borders of France (82,991), Belgium (41,376) and Germany (41,025) to work in the Grand Duchy.²

Despite dips reflecting post-crisis economic conditions, Luxembourg's economy is recovering, as shown in the table below and, with +2.0% growth in 2013, outperformed neighbouring Belgium (+0.2), France (+0.2) and Germany (+0.4).

Table 1: Luxembourg GDP Growth

2007	2008	2009	2010	2011	2012	2013
6.5	0.5	-5.3	5.1	2.6	-0.2	2.0

Source: Eurostat, 22/12/2014

With Luxembourg's GDP per capita (in PPS) of 68,900 (2011), 69,800 (2012) and 68,500 (2013), versus the EU28 average of 26,600 (2013), the Grand Duchy's population is by far the wealthiest in the EU.³

Despite its wealth, Luxembourg's GERD has declined from 1.72% of GDP in 2009 to 1.16% in both 2012 and 2013.⁴ While public sector contributions to GERD represented 0.66% of GDP in 2012 and 0.64% in 2013, private sector contributions (BERD) have dropped from 1.22% in 2009 to 0.71% in 2013. The figures mean that Luxembourg is unlikely to meet its intermediate objective for GERD of 2.0% by 2015 (Government of Luxembourg, 2013).

While the reasons behind the decline in BERD are not clear, the number of researchers employed in the business sector also dropped during this period, from 1,518 in 2011 to 927 in 2012. One possibility for the decline in both BERD and researchers is the impact of the financial crisis. A second factor to be considered is the campaign to form public-private partnerships as evidenced in the Business Meets Research events⁵ and provisions in the law of 5 June 2009⁶ subsidising the secondment of public sector researchers to the private sector.

¹ Population as of 01/01/2014 Retrieved December 20, 2014 from http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=9396&IF_Language=fra&MainTheMe=2&FldrName=1&RFPPath=68

² A mere 27% of the country's workforce are Luxembourg citizens. Workforce as of 3Q 2014 Retrieved December 20, 2014 from http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=7252&IF_Language=fra&MainTheMe=2&FldrName=3&RFPPath=92

³ Retrieved December 20, 2014 from <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tec00114&plugin=1>

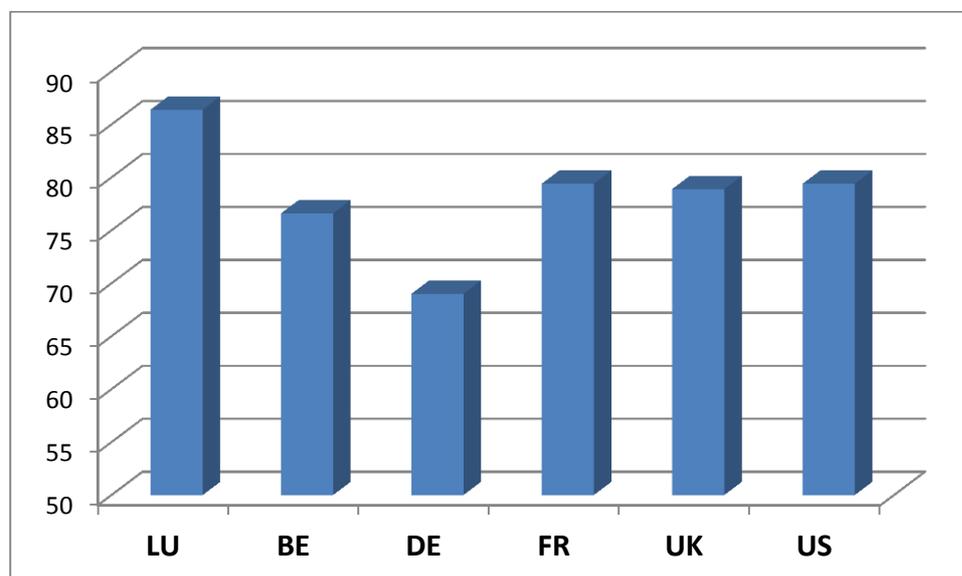
⁴ Retrieved December 20, 2014 from http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_20&plugin=1

⁵ <http://www.business-meets-research.lu/>

⁶ <http://www.legilux.public.lu/leg/a/archives/2009/0150/index.html>

Another aspect of Luxembourg's economy which affects levels of BERD is the dominance of the financial services industry, which represents 38% of GDP, and the substantial contribution of the Services Sector to GDP, as shown in the figure below.

Figure 1: Contribution of the Services Sector to GDP % (2013)⁷



Finally, Luxembourg's turnover from innovation as a percent of total turnover has also been decreasing, from 15.6% (2004) to 12.6 (2006) to 8.9% (2008) to 8.3% (2010), which is the most recent figure available.

1.2 Main features of the R&I system

Luxembourg's national research system (NRS) is small, well-funded and well-defined. It can also be distinguished by its youth. The Grand Duchy's oldest public research institutions were established in the late 1980's and its sole university was launched as recently as 2003. Consequently, the NRS is still developing absorptive capacity and the preponderance of research has historically been undertaken by the private sector.

Also because of its small size—Luxembourg is its own NUTS2 region—the research system is centralised. It is characterised by multi-annual planning and thematic research funding. An example of the former is the government's instituting Performance Contracts for all public sector research actors, which currently run from 2014-2017. Examples of the latter are the National Research Fund's (FNR) [CORE programme](#), with its five key priority areas and the University's designated [strategic research priorities](#).

⁷ Retrieved December 20, 2014 from <https://www.cia.gov/library/publications/the-world-factbook/index.html>

1.3 Structure of the national research and innovation system and its governance

The structure of Luxembourg's national research system is simple and straightforward. In addition to the Parliamentary Commission of Higher Education, Research, Media, Communication and Space (Commission de l'Enseignement supérieur, de la Recherche, des Médias, des Communications et de l'Espace), there is the High Committee for Research and Innovation (Comité Supérieur de la Recherche et de l'Innovation), which has as its objective ensuring consistency and coherence in RDI policy. Established in 2008, its co-chairs are the Ministers of the Economy and of Higher Education and Research.

The [Ministry of Higher Education and Research](#) (MESR) is in charge of all public research performers and implements policy. The primary public research funding agency, the [National Research Fund](#) (FNR) is also overseen by the MESR. Founded in 1999, the FNR administers funding for public sector research programmes as well as the national funding programme for doctorate and post-doctorate studies, [Aid for Research Training](#) (AFR).

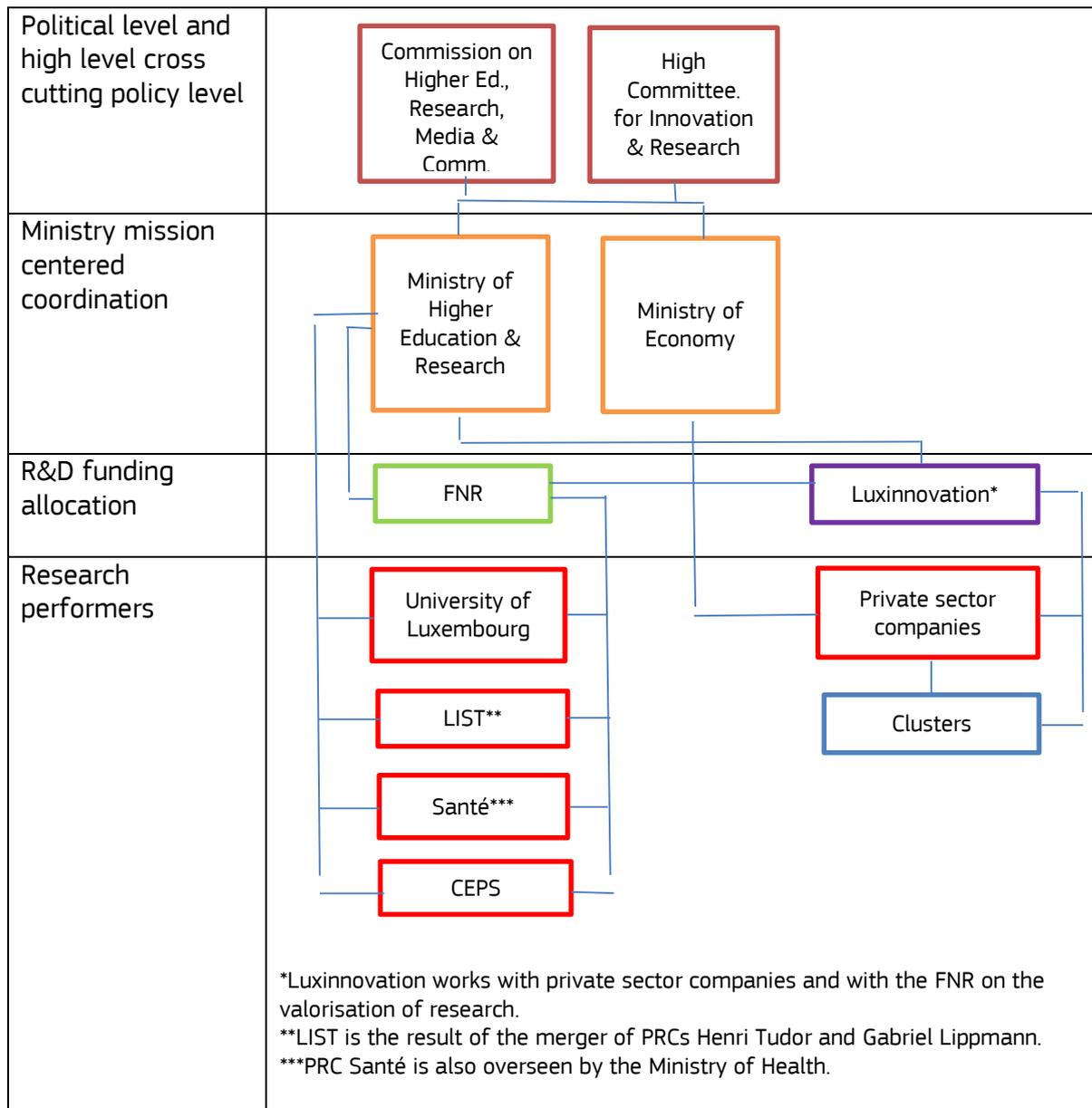
The [Ministry of the Economy](#) (ME) manages private sector research programmes under the [law of 5 June 2009](#). Its Directorate of Research, Intellectual Property and New Technology specifically deals with private sector RDI. Bridging the private and public sectors is the national agency [Luxinnovation](#). Established in 1984, Luxinnovation works with companies on identifying sources of funding, managing innovation and intellectual property, promoting possibilities for public-private partnerships (PPPs), organising sectorial clusters and assisting firms with EU and ESA project participation. In 2014, Luxinnovation also began to work with the FNR to identify the potential for the valorisation of the projects it funds.

The FNR has a Scientific Council that advises the Board on all scientific questions and prepares and supervises the scientific evaluation process. The University also has a Scientific Consultation Committee comprised of foreign academics.

Luxembourg's main public sector research performers are the [University of Luxembourg](#), the Public Research Centres LIST, formed from the merger of [Henri Tudor and Gabriel Lippmann](#), and [Santé](#) and [CEPS/INSTEAD](#). Private sector research performers include ArcelorMittal, Delphi, Goodyear and numerous small- and medium-sized enterprises.

Note that because of Luxembourg's policy of multi-annual planning and targeted research domains, the national research system tends to be stable even with political transitions.

Figure 2: Luxembourg's RDI governance system



Main changes in 2014

...New performance contracts for 2014-2017 between the MESR and public research institutions.
...Budget cuts or lack of budget increases for public sector research institutions for period 2014-2017.
...New laws covering expanding FNR funding recipients, merging PRCs Henri Tudor and Gabriel Lippmann and Luxinnovation review of CORE programme proposals for their valorisation potential.
...Launch of NFR Proof of Concept programme to assist valorisation of research projects.

Main Changes in 2013

...Early election results in new coalition government of Liberal Democrats, Socialists and Greens.
... Three Ministers of Higher Education and Research, the first minister retired and the second was replaced as a result of the new government being formed.

Main changes in 2012

...Establishment of Life Sciences Fund and Luxembourg Future Fund by government.
...Launch of FNR Open programme
...Announcement of future merger of PRCs Henri Tudor and Gabriel Lippmann

Main changes in 2011

...New performance contracts between the MESR and the public research institutions for the period 2011-2013

Main Changes in 2010

...End of performance contracts between MESR and the public research institutions 2008-2010
...Launch of Luxembourg Centre for Systems Biomedicine (LCSB) (end 2009)

2. Recent Developments in Research and Innovation Policy and systems

2.1 National economic and political context

Luxembourg's overall economic performance improved in 2013, with GDP growing at a rate of +2.0%, compared to 2012's moribund -0.2%. Luxembourg significantly outpaced the Eurozone 28's average GDP of +0.1%, as well as the lacklustre performances of neighbouring Belgium (+0.2%), France (+0.2%) and Germany (+0.4%). OECD predictions of GDP growth are +3.1% for 2014, followed by +2.6% (2015) and +2.2% (2016).⁸

Unemployment is still a concern, remaining intractably at 6.0-6.2%. While this may seem modest compared to the Eurozone 28's rate of 10.1% (2014Q3),⁹ 2013's improved GDP growth might have been expected to have had a greater impact. The government notes in *Luxembourg 2020* (Government of Luxembourg, 2012) that many of the new jobs created are being filled by *frontaliers*, Luxembourg's cross-border workers, who have the skillsets that are in short supply locally. This assessment raises the spectre of structural unemployment in the Grand Duchy.

The most significant political event of 2013, which continues to carry over into 2014, was the result of the early election on 20 October 2013. With the Christian Democratic Party (CSV), having won every national election in Luxembourg since its establishment in 1944 (with one exception in 1974), it was a surprise when the CSV lost just enough support that three other parties were able to form a coalition. The new coalition is comprised of the Liberal Democrats (DP), Socialists (LSAP) and the Greens. The Prime Minister is the DP's Xavier Bettel, aged 42. The Minister of the Economy (ME) remained Socialist Etienne Schneider, while the Minister of Higher Education and Research (MESR), who is also the Minister of National Education and Youth, is DP Claude Meisch. Meisch was the third Minister of Higher Education and Research in 2013. He succeeded CSV Minister Martine Hansen, who had replaced François Biltgen, who was also a member of the CSV.

2.2 National R&I strategies and policies

Despite the change in government, Luxembourg's R&I structure has remained stable and well-coordinated policies remain in place. Luxembourg employs multi-annual planning supported by accompanying budgets and performance contracts. The current planning period runs from 2014-2017.

Because of Luxembourg's small size, the R&I structure is straightforward and well-defined. It covers the public sector, under the MESR, and the private sector, under the ME.

Also because of Luxembourg's small size and the relative youth of its research system, programmes tend to be thematic, as evidenced by [CORE](#), the main public research funding programme.

⁸ Retrieved December 21, 2014 from <http://www.oecd.org/statistics/>

⁹ Retrieve December 21, 2014 from

<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tipsun30&plugin=1>

Many current R&I strategies and policies derive from [a study by the OECD](#) sponsored by the government in 2006 and a [Foresight Study](#) of its [National Research Fund](#) (FNR) and its programmes in 2006-2007. The former recommended all public research organisations (PROs) establish performance contracts with the MESR, that they stress the exploitation of research results and that they encourage the formation of public-private partnerships (PPPs) and other competitive sources of funding. The Foresight Study identified the research themes which form the basis of the FNR's aptly named [CORE programme](#). Thematic domains generally reflect EU priorities. The [INTER](#) programme supports cross-border cooperation, while performance contract requirements for competitive funding encourage participation in EU instruments. Note that Luxembourg does not have a national R&I policy document. However, policies and strategies relating to R&I are well-defined in Luxembourg's annual plan [Luxembourg 2020](#) (Government of Luxembourg, 2014).

In 2013 the government commissioned a new, independent study of the national research and innovation (R&I) system to evaluate the level and degree of quality of the implementation of the OECD report recommendations. The study is expected to be published in the first half of 2015.

In April 2012, legislation modifying the law of 31 May 1999 relating to the FNR was submitted to Parliament. One of the more important changes proposed was the possibility of opening funding not only to public institutions but also to non-profit organisations and foundations undertaking research activities. In December 2012, new legislation concerning the public research centres was also submitted. Provisions in the law cover the mission and organisational basis of the research centres, propose the integration of the Integrated BioBank of Luxembourg (IBBL) with PRC Santé and the merger of PRCs Gabriel Lippmann and Henri Tudor into LIST (Luxembourg Institute [for](#) Science and Technology). The laws were finally ratified in late 2014. The legislation relating to the FNR became the law of [27 August 2014](#) and the legislation merging PRCs Henri Tudor and Gabriel Lippmann became the [law of 3 December 2014](#).

The [OPEN](#) programme, launched in 2013 to fund the work of senior researchers outside of the themes defined by the CORE programme, had a budget of €1m in 2014 and awarded two grants. However, on the basis of the new FNR performance contract, the programme will be discontinued as of 2015.

In September 2014, the FNR and Luxinnovation, the national agency for innovation and research, signed a collaboration agreement for 2014-2017. The agreement covers the fostering of public-private partnerships, the exploitation of research funded by the FNR, and the support of both private and public sector participation in European programmes including ERA-NETs, Horizon 2020, AAL and Eurostars.¹⁰ A new, related programme is [Proof of Concept](#) that is intended to support the commercialisation of selected research projects. The programme is open to the domains Biomedical Sciences, Advanced Materials, Engineering, and ICT, with a particular emphasis on ICT.

For more than a decade, Luxembourg has been undertaking a massive research infrastructure project called The City of the Sciences. The project, with a budget of more than half a billion euros, is designed to provide facilities for the University of Luxembourg and PROs CEPS and LIST. It also includes a business incubator, laboratories for public-private partnerships and the Luxembourg Centre for Systems Biology.

¹⁰ <http://www.fnr.lu/press/press-releases>

In terms of main research programmes, there have been few changes apart from budget commitments for 2014-2017. The total FNR budget for the period is €232m. This breaks down into €10m for the [ATTRACT](#) programme that seeks to bring outstanding young researchers to Luxembourg, €25m for the [PEARL](#) programme which also seeks to bring outstanding senior researchers to Luxembourg to undertake a project and develop a project team, and €18m for the [INTER](#) programme that funds Luxembourg researcher participation in international projects. The budget for the CORE programme for 2014-2017 is €70m. Note that programme funding is budgeted for the entire period, in this case 2014-2017, and not broken down by year. Consequently, in some years fewer proposals may be funded and, in some, more, depending on the quality of the proposals received. For instance, there were no ATTRACT awards made in 2012, but three were made in 2013.

Changes to research programmes include the discontinuation of the OPEN programme that funded research on subjects not covered by the CORE programme and linking AFR post-doc grants exclusively to projects being undertaken by the University, PROS or in a PPP.

Table 2: GBAORD BY NABS Socio-economic objectives, 2013

	Millions of euros	% of total
Exploration and exploitation of the earth	2.369	0.8
Environment	2.396	0.8
Exploration and exploitation of space	1.204	0.4
Transport, telecommunications and other infrastructure	2.926	1.0
Energy	4.745	1.6
Industrial production and technology	11.531	3.9
Health	71.501	24.5
Agriculture	2.051	2.2
Education	13.285	4.5
Culture, recreation, religion and mass media	9.52	1.0
Political and social systems, structures and processes	24.904	8.5
General Advancement of knowledge financed from University Funds	34.795	11.9
General Advancement of knowledge financed from other sources	126.163	43.2
Defence	0	0
Total	292,261	100

Source: [Total GBAORD by NABS 2007 socio-economic objectives](#) 29/09/2014

Aside from the General Advancement of Knowledge which represents 55% of GBAORD, the largest proportion of GBAORD is for Health. This reflects the government's commitment to develop the sector of Biomedical and health sciences. Education, at 4.5% and Political and social systems, structures and processes at 8.5% are also characterised as reflecting "societal challenges" for Luxembourg.

In conclusion, Luxembourg's policies relating to R&I are consistent and coherent and reflect multi-annual planning, committed budgets and a thematically-based focus. Both the public and private sectors are included in government strategies as well as the University. Education policies for primary and secondary education are covered separately. Because of Luxembourg's small size and the relative youth of its research system, the decision was made to focus on applied rather than fundamental research.

2.3 National Reform Programmes 2013 and 2014

Both [Luxembourg 2020 April 2013](#) and [Luxembourg 2020 April 2014](#) detail a range of accomplishments in relation to the Grand Duchy's RDI programmes. Achievements cited included:

- Concentrating on a limited number of research domains, exemplified by the CORE programme
- Supporting the development of researchers through the programme Aid for Research-Training (AFR) of the FNR
- Initiatives to support the innovation potential of SMEs, including organising an Innovation Master Class
- Organisation of "Business Meets Research" days to support public-private partnerships
- Increased participation in FP7 and ESA projects
- The Luxembourg Cluster Initiative which supports clusters in Materials, ICT, Space, BioHealth, EcoInnovation and Automotive Components
- Funding of private sector research under the law of 5 June 2009.

Both documents reiterate Luxembourg's commitment to a 2020 research intensity target of 2.3-2.6% of GDP, of which 0.7-0.9% is from government funding. (Luxembourg's ability to meet this target is commented on in Section 2.4 below.)

In addition, since Luxembourg favours multi-annual planning, the 2014 version provides public sector funding commitments to the University and PROs for the period 2014-2017 as well as their targets for third party funding and other performance indicators (For specifics, see Section 2.5.2 below). The NRP also provides the results of performance contract targets for the period 2011-2013, which were largely met or exceeded.

Specific to [Luxembourg 2020 April 2014](#) were additional initiatives in promoting greater gender equality, the opening of the labour market for researchers and optimising the circulation and transfer of scientific knowledge through Open Access (see section 4.4 below). Of these initiatives, the opening of the labour market for researchers is well implemented and Open Access initiatives have been launched. Promoting gender equality is still under development.

2.4 Policy developments related to Council Country Specific Recommendations

Luxembourg' Country Specific Recommendations relating to R&I in both 2013 and 2014 cited the need to diversify Luxembourg's economy away from the dominant financial services sector through the development of "highly specialised firms as a springboard for innovation-driven growth."¹¹

The 2014 recommendations reiterated that Luxembourg is not on track to meet its 2020 R&D research intensity target of 2.3-2.6% of GDP largely because of decreases in BERD,

¹¹ <http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2010795%202014%20REV%201>

which had dropped to 0.71% in 2012. The reasons for the drop in BERD are being explored but no conclusions have yet been reached.

In response, the government is encouraging the development of logistics, eco-technologies and health technologies, along with ICT and space technologies. In addition, under the oversight of Luxinnovation, it has an active cluster programme in ICT, Space, Biohealth, Ecoinnovation, Materials and Automotive Components. Performance contracts with the University and PROs set targets for third party revenues from PPPs, patents and spin-offs and business incubators support innovative start-ups. These are described in Section 2.5.2 below.

2.5 Funding trends

2.5.1 Funding flows

The figures in Table 3 below highlight some of the points previously made in this report, especially the declines in BERD and GERD levels that significantly lag the EU 28 average GERD of 2.02% of GDP vs Luxembourg's 1.16% (2013). R&D funded by the private sector has also declined. R&D performed by HEIs which in Luxembourg's case is its sole university has been increasing, from 8% of GERD in 2009 to 13.6% in 2013, and reflects the development of the infant institution. Research performed by the government sector includes the public research institutions and has also increased from 16% of GERD in 2009 to 23.3% of GERD in 2013, vs. an EU 28 average of 12.2% (2012). Declines in R&D performed by the business sector are also evident. The comparatively low number of workers employed in medium- and high tech manufacturing is not surprising given the dominance of the Grand Duchy's services sector. This is emphasised by the high levels of employment in knowledge-intensive services which was 56.6% of the workforce in 2013. Finally, although not included in Table 3, R&D funded by framework programmes (FP7) between 2007-2013 was €60.42m, while R&D funded by Structural Funds between 2007-2013 was €16.01m.

Figure 3: Proportion of FDI from Special-purpose enterprises and non-special purpose enterprises

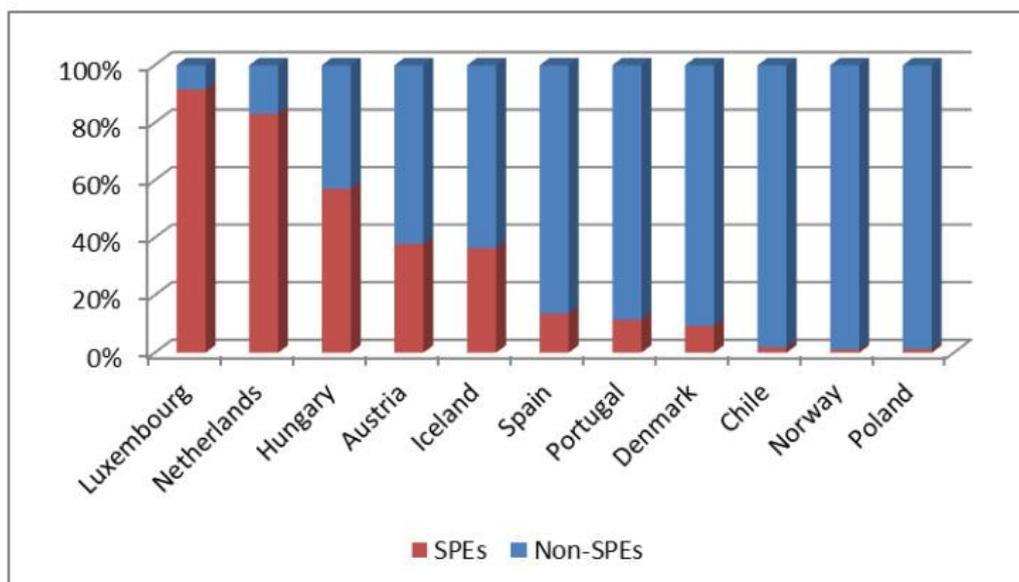


Table 3: Basic indicators for R&D investments

	2009	2010	2011	2012	2013	EU28 (2013)
GDP growth rate	5.6	3.1	1.9	-0.2	2-3	0.1
GERD (% of GDP)	1.72	1.50	1.41	1.16	1.16p	2.02
GERD (euros per capita)	1,256.9	1,178.3	1,169.1	1,191.2	-	530.1 (2012)
GBAORD - Total R&D appropriations (€ million)	409.5	454.7	501.2	538.3	544.2	90,505.611
R&D funded by Business Enterprise Sector (% of GDP)	1.30	1.02	0.96	0.71	0.71p	1.12% (2011)
R&D funded by Private non-profit (% of GDP)	0.00	0.00	0.02	-0.00	0.00	0.03% ^e (2011)
R&D funded from abroad (% of GDP)	0.09	0.31	0.29	-	-	0.19% (2011)
R&D performed by HEIs (% of GERD)	8.0	13.0	11.3	12.4	13.8	23.6% (2012)
R&D performed by Government Sector (% of GERD)	16.0	20.0	19.2	18.9	23.3	12.2% (2012)
R&D performed by Business Enterprise Sector (% of GERD)	76.0	68.0	69.5	68.6	61.2	63.3% (2012)
Share of competitive vs. institutional public funding for R&D	5.9%	7.9%	8.1%	6.8%	6.1%	N/A
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	0.9	0.9	0.7	0.9	-	5.6% (2011)
Employment in knowledge-intensive service sectors as share of total employment	55.6	55.0	55.4	56.6	-	38.9% (2011)
Turnover from Innovation as % of total turnover ¹²		8.3%				13.4% (EU-27, 2010)

Sources: EUROSTAT

While there are no figures on R&D related FDI, the figure below indicates the role SPEs (special purpose entities) play in FDI in the Grand Duchy.

2.5.2 Project vs. institutional allocation of public funding

The table below indicates that, in terms of institutional vs. project funding, Luxembourg shows no discernible trend and that institutional funding dwarfs project funding.

Table 4: % GBAORD by Funding Mode¹³

	2009	2010	2011	2012	2013
Institutional	94.39	92.64	92.49	93.46	94.24
Project	5.61	2.36	7.51	6.54	5.76

Source: Eurostat

¹² Although not reflected in the table, Luxembourg's turnover from innovation as a percent of total turnover has been decreasing from 15.6% (2994) to 12.6% (2006) to 8.9% (2008) to 2010's 8.3%.

Retrieved December 22, 2014 from

<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdec340&plugin=1>

¹³ Retrieved December 29 2014 from <http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

2014 saw new performance contracts for the period 2014-2017 signed between the MESR and the University and public research organisations (PROs). Performance contracts, which are considered to be essential policy documents by the MESR, have specified the proportions of third party, i.e., project, vs government, i.e., institutional, funding for Luxembourg's University and PROs indicated in Table 5. Third party funding includes FNR grants, EU project participation, public-private partnerships, etc.

Government funding is distributed through the MESR, while the FNR is in charge of public research project funding through its various programmes. The FNR issues calls for its various programmes and publishes complete information on its website that includes forms and documentation. Calls are competitive and all proposals are evaluated by external international experts and awarded on the basis of scientific merit. The thematic CORE programme is the main source of public project funding. In addition, the ATTRACT and PEARL programmes bring researchers to Luxembourg, often in conjunction with a CORE project, while the INTER programme funds the participation of Luxembourg researchers in international projects.

Table 5: Proportions of government vs. third party funding (€ millions)

	2014	2015	2016	2017
University				
Government	124.7	145.4	145.4	145.5
Third Party	32.0	34.0	36.0	38.0
Total	160.7	179.4	181.4	183.5
% third party	18.9	19.0	19.7	20.7
PROs				
PRC H Tudor*	22.0			
PRC G Lippmann*	15.0			
LIST ¹⁴ *	(37.00)	39.0	39.0	39.0
PRC Santé*	23.0	23.5	23.5	23.5
CEPS*	10.4	10.5	10.5	10.5
Total Gov. all PROs	70.4	73.0	73.0	73.0
3Third Party	40.1	42.4	43.4	44.1
Total PROs	110.5	115.4	116.4	117.1
% third party	36.3	36.7	37.3	37.7

Source: MESR *Government funding

Note that for the period of the previous performance contracts, 2011-2013, the total amount of funding for the PRCs and CEPS was €318.1m of which €201.3m, or 63.3% was from the state and €116.8m, or 36.7% was from third party funding. The table below provides a detailed breakout.

¹⁴ LIST –the Luxembourg Institute of Science and Technology—is the name of the entity to be formed when PRCs Tudor and Lippmann merge in early 2015.

Table 6: Public and External Funding of PROs 2011-2013, in millions of euros

	2011	2012	2013	Total
PRC Henri Tudor				
Government	21.40	22.42	23.40	67.22
Contractual	8.93	9.91	11.00	29.84
Competitive	5.30	6.40	7.60	19.3
International*	0.53	0.64	0.76	1.93
PRC Gabriel Lippmann				
Government	15.00	15.30	15.60	45.90
Contractual	3.70	3.80	3.90	8.40
Competitive	6.10	6.20	6.30	18.60
International*	0.54	0.57	0.59	1.70
CEPS/INSTEAD				
Government	9.81	10.15	10.49	31.45
Contractual	2.94	3.31	3.65	9.90
Competitive	3.10	3.50	4.00	10.60
International*	0.20	0.25	0.30	0.75
PRC Santé				
Government	20.10	21.50	23.00	64.60
Contractual	3.92	4.47	5.07	13.46
Competitive	8.64	9.56	10.60	28.80
International*	0.69	0.86	1.06	2.61
University				
Government	106.00	120.20	131.70	357.90
Third Party	18.00	20.00	23.00	61.00

*Note that International funding is a subcategory of Competitive funding. Source: Ministry of Higher Education and Research, 2011

In addition, performance contracts with the University and the PROs include the following indicators:

Table 7: Performance Contract Indicators and Targets

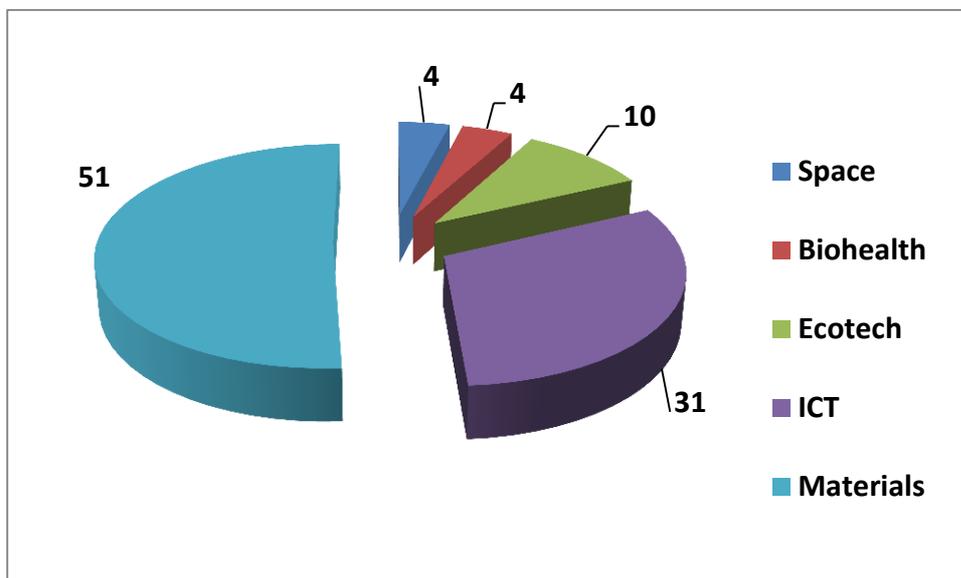
Indicator	2011-2013 target	2011-2013 achieved	2014-2017 target
Number of scientific publications (having an impact factor over 2)	558	775	1,040
Number of doctoral theses completed	91	90	167
Number of patents applied for	23	34	45
Number of spin-offs created	6	4	10

Source: MESR

2.5.3 R&I funding

The vast majority of R&I funding in Luxembourg continues to be direct. In addition to the public research funding described above, the Ministry of the Economy (ME) funds private sector research under the law of 5 June 2009. The law provides for the secondment of researchers from the public sector and encourages public-private partnerships (PPPs). It is particularly focussed on SMEs and innovation in the services sector, which accounts for 86% of the Grand Duchy's GDP. During the period 2011-2013, 240 applications for subsidies were submitted. Note that the government does not disclose the monetary value of the R&D subsidies it provides to the private sector or the names of the recipients. The figure below shows the distributions of funding by sector.

Figure 4: Private Sector Research Funding by Sector, in % 2013



Source: Luxembourg 2020 (Government of Luxembourg, 2014)

While most funding is direct, one exception is the law which went into effect on 5 March 2009 that gives preferential tax treatment to revenue from intellectual property (IP). Under this law, up to 80% of the net income generated by the exploitation of an IP right is exempt from tax, which means the effective average tax rate on IP income is 5.7%. The law covers patents, trademarks, designs, domain names and software copyrights and applies to companies located in Luxembourg. There is no information available about the economic impact of the IP law.

Note that because of the small size of its NRS, Luxembourg focuses on applied, rather than fundamental, research.¹⁵ Although there are no programmes covering the entire value creation scheme, a recent development has been the involvement of Luxinnovation in projects funded by the FNR, so that issues involving the possible valorisation of the work

¹⁵ Note that although the law of 5 June 2009 technically includes the subsidising of experimental development, industrial research and fundamental research, due to a lack of transparency as to what is funded, it is difficult to assess how much fundamental research is actually supported. Certainly the bias has always been to thematically-specific applied research. See <http://www.innovation.public.lu/en/financer-projets/rd-entreprise/experimentprojets-programmes-rd/index.html>.

are taken into consideration from the project's inception. The new [Proof of Concept](#) programme is designed to support this new initiative.

The third party funding targets defined by performance contracts are intended to reduce PRO dependence on government block funding. One result is that PROs actively seek public-private partnerships (PPPs). Luxinnovation organises "[Business Meets Research](#)" days to inform private sector companies about public sector research capabilities and works to partner companies with researchers. The City of the Sciences infrastructure project includes facilities for PPPs as well as the [Technoport](#) business incubator.

2.6 Smart Specialisation (RIS3)

In the National Reform Plan (NRP) Luxembourg 2020 for 2013 (Government of Luxembourg, 2013), the government targeted three areas for Smart Specialisation. Those were BioHealth, EcoTechnologies and Logistics. Note that because of Luxembourg's small size, there are no regional specialisation strategies. Luxembourg is its own NUTS2 region.

In Luxembourg 2020 for 2014 (Government of Luxembourg, 2014), smart specialisation is not specifically mentioned. The RIS3 website lists areas of specialisation for Luxembourg that are identical with the thematic priorities of the [CORE](#) funding programme. These are: Innovation in services; Sustainable resource management in Luxembourg; New functional and intelligent materials and surfaces and new sensing applications; Biomedical and health sciences; Societal challenges.

However, in the Luxembourg 2020 section responding to Country Specific recommendations, the government again references logistics, eco-technologies and health technologies, along with ICT and space technologies, as areas in which the government is concentrating its efforts to diversify the economy away from the dominant financial services sector (Government of Luxembourg, 2014).

2.7 Evaluations, consultations, foresight exercises

As mentioned in Section 2.2 above, the OECD undertook a study of Luxembourg's national research system in 2006 and a [Foresight Study](#) of the National Research Fund and its funding programmes was performed in 2006-2007. The OECD study resulted in the government's instituting performance contracts, the merger of PRCs Henri Tudor and Gabriel Lippmann and a greater emphasis on third party funding, including PPPs (OECD, 2006). The Foresight Study resulted in the identification of the themes of the CORE programme. In 2013 the government commissioned a new, independent study of the national research and innovation system to evaluate the level and degree of quality of the implementation of the OECD report recommendations. The study is expected to be released in the first half of 2015.

Regular evaluations of the University are a condition of its founding legislation. An evaluation by independent external experts was performed in 2013 and the results published on the University website. In addition, the University publishes an annual report of "Key Performance Indicators." PROs are also mandated to have annual evaluations by external international experts as a requirement of their performance contracts. The FNR

and Luxinnovation have had evaluations as well. Evaluations from 2010, 2011 and 2012 are published on the [MESR website](#).

All proposals submitted to the FNR are evaluated by independent, external experts. In fact, the FNR is exemplary in its use of external evaluators in its funding programmes and, under the fostering of the MESR, Luxembourg's NRS now enjoys a culture of evaluation. Indicators required by performance contracts mandate additional objective assessments of system performance.

Note that there have been no attempts to macro-economically model R&I impact. Luxembourg's economy derives 86% from the services sector and 38% of GDP comes from financial services. Growth of the contributions of other sectors to GDP that the government supports, such as biomedical and health sciences, would be one indicator of R&I impact. In Luxembourg 2020 (Government of Luxembourg, 2014) the government states that "In general, the performance of non-financial services in the current account balance, which is both largely positive and features significant evolution over recent years, indicates a genuine degree of success of the multi-specialisation strategy." However, specific figures are not available.

3. National progress towards realisation of ERA

3.1 ERA priority 2: Optimal transnational co-operation and competition

Because of its small size, Luxembourg has always been committed to transnational co-operation and the FNR has established widespread [bilateral and multilateral agreements](#) with other international research performers and consortia that support joint activities. These include participation in seven ERA-Nets as well European Cooperation in Science and Technology (COST), European Research Consortium in Informatics and Mathematics (ERCIM) and ESF Research Networking Programmes.

As an agency, the FNR participates in European Heads of Research Councils (EUROHORCs), the European Science Foundation (ESF) and the International Council for Science (ICSU). The FNR is also a member of Science Europe. As of 2012, proposals under the bilateral agreements with Germany's DFG and Switzerland's SNF with Luxembourg as the Lead Agency are submitted under the FNR's CORE programme. As noted above, all proposals submitted to the FNR are subject to independent, international peer review.

Luxembourg's CORE programme is targeted towards specific thematic domains. Participation in related ERA-Nets ensure Luxembourg research takes into account what is being done in other Member States. The INTER programme, with a budget of €18m for 2014-2017, is designed to fund the participation of Luxembourg researchers in international projects. FNR programmes, including INTER, are reviewed as part of regular evaluations of the funding agency. However, common ex-post evaluations are not undertaken at present.

Luxembourg's Lead Agency agreements with [Germany's DFG](#) and [Switzerland's SNF](#) are specific about defining common principles for joint projects. The FNR website provides extensive information about participation in joint projects for each of its bi- and multilateral agreements.

3.2 ERA priority 3: An open labour market for researchers. Facilitating mobility, supporting training and ensuring attractive careers

3.2.1 Introduction

Luxembourg research institutions enjoy a high degree of autonomy in their recruitment of researchers. The table below indicates the number of researchers by their sector of performance; in 2013, researchers represented 0.8% of the workforce. Note the 39% decrease in private sector researchers between 2011 and 2012 which is also reflected in decreasing levels of BERD and may be attributed to the lingering impact of the financial crisis.

Table 8: Researchers by Sectors of Performance¹⁶

	2011	2012	2013
Total	3,031	2,491	2,615
Business	1,518	927	1,009
Government	737	700	721
Higher Education	776	864	890
Non-profit	-	-	-

The other predominant characteristic of researchers working in Luxembourg is that the vast majority are foreign, as indicated in the table below.

Table 9: Origin of Researchers in PROs 2011-2013

PRC	2011	2012	2013
Lippmann			
Luxembourg	25	20	19
EU	185	197	213
Non-EU	17	15	17
Tudor			
Luxembourg	48	45	43
EU	367	344	315
Non-EU	47	42	38
Santé			
Luxembourg	65	50	35
EU	190	207	216
Non-EU	25	33	29
CEPS/INSTEAD			
Luxembourg	25	14	22
EU	94	99	90
Non-EU	12	15	19

Source: MESR Annual Report 2014

3.2.2 Open, transparent and merit-based recruitment of researchers

As indicated by the table above, Luxembourg can be regarded as a poster child for open and merit-based recruitment. Vacancies are announced on a Euraxess site as well as on the site of the recruiting institution and deadlines are reasonable and defined. The announcements are specific about the skills, competencies and other information required and the University offers an online application facility. Because many of the institutions work in French, English and German, language is not a barrier as it would be in some Member States.

The candidate selection process varies depending on the vacancy. Applicants for ATTRACT and PEARL fellowships and other high level positions are considered by selection panels made up of both local and independent international experts. Applications for the AFR programme for PhD and post-doc grants are also reviewed by international experts. Junior positions have more limited review processes.

¹⁶ Retrieved December 28, 2014 from

<http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tsc00004&language=en>

As part of a study done for the Directorate-General for Research and Innovation (DG RTD) in 2013 titled [Impact Assessment Study on Open, Transparent and Merit-Based Recruitment of Researchers](#), HR departments of several Luxembourg PROs were interviewed and reported that candidates for positions were able to ask for feedback. If they did, it would be provided, but it was unusual. Also the composition of selection panels is not normally published.

As part of PRO performance contracts, HR Departments have been mandated to develop career paths for researchers and annual staff evaluations are standard practice. The law of 28 August 2008, on the free circulation of people and immigration, allows public research institutions to receive a license to enable them to receive researchers from outside of the EU without the need to apply for individual work permits. Terms of employment are covered in the law of 3 August 2003 establishing the University. In addition, researcher fixed-term contracts can be extended to five years, rather than the normal duration of two-years.

The University was founded as a “research” university and has targeted strategic research priorities. In 2013, the [Luxembourg University Foundation](#) was established for the purposes of funding research projects and research chairs as well as providing support for scientific conferences and scholarships for needy students.

Because many Luxembourgers study abroad and the workforce is comprised of a high percentage of foreign residents and frontaliers, the MESR has a department “Reconnaissance et homologation de titres universitaires” that certifies foreign diplomas. Consequently a foreign diploma is not considered to be a barrier for a researcher.

Young researchers are recruited and the ATTRACT programme was specifically established to “attract” outstanding young researchers to Luxembourg. In addition, [AFR post-doc grants](#) are open to foreigners.

3.2.3 Access to and portability of grants

Access to grants is limited to researchers based in Luxembourg. As most grants are given to a project and not an individual, neither are grants portable. In projects that come under the bi- and multilateral agreements between the FNR and other foreign research institutions, the FNR funds the Luxembourg portion of the project and the foreign institution funds its part. The INTER programme funds Luxembourg researcher participation in external projects.

An exception to the access and portability issue is the [AFR](#) programme that funds PhDs. Recipients can be of any nationality and do their study anywhere; the deciding criterion is that the work be of interest to Luxembourg. AFR post-doc candidates can also be from outside of Luxembourg but recent changes to the programme foresee that the post-doc work is undertaken in the Grand [Duchy](#).

3.2.4 EURAXESS

Luxembourg has an active [Euraxess](#) portal. All Luxembourg PROs are participants. In addition to position postings, the portal provides complete information about being a researcher in Luxembourg as well as a .pdf version of the brochure “Foreign Researcher’s Guide to Luxembourg.”

Given Luxembourg's small size, the Euraxess site is able to offer complete and inclusive information that is specifically tailored to researchers interested in working in the Grand Duchy.

3.2.5 Doctoral training

The University of Luxembourg has seven [doctoral schools](#). They are Systems and Molecular Biomedicine, Economics and Finance, Educational Sciences, Computer Science and Computer Engineering, Law, Social Change and Sustainable Social Development and IPSE: Identities, Politics, Societies and Spaces. The PROs also offer opportunities for doctoral students and performance contracts for 2014-2017 have a combined target of 167 doctoral theses to be completed during that period.

The national programme for Innovative Doctoral Training is the [Aide for Research Training \(AFR\) programme](#). It provides funding for PhD candidates for up to four years.

The funding scheme is in line with the principles advocated in the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers. It has no thematic limitations and is open to all researchers, regardless of their nationality, desirous to engage into research training in Luxembourg or abroad. It embodies the principles of research excellence, an attractive institutional environment, exposure to industry and other relevant sectors, international networking, transferable skills training and quality assurance. Participants are required to be covered by social security, enjoy work contracts and may do their research with qualifying companies.

3.2.6 HR strategy for researchers incorporating the Charter and Code

All public research institutions, including the Ministry of Higher Education and Research and the FNR, are signatories to the Charter and the Code. The MESR provides a [statement](#) on its website affirming its adherence to the principles of the Charter and Code which amounts to an enabling framework.

The [University of Luxembourg](#) has been awarded the "HR Excellence in Research" and has implemented HRS4R. PRC Santé has also received the "HR Excellence in Research" certification and has implemented HRS4R.

Although there are no incentive programmes for implementing HRS4R, the fact that two institutions have HRS4R initiatives and all PROs are Code and Charter signatories suggests additional implementations will follow.

Luxembourg is a wealthy nation and offers its residents a high quality of life. Luxembourg depends on foreign researchers and provides an attractive work environment that includes health care and pensions, work contracts and all other entitlements enjoyed by the Grand Duchy's workforce. No legal, financial or social barriers exist for any researcher working in Luxembourg. This is confirmed by the study on OTM recruitment done for DG RTD previously that states "no obstacles or practices compromising OTM procedures were identified."

3.2.7 Education and training systems

Luxembourg has the EU's highest level of human resources in science and technologies (HRST): 56.5% as a percentage of total employment versus an EU 27 average of 42.7% in 2011 and 58.3% in 2012.

The University offers all doctoral students courses in [Transferable Skills Training](#). The University also offers courses in vocational training, while PRCs also offer certificate programmes. The [Institut national pour le développement de la formation professionnelle continue](#) (INFPC), the agency that promotes continuing education, manages the portal [lifelong-learning.lu](#) that lists continuing education courses. Businesses have the opportunity for government co-funding for the costs of employee training.

To address the "innovation skills gap," the University offers a Masters degree in Innovation and Entrepreneurship. Luxinnovation also offers Innovation Master Classes. The AFR programme actively encourages private sector companies sponsoring doctoral and post-doctoral grant recipients.

Part of the mission of the FNR is to promote careers in science and technology as well as research. Its activities include organising "Researcher Days," when researchers present their work to the public and in schools, offering funding for projects that promote science to the public, running workshops to train researchers how to present their work to the public and to train young people how to organise activities that promote science at summer camps, after school programmes, etc. The FNR also manages a group of websites that promote science that include [science.lu](#), [letzbio.lu](#), [letzgreen.lu](#), and [Mr Science](#). The FNR activities are largely targeted at students.

3.3 ERA priority 5: Optimal circulation and access to scientific knowledge

3.3.1 e-Infrastructures and researchers electronic identity

In terms of e-infrastructure, Luxembourg's is ranked 21 out of 142 nations in the World Economic Forum's [Global Information Technology Report 2012](#) and gives Luxembourg's infrastructure a rating of 6.3 out of 7. An example of Luxembourg's e-infrastructure that relates to research is the CVCE (Centre Virtuel de la Connaissance sur l'Europe) that is a research and documentation centre for European studies. The Centre creates digital publications which are particularly geared towards researchers and lecturers, while remaining open to a wider public. Like the National Library, it is also a major actor in "Digital Humanities."

In addition to the CVCE, Luxembourg has the [LIS Cross-National Data Center](#)- The Data Center provides digital information from the Luxembourg Income Study (LIS) and its team was recently joined by Dr Paul Krugman, winner of the 2008 Nobel Prize in economics.

The university library has electronic resources that give online access to e-books and reviews of the university community as well as links to the digital services of the National Library (BnL). This is the central documentary platform of the Grand Duchy that is actively pursuing the national coordination and technological innovation policy in the area of documentary services production and dissemination.

The BnL offers an innovation policy for scientific and research libraries. In 2013, bibnet.lu, the national library's network, took on 17 new member libraries, for a total of 57 members. Six additional libraries are in the process of joining the network. By the end of 2014, a large majority of scientific and research libraries in the country will be included.

In addition, the Luxembourg Consortium, made up of BnL, the University of Luxembourg and the three CRPs, offers 50,000 periodicals, 80,000 books and over 350 specialised databases, plus reference books in English, French and German through the [Findit](#) portal. Beginning in 2013, this content also became available through, [a unified research portal](#). Statistics for 2013 again indicate significant increases in the use of the digital library of 50%, a figure that does not include purchased content. If the growing portion of open access content were included, consultation of works would be even higher. The number of users who consulted the digital library grew by 24% in 2013.

Note that although there is no electronic identity for researchers, any resident of Luxembourg can obtain electronic access to BnL digital resources.

Luxembourg has very strict laws covering data security, with severe penalties for their violation, and for this reason has developed a niche for data centres.

3.3.2 Open Access to publications and data

In May 2013, the University of Luxembourg organized an information session on Open Access, based on a cooperation agreement to be signed with the University of Liège (ULg) that includes the establishment of a strategy and a “green” policy on Open Access (OA) at the University of Luxembourg and the creation of an Institutional Repository ORBi based on the model developed successfully at ULg. Under the European Commission's Openair project, the University library will be transformed into a National Free Access Office (NOAD) for Luxembourg.

Additionally, the FNR is also working to develop a policy on Open Access. As a member of ScienceEurope, the FNR endorsed a statement of principles that “advocate that research publications should either be published in an Open Access journal or made available or be deposited as soon as possible in a repository.”¹⁷

In light of the initiatives of the University and the FNR, the report on Open Access Strategies (Caruso et al., 2013) that does not identify any movement in the Grand Duchy on this issue appears to be incorrect. It does state that, “All in all, the number of policies alone is a weak indicator of commitment to OA in a given country.” The report also estimates that, “if the precision and recall of the harvesting instrument is taken into account,” 50% of journal articles in Luxembourg are being published in OA journals.

PRO CEPS/Instead publishes a full text selection of its research work on its website that is not published in “commercial” journals. PRC Lippmann provides bibliographic information on its publications but no links to the publications themselves. PRC Santé publishes information on its publications, abstracts and, when possible, provides Open Access versions of the full text. PRC Henri Tudor provides a catalogue of its publications, but without access to articles. Finally, like PRC Henri Tudor, the University of Luxembourg provides a listing of publications but with limited information or links to the articles themselves.

¹⁷ <http://www.fnr.lu/en/Press/Press-Releases>

Archambault et al. (2013) estimated the proportion of OA per country, in a 4-year non-weighted sampling covering 2008-2011. Using a sample of 35 papers, Luxembourg had 11, papers, or 35%, in green or hybrid journals, 2, or 5% in gold journals and 15, or 41% available via Open Access.

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Again, the National Library has taken the lead in the long-term preservation of information in an initiative it calls the “Digital Humanities.” This project offers public access via the internet to digital copies of previously inaccessible works and is being extended to the national digitisation platforms, such as www.eluxemburgensia.lu. The National Library also has initiatives in capturing “born again” digital content for researchers.

4. Innovation Union

4.1 Framework conditions

Luxembourg has good framework conditions in place conducive to business investment in R&I. However, it seems to be a case of “You can lead a horse to water, but you can’t make him drink,” as evidenced by declining levels of BERD and decreases in the number of researchers employed in the private sector. However, it should be emphasised that these decreases are due more to the impact of the financial crisis as well as the dominance of the financial services sector than to Luxembourg’s R&I ecosystem.

The law of 5 June 2009 encourages firms to undertake research through a subsidies programme. Luxinnovation also works with firms to identify sources of funding and does matchmaking between business and research organisations to promote PPPs. The Ministry of Economy has an Office of Intellectual Property to assist firms with identifying, managing and registering their IP as well as a law that gives preferential tax treatment to IP revenues.

Luxembourg is small and its government is accessible and responsive to business needs. The IP law was the result of a grass-roots taskforce that drafted the legislation and presented its work to the Minister of the Economy that was subsequently ratified. A similar initiative is addressing issues involved in social entrepreneurship, including establishing a special legal status for socially innovative companies.

Also because of its size, R&I policies are coherent and co-ordinated and the R&I system is subject to periodic evaluation.

4.2 Science-based entrepreneurship

The University has a Vice Rector in charge of knowledge transfer and valorisation of research. It also has a well-defined policy on IP. Targets for spin-offs are part of performance contracts for PRCs as well as the University. Luxinnovation is working with the FNR to evaluate prospects for commercialisation of proposals submitted and a new FNR programme, [Proof of Concept](#), is described as “an effort to bridge the gap between research and the early stage of a marketable innovation.”

In terms of start-up funding, Luxinnovation sponsors the [1-2-3 Go](#) business plan competitions and other organisations such as the Impactory organise “Pitching Days.” There is also a competition, [Creative Young Entrepreneur Luxembourg](#) (CYEL) that serves to promote start-ups. The government co-sponsors the [Technoport](#) business incubator which enjoys a purpose-built facility in the City of Sciences that will also house the University and several PROs.

While there are no particular schemes or policies for start-ups, there are many opportunities for them to promote themselves. There are business expos in Luxembourg and Luxembourg has stands at events such as CeBIT where young companies are invited to be present. The Ministry of the Economy promotes external trade, as does the Chamber of Commerce. [FOCUS](#) magazine, produced by Luxinnovation, highlights new innovative companies and is distributed to embassies and trade missions around the world.

The Luxembourg Portal for Innovation and Research has a section, [Collaborations and partnerships](#), where companies can present themselves and look for either local or international partners. Finally there is a chapter of [FirstTuesday](#) in Luxembourg that organises networking events for entrepreneurs as well as a local [Startup Grind](#).

4.3 Knowledge markets

Luxembourg's Ministry of the Economy has a DG for Research, Intellectual Property and New Technologies. Its Office of Intellectual Property organises an IP Day each April. In 2013, more than 300 people attended the event. To further encourage awareness of IP, the "Boost IP" project, financed by FEDER (European Funds for Regional Development) and supported by the ME, was directed at SMEs in the eco-technology and artisan sectors. Diagnostics of intellectual property practices were offered by means of an individual and personalized interview. In 2012, around 33% of companies contacted were granted a personalised interview. In addition, 14% of SMEs who had a personalised interview expressed an interest in carrying out a financial evaluation of patents.

Luxembourg has a law giving preferential tax treatment to revenues from IP (circular L.I.R. n°50bis of 5 March 2009). Under this scheme, up to 80% of the net income generated by the exploitation of an intellectual property right is exempt from tax, subject to certain conditions. In other words, the effective average tax rate on IP income is 5.7%. The scheme covers patents, trademarks, designs, domain names and software copyrights and applies to companies located in Luxembourg. In addition, the law of 5 June 2009 relating to the promotion of research, development and innovation provides the framework for a financial aid scheme that contributes to the costs linked to the [protection of technical industrial property](#).

In September 2014 the formation of a [Luxembourg Institute of Intellectual Property](#) (IPI) was announced, a joint effort of the Office of Intellectual Property and a unit of PRC Henri Tudor. It is due to be launched in early 2015. Its purpose is to promote the identification, protection, exploitation and respect for the rights of intellectual property.

Luxembourg participates in all the major IP treaties and conventions, including the Bern Convention, the Patent Cooperation Treaty (PCT), the Paris Convention and the Patent Law Treaty (PLT), as well as the Madrid Agreement and Protocol. The country is a signatory of the European Patent Convention, which was set up by the European Patent Office (EPO).

Note that there are no marketplaces for patents in Luxembourg.

4.4 Knowledge transfer and open innovation

Luxembourg's R&I strategy is strongly oriented towards public-private partnerships (PPPs). Performance contracts between the government and the University and PROs require third party income¹⁸ that includes PPPs, while the law of 5 June 2009¹⁹ provides government

¹⁸ Note third party income includes NRF project funding, EU and ESA funding, etc. as well as revenue from PPPs.

¹⁹ For the full version, see <http://www.legilux.public.lu/leg/a/archives/2009/0150/index.html>

For an overview of the law's provisions, in English, see <http://www.innovation.public.lu/en/financer-projets/rd-entreprise/projets-programmes-rd/index.html>

support for private sector research and includes provisions for augmented funding for projects covering experimental development, industrial research and fundamental research undertaken in collaboration with a public research organisation or an SME.

A repositioning of the AFR programme that funds PhD and postdoc research also stresses public-private partnerships. In 2015, the AFR Postdoc will be limited to the AFR-PPP in collaboration with accredited companies based in Luxembourg. Luxembourg companies are also encouraged to take advantage of undertaking a project with a PhD candidate funded by the AFR scheme.²⁰

Opportunities for PPP collaboration and matchmaking are showcased in “Business Meets Research” days organised by Luxinnovation.²¹ The most recent event took place on 18-19 June 2014, included participants from throughout the “Grand Region” of neighbouring France, Germany and Belgium, and featured sessions on additive manufacturing, robotisation of small scale production, manufacturing environmental sustainability and nanocomposites.

Performance contracts also set indicators in numbers of patents and spin-offs. In 2011-2013, 34 patents were applied for and four spin-offs were launched, with 23 patents and six spin-offs targeted. For the 2014-2017 period, 45 patent applications and ten spin-offs have been established as goals for the University and PROs. In the period 2011-2013, 36.7% of the funding of the PROs came from third party financing. Note however that the 36.7% included all “competitive funding” from the FNR, FP7, ESA, etc. as well as PPPs.

4.5 Innovation framework for SMEs

Luxembourg provides a supportive environment for innovative SMEs, from business incubators to the possibility for research funding under the law of 5 June 2009.

Start-up facilities range from [The Impactory](#) which describes itself as “a community and place where people come to build their business or work on a project that matters” for the earliest stages of entrepreneurship, to [The Future Lab](#), which offers office space and support facilities in the centre of Luxembourg Ville for more developed start-ups, to the [Technoport](#), whose purpose-built facilities in the City of the Sciences combines a business incubator with co-working opportunities and a Fab Lab for tangible product development.

Administrative support services range from the [Guichet](#) that offers “clicks and mortar” information for businesses on administrative issues in three languages, to the [Espace Entreprises](#) of the Chambre of Commerce that is “aimed particularly at business creators, from the conception of the project to the creation of the company, and at already established businesses relating to various administrative procedures.”

[Luxinnovation](#) is the national agency that offers a range of services for both start-ups and established companies. These include identifying both national and European funding opportunities, innovation management, technology transfer and IP management. Luxinnovation also runs Luxembourg’s [cluster initiative](#). Luxembourg currently has clusters in Materials, ICT, Space, BioHealth, EcoInnovation and Automotive Components and members represent a broad range of knowledge triangle actors. Maritime and Logistics Clusters operate separately.

²⁰ See <http://www.fnr.lu/af-r-phd-postdoc-grants/public-private-partnerships-under-af-r>

²¹ See <http://www.business-meets-research.lu>

Luxinnovation also supports SME involvement in European projects and is the [National Contact Point](#) for Horizon 2020. In addition to funding support for proposal development via [Fit4Horizon2020](#), there are also programmes to support SMEs in ESA projects, notably [LuxLaunch](#), that provides as much as €100,000 for up to six months for “preparatory studies that help SMEs position themselves in the space market.”

Given Luxembourg’s size, there are limited support schemes and no voucher systems. The main instrument is the law of 5 June 2009 that supports R&D projects and is targeted at SMEs. It is supposed to be particularly aimed at Luxembourg’s dominant services sector. However, as can be seen in the figure in Section 2.5.3, the majority of funding continues to go to the Materials sector. It is also reported as being heavy on administration and selection criteria are not straightforward.²²

Insolvency regulations are an obstacle as an entrepreneur whose company fails cannot start a new business for eight years. In addition, bankruptcy proceedings can be lengthy. In certain circumstances, the entrepreneur may be personally liable for the company’s debts. Insolvency regulations are one of the few areas of the Small Business Act (Commission of the European Communities, 2008) that Luxembourg fails to address.

4.6 Venture capital markets

A dearth of venture capital has long been an issue in Luxembourg and cited as one of the main innovation challenges in previous country reports. The grass-roots resurrection of the [Luxembourg Business Angels Network](#) (LBAN), headed by two veteran entrepreneurs, has been a positive development. LBAN is partnered with the Chamber of Commerce, Luxinnovation, Seed4Start and the Technoport business incubator to work with start-ups and provide seed capital. It offers coaching and organises “pitching days.” It is also focussed on social innovation and is part of the European Business Angel Network (EBAN.) In 2012, LBAN members invested €2.3m in nineteen companies. According to EBAN (EBAN, 2014), LBAN is Luxembourg’s sole business angel network with 80 business angels. In 2013, 17 investments were made totalling €1.7m which created 59 jobs. Average investments were €94,118.

Another development which should have been positive, the formation of a €150m Future Fund, co-managed by the European Investment Fund (EIF) and the National Society for Credit and Investment ([SNCI](#)) has been less happy. With a stated purpose of making investments in innovative SMEs, it has taken more than twenty-eight months since the announcement of the fund in January 2012 to its actual launch, reportedly between July and September 2014,²³ although at year end 2014 there was still no evidence of any activity.

The European Private Equity and Venture Capital Association (EVCA) points out that “Luxembourg provides sophisticated investment fund structures for private equity and venture capital investment” and that “while corporate tax rates... are not particularly low, Luxembourg investment fund vehicles benefit from extensive tax exemptions, which ensure an almost tax-neutral environment in Luxembourg at the level of both the fund vehicle and

²² There is a significant lack of transparency in the administration of the law of 5 June 2009. The recipients and the funding they receive are not identified and there is no public accounting or known evaluations of the results of the support.

²³ Retrieved December 29, 2014 from <http://paperjam.lu/news/le-luxembourg-future-fund-enfin-sur-les-rails>

its investors.” (EVCA, 2013). The two vehicles are SICARs (Société d’Investissement en Capital à Risque) and SIFs (Fonds d’Investissement Spécialisé). Both instruments are meant to encourage investment but are not limited to venture capital investments—portfolios can contain exchange-traded equities, for instance.

There are no crowdfunding sites dedicated specifically to Luxembourg ventures.

4.7 Innovative public procurement

In the report, *Innovation in Public Services*, Luxembourg gets “green lights” for having no external or internal barriers to innovation in public services and also a “green light” rating for its procurement of innovative technologies. This is reflected in the improvement noted in the report in “eLuxembourg” from 2000 to 2010. The “Guichet” (www.guichet.lu) is a good example of innovative delivery of public services.²⁴ When it comes to actual procurement, however, both business and civil servants agree that price and not innovativeness is the primary driver in the procurement selection process (DG Enterprise and Industry, 2013). There are no policies that encourage the procurement of innovative solutions nor targets for the procurement of innovative goods and services.

²⁴ Note that this is innovative by Oslo Manual Standards which would designate as innovative services offered for the first time by Luxembourg rather than the first time offered anywhere.

5. Performance of the National Research and Innovation System

5.1 Performance of the National Research and Innovation system

While the innovation leaders in the 2014 Innovation Union Scoreboard were “the usual suspects,” Luxembourg rose to fifth place as the first of the Innovation Followers, which represents a steady progression from previous years. This performance is despite the concerns about decreases in GERD and BERD noted previously.

Luxembourg’s strengths were in international scientific publications, venture capital investments and such IP-related indicators as community trademarks and community designs. Low performers were non-R&D expenditures and new doctoral graduates. Note that the latter reflects the relative youth of the University.

The highest growth was observed in international scientific co-publications, most cited scientific publications and R&D expenditures in the public sector. The indicators non-R&D innovation expenditures, sales share of new innovations and R&D expenditures in the business sector showed significant declines. The drop in BERD has been previously discussed in this report.

Declines in GERD and BERD make Luxembourg’s innovation outputs even more impressive, especially in the area of scientific publications. Luxembourg significantly exceeds the EU average of its population with tertiary education. Outputs represented in economic effects reflect the role services play in the Grand Duchy.

On average in 2012, Luxembourg produced 22.41 publications per 10,000 inhabitants, well above the EU-28 average of 13.8. 74.49% of publications were internationally co-published. In 2012, Luxembourg had approximately 1,669 international scientific co-publications per million inhabitants, making it the EU leader except for Denmark’s 1,915.8. In the period 2002-2012, 12.56% of Luxembourg’s scientific publications were in the top 10% most cited publications worldwide in comparison with 11.17% of top scientific publications produced in the EU28 (Science Metrix, 2014).²⁵ The share of public-private co-publications in Luxembourg is 2.2% in the period 2008-2013, compared to 2.8% for the EU28.²⁶

²⁵ These publication data are based on Elsevier's Scopus database. ScienceMetrix, Analysis and Regular Update of Bibliometric Indicators, study conducted for DG RTD. They represent an update of the data displayed in the table below. See also http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=other-studies

²⁶ Scival 2014, Scopus based publication indicators derived from Elsevier's SciVal platform, www.scival.com last accessed December 2014.

Table 10: Assessment of the Performance of the National Research and Innovation System

1. ENABLERS	Year	LU	EU
Human resources			
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	2011	0.80	1.70
Percentage population aged 30-34 having completed tertiary education	2012	49.60	35.80
Open, excellent and attractive research systems			
International scientific co-publications per million population	2012	1,558.53	343.15
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	2009	12.42	10.95
Finance and support			
R&D expenditure in the public sector as % of GDP	2012	N/A	0.75
Venture capital (early stage, expansion and replacement) as % of GDP	2012	0.31	0.08
2. FIRM ACTIVITIES			
R&D expenditure in the business sector as % of GDP	2012	1.00	1.31
Linkages and entrepreneurship			
Public-private co-publications per million population	2011	35.53	52.84
Intellectual assets			
PCT patent applications per billion GDP (in PPS€)	2010	1.55	3.92
PCT patent applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	2010	0.37	0.85
3. OUTPUTS			
Economic effects			
Contribution of medium and high-tech product exports to trade balance	2012	-4.43	1.27
Knowledge-intensive services exports as % total service exports	2011	75.29	45.26
License and patent revenues from abroad as % of GDP	2012	1.17	0.59

Source: European Commission, IUS Database (2014).

5.2 Structural challenges of the national R&I system

Previous Country Reports identified four structural challenges: While some progress has been made on certain of the issues, the challenges remain. They are:

- Increasing absorptive capacity
- Increasing Luxembourg's research profile through international cooperation
- Developing human resources in RDI
- Promoting a culture of entrepreneurship.

Increasing absorptive capacity. At 1.16% of GDP in 2013, compared to an EU-28 average of 2.02%, Luxembourg's GERD is perturbingly low. The reasons traditionally given for this underperformance are the youth of Luxembourg's public research system and the consequent need to develop absorptive capacity. However, developing absorptive capacity is dependent not only on effective RDI policies, many of which are in place, but also on such factors as the economic environment and a successful diversification away from the dominant financial services sector.

A major concern in increasing absorptive capacity is the decrease in GERD from 1.72% of GDP in 2009 to 1.16% of GDP in 2013 and BERD, from 1.31% of GDP in 2009 to 0.71% in 2013. Council specific recommendations for Luxembourg are pessimistic about the Grand

Duchy meeting its national objective for R&D intensity of 2-3%-2.6% of GDP, with 0.7%-0.9% coming from the public sector and 1.6%-1.9% from the private sector. An intermediate target of 2.0% of GDP overall has been set for 2015. (Government of Luxembourg, 2014) and even meeting this target looks like it will be difficult.

Increasing Luxembourg's research profile through international cooperation. The FNR recognises the need for international cooperation and the same need is identified in the NRP for 2011, *Luxembourg 2020*. The Innovation Union Competitiveness Report 2013²⁷ indicates that Luxembourg received FP7 funding that represented only 5.7% of GERD—an EU low in 2011. Its success rate of 13.1% is in the low mid-range. In addition, despite the Fit4Europe (now Fit4Horizon2020) initiative that provided support to SMEs applying to European programmes,²⁸ Luxembourg SMEs also had a lower success rate than the EU-27 average. These rates imply the existence of ongoing roadblocks to raising Luxembourg's international research profile.

Developing human resources in RDI. Luxembourg is a model for researcher mobility, open recruitment, equitable work contracts and fair compensation. All Luxembourg research organisations are signatories to the Charter and Code; two have received HR Awards of Excellence and have also implemented HRS4R. Nevertheless, developing human resources in RDI remains a challenge as numbers of Luxembourg researchers continue to decline at PROs.

Improving gender equality as a component of developing RDI human resources is a greater challenge. In the EU study SheFigures 2012,²⁹ Luxembourg continues to rank at the bottom of the EU in such measures of gender equality as the proportion of female researchers, the proportion of women in Grade A academic positions (9%) and the proportion of Women on Boards. Only 21% of researchers are female, compared to an EU-27 average of 30%.

Promoting a culture of entrepreneurship. Also identified as a challenge in the Self-Assessment done for DG RTD in April 2011, as well as previous ERAWATCH and TrendChart reports, a culture of entrepreneurship still needs additional development in Luxembourg.

While the creation of spin-offs using IP from research activities are included in several PRO performance contracts, the number achieved in the period 2011-013 was four, with a goal for 2011-2013 of six. The target for the period 2014-2017 is ten spin-offs. It can also be noted that although the law of 5 June 2009 has special provisions for SMEs, there are no specific policies, laws or incentives for entrepreneurs or start-ups, while in 2013, of the 22 students in the University's Masters in Entrepreneurship and Innovation, only one was a Luxembourg citizen.³⁰

²⁷ Retrieved on December 28, 2014 from http://ec.europa.eu/research/innovation-union/pdf/competitiveness_report_2013.pdf

²⁸ Retrieved on December 28, 2014 from <http://www.innovation.public.lu/en/financer-projets/programmes-europeens/fit4europe/index.html>

²⁹ Retrieved on December 28, 2014 from http://ec.europa.eu/research/science-society/document_library/pdf_06/she_figures_2012_en.pdf

³⁰ Personal communication of the Programme Director.

Table 11: Policy measures addressing structural challenges in Luxembourg

Challenge	Policy measures/actions addressing the challenge	Assessment in terms of appropriateness, efficiency and effectiveness
Increasing absorptive capacity	Law of 5 June 2009. Business Meets Research Days. Performance contracts mandating third party income.	Ongoing declines in GERD and BERD indicate additional measures are necessary to meet 2020 targets.
Increasing Luxembourg's research profile through international cooperation	Fit4Horizon2020, LuxLaunch, participation in ERA Nets and bi- and multi-lateral agreements.	Given increases in participation in FP7 compared to FP6, measures are showing their effectiveness.
Developing human resources in RDI	Signatories of Charter and Code, HRS4R implementation. Euraxess.	Native researchers are decreasing in PROs and a wide gender gap exists. Additional measures are needed.
Promoting a culture of entrepreneurship	Business incubators. 123 Go. Luxinnovation. Masters in Innovation and Entrepreneurship. Innovation Master Classes.	Measures are appropriate; more are needed such as the 1,1,1 initiative, less punitive measures relating to bankruptcy, more sources of funding.

5.3 Meeting structural challenges

Luxembourg has policies in place intended to address each of the challenges identified above. Some are showing a measure of success while one has become even more of a challenge.

Increasing absorptive capacity. Measures in place to encourage increases in BERD include the Law of 5 June 2009 for private sector research subsidies, the law supporting innovation in EcoTechnologies and the IP Law of 2008. Luxinnovation promotes private sector R&D through the Cluster initiative, Business Meets Research days and identifying other funding opportunities. The continuing decline in BERD, as evidenced by a -33.5% decrease in private sector researchers between 2011–2013, suggests additional measures are needed

Increasing Luxembourg's research profile through international cooperation. Measures to increase Luxembourg's research profile include Fit4Europe/Fit4Horizon2020 and LuxLaunch, as well as the FNR's bilateral and multilateral funding agreements. Performance contracts targets for third party funding incentivize PROs to find international partners. The table below indicates these measures are beginning to show some success.

Table 12: Luxembourg FP6 and FP7 Participation

FP6 2002-2006			FP7 2007-2013		
Projects	Participants	EC financial contributions to partners	Projects	Participants	EC financial contributions to partners
2,830	5,189	€962,792,206	6,432	11,377	€3,309,820,746

Source: JRC

Developing human resources in RDI. The AFR programme, which funds PhD and post-doc work and is administered by the FNR, is currently supporting more than 600 researchers. The ATTRACT and PEARL programmes “import” outstanding researchers and the FNR’s “Promotion of Scientific Culture” and related activities aim to make a career as a researcher interesting to students. The decline of the number of researchers who are Luxembourg nationals detailed in Table 8 indicates more measures may be needed.

A new policy requiring Boards of PROs to have at least 40% members of the underrepresented sex (in all cases this would be women) was initiated in the Fall of 2014. The impact is yet to be seen. However, this is the only measure to address the gender gap and more action is needed.

Promoting a culture of entrepreneurship. As noted in Section 4.5 above, there are many structures in place to support entrepreneurship which include a Master in Entrepreneurship and Innovation; Innovation Master Classes, Luxinnovation, business incubators (Technoport, FutureLab, Impactory), the Chamber of Commerce’s Espace Entreprises, the IP Law of 2008, performance contracts that mandate spin-offs and an active business angel network.

A study by DG Enterprise and Industry on Member States meeting three criteria for ease of starting a company—“one stop shop,” days to incorporate and cost—gave Luxembourg two green lights, but the assessment is questionable. The Guichet for Business (www.guichet.lu) has some information but it is not complete; the three days cited to start a business is a gross underestimation if a business license is required and the cost given of €1,100 is also considerably too low. It overlooks the capital requirements of €12,500 for an S.à.r.l. and €32,000 for an S.A. as well as average notary and accountant charges.

Despite a range of measures that offer support for entrepreneurs, more efficient and effective measures are needed. Company start-up costs are high and funding and capital are scarce, especially for non-high tech ventures. Indirect funding such as tax incentives or credits would improve the success rate. A new initiative is the “111” movement, which advocates the establishment of a simplified procedure for starting an S.à.r.l.—“one person, one day, one euro”³¹ and is being promoted by the private sector.

³¹ Retrieved on December 29,2014 from <http://www.change.org/en-GB/petitions/etienne-schneider-launch-the-111-company-simplified-s%C3%A0rl-and-make-luxembourg-the-place-to-be-for-start-ups-and-entrepreneurs>

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Annex 2 - Abbreviations

AFR	Aid for Research Training (PhD and post-doc funding)
BERD	Business Expenditures for Research and Development
BnL	Luxembourg National Library
COST	European Cooperation in Science and Technology
CVCE	Centre for the Virtual Knowledge of Europe
DG RTD	Directorate-General for Research and Innovation
EBAN	European Business Angels Network
ERA	European Research Area
ERA-NET	European Research Area Network
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU-27	European Union including 27 Member States
EU-28	European Union including 28 Member States
FDI	Foreign Direct Investments
FEDER	European Funds for Regional Development
FP7	6th Framework Programme
FP7	7th Framework Programme
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HRS4R	Human Resources Strategy for Researchers
IBBL	Integrated Biobank of Luxembourg
IP	Intellectual Property
LBAN	Luxembourg Business Angel Network
ME	Ministry of the Economy
MESR	Ministry of Higher Education and Research
FNR	National Research Fund
NRP	National Reform Plan
NRS	National research system
OECD	Organisation for Economic Co-operation and Development
PPP	Public-private partnership
PRC	Public Research Centre
PRO	Public Research Organisation
R&I	Research and innovation
RDI	Research, development and innovation
RI	Research Infrastructures
RIS3	Research and Innovation Strategies for Smart Specialisation
RTDI	Research Technological Development and Innovation
SME	Small and Medium Sized Enterprise
S&T	Science and technology
ULg	University of Liège
VC	Venture Capital

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