Country Profile

LUXEMBOURG

Luxembourg is a small open economy with one of the world's highest income per capita. In recent years, the government has invested heavily in building an advanced science base, virtually from scratch, and is now looking to consolidate these investments, with a strong focus on the efficiency and effectiveness of the science base and the roles it can play in supporting national innovation performance and structural change of the Luxembourg economy.

Table 1. Gross domestic expenditure on R&D (GERD)

	LUX	OECD
GERD		
USD million PPP, 2014	668	1 181 495
As a % of total OECD, 2014	0.1	100
GERD intensity and growth		
As a % of GDP, 2014	1.26	2.38
(annual growth rate, 2009-14)	(-3.0)	(+2.3)
GERD publicly financed		
As a % of GDP, 2013	0.65	0.61
(annual growth rate, 2008-13)	(+15.8)	(+2.5)

Hot issues

Strengthening public R&D capacity and infrastructures

The government's R&D budget has continued to increase, with total government budget appropriations or outlays for R&D (GBAORD) climbing at a high rate from USD 72 million (EUR 60 million) in 2004 to USD 318 million (EUR 264 million) in 2013. The number of researchers in the public sector has also grown substantially. These large increases reflect the government's intention to expand the research system in order to develop and diversify the economy. The rate of budget increase has slowed markedly recently, however, a trend that can be expected to continue as the research system enters a phase of consolidation.

Improving coordination and participatory governance

Recently, the government launched a plan to strengthen the cooperation among different public research actors, by grouping and merging some institutions (see above) and by focusing on strategic sectors for the national economy like ICTs, biomedicine and material sciences. Two draft laws have been passed to further strengthen and harmonise the research system. One law focused on reforms of Luxembourg's only research council, the *Fonds National de la Recherche* (FNR) to strengthen its autonomy, to enlarge its missions beyond funding and to allow it to fund research in a wider variety of types of organisations. The second introduced modifications to the public research institutes, the *Centres de Recherche Public* (CRPs), specifically the merger of CRP-Gabriel Lippmann and CRP-Henri Tudor and the incorporation of the Integrated BioBank into CRP-Santé. An ambitious infrastructure project, the *Cité des Sciences, de la Recherche et de l'Innovation* at Belval, groups most of Luxembourg's public research (the University of Luxembourg and CRPs) in one campus , with facilities for public-private partnerships and an incubator for start-ups. Since 2015, 2 000 students and 1 500 researchers and R&D personnel are located in Belval. Cooperation between research performing organisation is further fostered by joint professorships between the University and the CRPs as well joint doctoral schools.

Addressing challenges of STI globalisation and increasing international cooperation

Luxembourg has made international research co-operation a priority, and this is reflected in high shares of international co-authorship (4[q]) and international co-invention (4[r]). The government places considerable emphasis on strong participation in the EU's Horizon 2020, particularly as levels of national funding are set to increase more moderately over the next few years. Participation in EU's Horizon 2020 is increasing compared to past EU programmes. It has also signed many bilateral agreements.

Improving STI policy evaluation and impact assessment

Public research institutions in Luxembourg are subjected to performance contracts. The government has defined the new round of performance contracts for the period 2014-17: public research institutions subjected to performance contracts need to fulfil the objectives detailed in the contracts and measures according to relevant indicators in return for the financial allowance provided by the Government. The Government defines and realises result-oriented evaluations to make sure that public research funding meet the objectives described in the performance contracts. In 2015, for example, the Government has requested an external comprehensive evaluation of the University of Luxembourg which compares the different outputs of the research units and interdisciplinary research centres. Luxembourg requested a second OECD review of the national STI policy in 2015 which is being used to prepare a new national STI strategy.

Improving the education system

The proportion of the adult population with tertiary-level education is above the OECD median (4[t]). However, there is widespread perception that young people are not very interested in scientific careers. Measures such as Go for Science and ProScience seek to raise awareness of science among young people and to attract them to scientific careers. The FNR's *Aides a la Formation-Recherche* (AFR) programme aims to make scientific careers more attractive by offering better work contracts, working conditions and training opportunities to PhD and postdoctoral students. The setting up of a series of doctoral schools will contribute to improve the professional skills of doctorate candidates in the coming years. The FNR also provides institutions with funding to attract high-level senior researchers and exceptional young researchers from abroad.

Some key STI performance indicators

Figure 1. Economic performance

Labour productivity, GDP per hour worked, index 2005=100

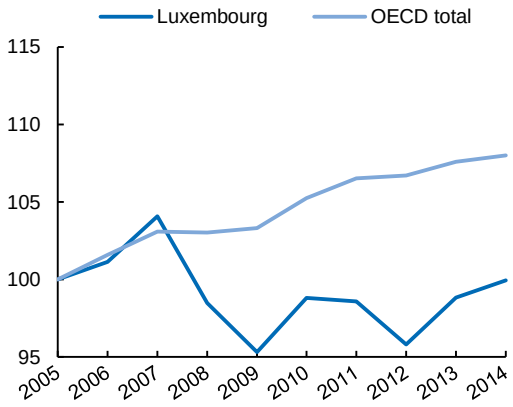


Figure 2. Environmental performance

Green productivity, GDP per unit of CO2 emitted, index 2005=100

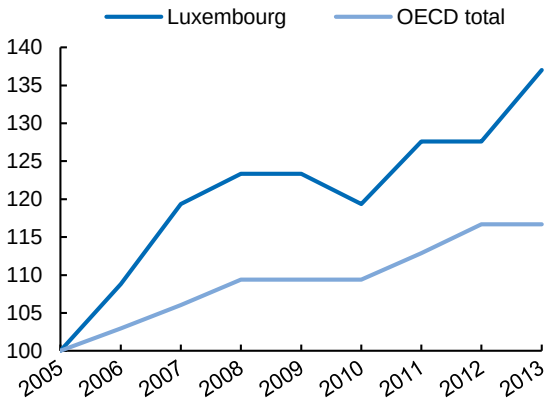
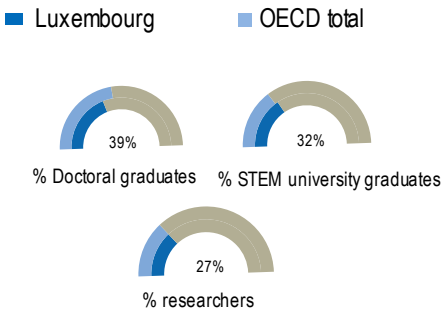


Figure 3. Women in science

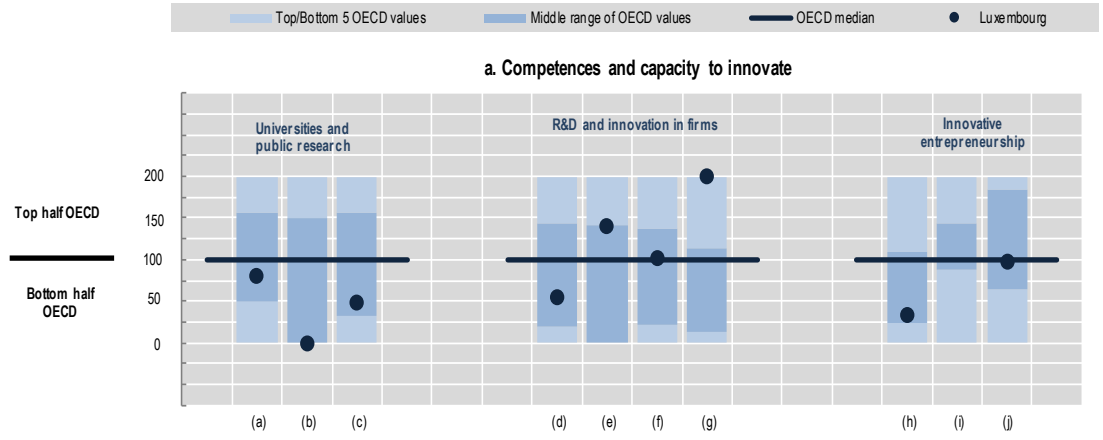
2013 or latest year available, percentages



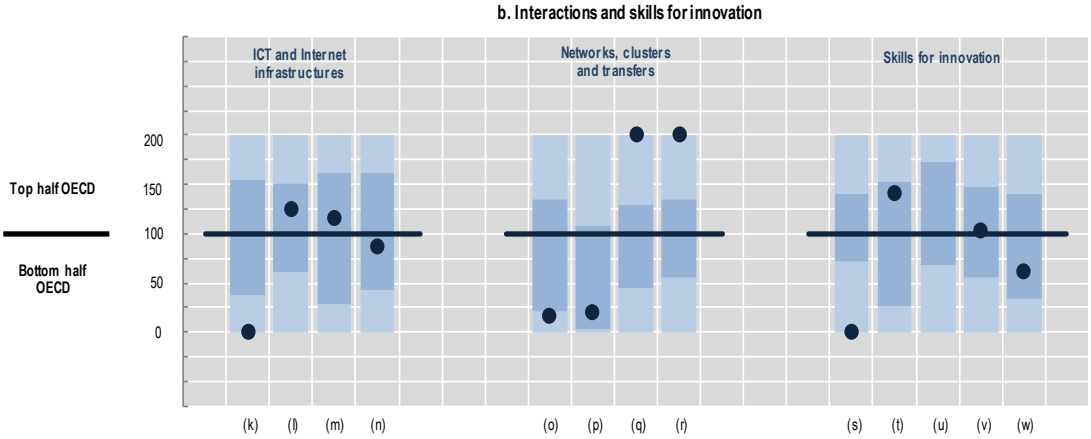
Benchmarking national STI systems

Figure 4. Science and Innovation in Luxembourg

Comparative performance of national science and innovation systems, 2016



(a) Public R&D expenditure (per GDP)
(b) Top 500 universities (per GDP)
(c) Publications in the top journals (per GDP)
(d) Business R&D expenditure (per GDP)
(e) Top 500 corporate R&D investors (per GDP)
(f) Triadic patent families (per GDP)
(g) Trademarks (per GDP)
(h) Venture capital (per GDP)
(i) Young patenting firms (per GDP)
(j) Ease of entrepreneurship index



(k) ICT investment (per GDP)
(l) Fixed broadband subscriptions (per population)
(m) Wireless broadband subscriptions (per population)
(n) E-government development index
(o) Industry-financed public R&D expenditure (per GDP)
(p) Patents filed by universities and public labs (per GDP)
(q) International co-authorship (%)
(r) International co-invention (%)
(s) Tertiary education expenditure (per GDP)
(t) Adult population at tertiary education level (%)
(u) Top adult performers in technology problem-solving (%)
(v) Top 15 year-old performers in science (%)
(w) Doctoral graduate rate in science and engineering (%)

Note: Normalised index of performance relative to the median values in the OECD area (Index median=100).

Highlights of the Luxembourg STI system

Universities and public research

As mentioned above, public research funding is tied to performance contracts between the government and research performers (the CRPs and the university) and the funding agency FNR as well as the innovation promotion agency Luxinnovation. For research performers, numbers of publications, doctorates, patents and spin-offs are among the main indicators used, along with targets for securing external funding. Regular external evaluations have also been introduced. New measures to support exploitation of research include the joint evaluation of thematic research project proposals by FNR and Luxinnovation. The CORE-PPP programme provides financial support for industry partnerships between public research institutions in Luxembourg and companies with a presence in Luxembourg. The FNR's Proof of Concept programme is the facilitation programme successful commercialisation of research results with the goal of encouraging the translation of research into commercially viable innovations,.

Innovation in firms

Relative to its size, Luxembourg hosts the headquarters of the largest number of top corporate R&D investors among OECD countries (4[e]). It files more trademarks (4[g]) than triadic patents (4[f]). Business is the largest performer of R&D (6), although BERD has fallen since the financial crisis and has yet to recover. The reasons for the decline are currently under investigation. A law on state aid for R&D, implemented in 2009, extended the scope of policy intervention. Measures include special subsidies for SMEs and innovative start-ups and schemes to promote knowledge flows between academia and industry. The new programme Fit4digital (launched in 2016) aims to support SMEs in the optimal usage of ICTs in very small companies.

ICT and Internet infrastructure

The national ICT infrastructure is well developed (4[l, m]), an important location factor for many leading international ICT companies. ICT expertise underpins the sustainable development of the financial, media, environment, logistics, automotive and space industries, all of which are important in Luxembourg. The financial sector, for example, depends strongly on the fact that Luxembourg has become one of Europe's top locations for ICT infrastructures (e.g. in terms of data centres and low latency network connectivity) and offers specialised expertise to keep firms' data safe. Luxembourg is also investing heavily in ICT research in order to build scientific excellence. For example, the Interdisciplinary Centre for Security, Reliability and Trust at the University of Luxembourg aims to put the country on the world map in terms of high-quality research in secure, reliable and trustworthy ICT systems and services.

Technology transfer and commercialisation

Luxinnovation is the main agency supporting innovative entrepreneurship, chiefly through advisory services, network building and information campaigns. Luxembourg has recently consolidated its various incubator structures in a single entity, Technoport S.A., whose mission is to facilitate the setup of start-ups and spin-offs. It offers a new physical incubator at the *Cité des Sciences, de la Recherche et de l'Innovation*, and aims to become an important relay between the university, the CRPs and the wider economy. It can also provide temporary premises for foreign companies planning to begin operations in Luxembourg. The installation of a fabrication laboratory has increased the diversity of the facilities. In addition, work has started on creating two new incubators in areas deemed national priorities, health technology and eco-technology. To support start-ups, Luxembourg will launch an ICT seed fund in 2016 dedicated to the areas of the ICTs with a budget of EUR 19.2 million. The programme Fit4Start will be launched with the aim to coach and fund start-ups in the field of ICTs.

The Government support the circulation and transfer of knowledge by promoting open access publishing from the University and Research Organisations. Luxembourg participates in a European Research and

Innovation Area committee Task Force on open access for both publications and data. In 2015, the FNR launched the initiative *Knowledge and Innovation Transfer Support* which enables research institutions to obtain funding to employ technology transfer specialists.

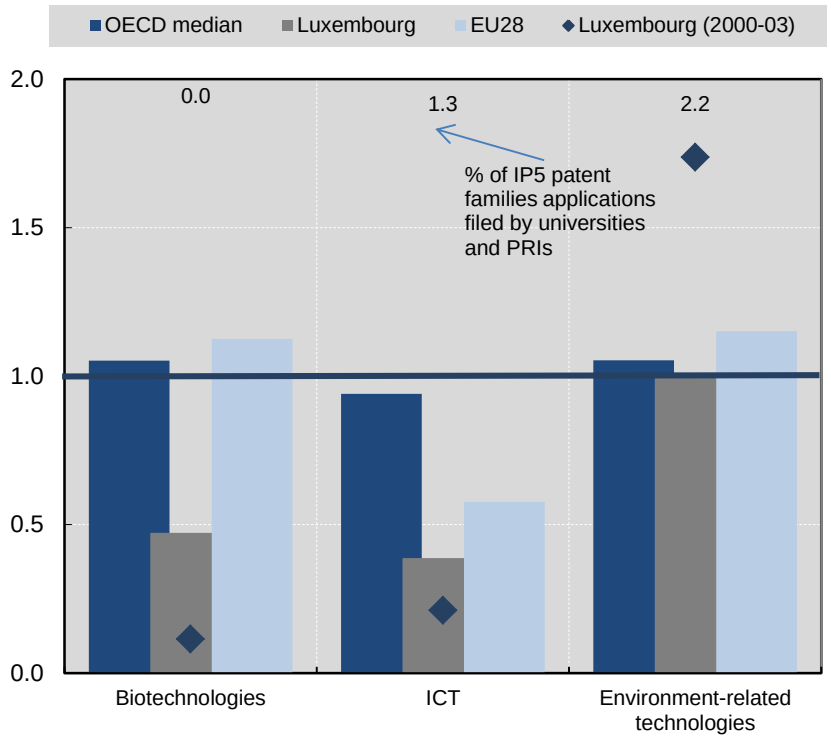
Clusters and regional policies

The Luxembourg Cluster Initiative has six theme-based clusters: materials, ICTs, space, health care and biotechnology, eco-innovation, and automotive components. In 2013, the clusters, in collaboration with the Ministry of the Economy, set up a new working framework based on five priority areas: business development, supporting flagship projects, improving brand image for the sector, intensifying promotion and prospecting, and developing the internationalisation of the initiative. Specific quantitative objectives have been set for each cluster. Luxembourg is finalising its Smart Specialisation Strategy which will be ready in 2016. The priority areas for the strategy are: industry, eco-technologies, logistics, health-technologies, ICTs.

Structural aspects and specialisation

Figure 5. Revealed technology advantage in selected fields, 2011-2013

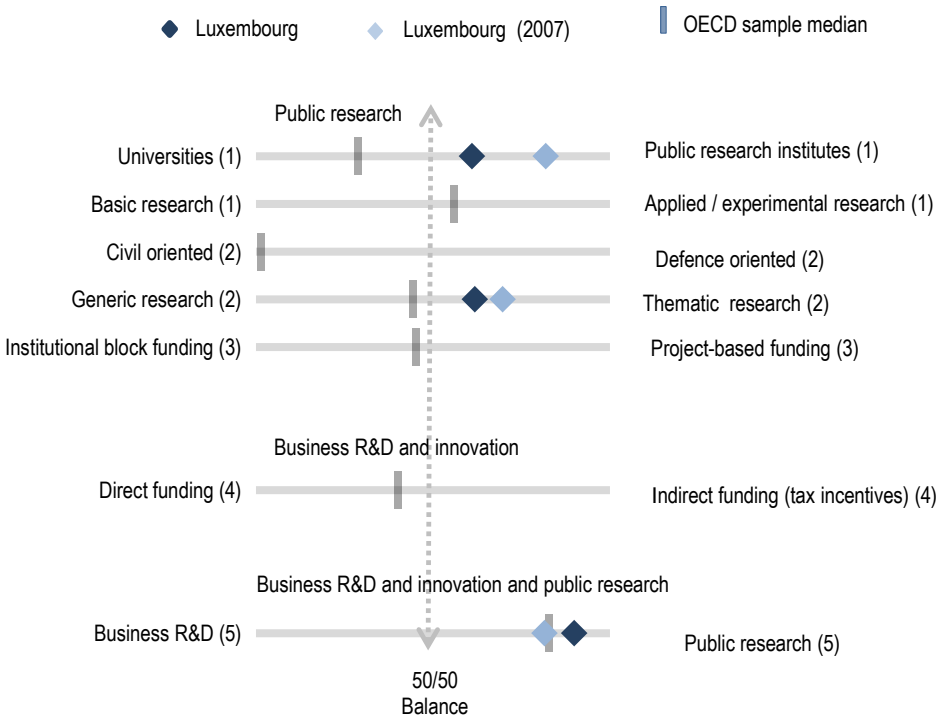
Index based on IP5 patent families applications



National STI policy mix

Figure 6. Allocation of public funds to R&D, 2014 or latest year available

By sector, type of R&D and mode of funding



(1). Balance as a share of both higher education (HERD) and government (GOVERD) R&D expenditure.
(2) Balance as a share of total government budget appropriations and outlays for R&D (GBAORD).
(3) Balance as a share of total funding to national performers.
(4) Balance as a share of both indirect funding (through R&D tax incentives) and direct funding (through grants, procurement, loans, etc.).
(5) Balance as a share of publicly-funded HERD and GOVERD and components of (4).

Note: Policy information comes from country responses to the EC/OECD International Survey on STI Policies (STIP) 2016 and 2014. Luxembourg's responses are available in the EC/OECD International Database on STI Policies, edition 2016 at http://qdd.oecd.org/DATA/STIPSurvey/LUX...STIO_2016.

Source: See the reader's guide and methodological annex.

StatLink http://dx.doi.org/10.1787/888933433942

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