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on the economic, social, employment, structural and budgetary policies of Luxembourg

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European Commission

Luxembourg

2024 Country Report

#EURO at25

ECONOMIC AND EMPLOYMENT SNAPSHOT

Luxembourg's historically strong economy contracted in 2023

Luxembourg's growth pattern reflects its sensitivity to changes in the international environment, unveiling challenges to its competitiveness([1]). The financial sector, serving as Luxembourg's traditional economic engine, has driven the country to the highest income per head in the EU, also contributing to a robust labour market and sound government finances. Yet, the country's historically strong economy has grown at half speed since the global financial crisis and contracted in 2023. Luxembourg's deep integration into international capital markets exposes the country to risks associated with global financial fluctuations and the regulatory environments of other countries.

The geopolitical situation and the tightening in monetary policy have negatively affected Luxembourg's open economy. Economic activity declined by 1.1% in 2023, mainly driven by the financial sector. Heightened uncertainty and the tightening of monetary policy impacted investment flows. In October 2023, assets under management by the fund management industry hit their lowest level since the peak reached in 2021 (see also Annex 18). Since the global financial crisis, economic growth has slowed to 2.5% on average annually, compared with 4.8% in the previous period, and on six occasions it has underperformed the euro area aggregate. Each time, activity in the financial sector decreased, most often linked to a decline in stock market valuations. Real GDP growth is expected to remain low in 2024, at 1.4%, before recovering to 2.3% in 2025. The below-average growth in 2024 is mainly due to weaker net exports and investment amid adverse financing conditions and geopolitical uncertainty. Furthermore, a drop in export of services linked to investment funds and the lower volume of transactions in the financial sector would imply a negative contribution from net exports (European Commission, 2024).

Wages have increased, but policy measures are keeping inflation below the euro area average. The softening of energy and food prices has driven a gradual easing of inflation, which had reached a peak in 2022. Yet, in 2023, a more pronounced slowdown was prevented by stronger wage growth – with real average labour costs increasing by 3.8% (after the wage indexation mechanism was exceptionally activated three times in 2023). Inflation forecasts for Luxembourg stand at 2.3% for 2024, when a single wage indexation is expected, further declining to 2.0% in 2025, mainly as energy and goods prices are expected to slow significantly. The impact of inflation on the domestic economy has been counteracted by government support measures (under the *Solidaritéitspak)* reducing the number of wage indexations. However, as per the Council recommendations addressed to Luxembourg in 2023, it remains important for the government to wind down these measures as soon as possible in 2024, or to ensure that any new emergency measures are temporary and targeted at vulnerable households and firms, and preserve incentives for energy savings.

Luxembourg's public debt, while comparatively low, has tripled since the

(1) The cut-off date for the data used to prepare the 27 Country Reports was 15 May 2024.

global financial crisis and presents long-term challenges to public finances. The government deficit edged up to 1.3% of GDP in 2023 and is forecast to increase to 1.7% of GDP in 2024. This uptick is primarily due to ongoing support measures under the *Solidaritéitspak* to soften the impact of energy price hikes and bolster the construction sector. Government debt is expected to rise to 27.1% of GDP in 2024, up from 25.7% in 2023. The overarching challenge to Luxembourg's public finances is to ensure long-term sustainability, particularly due to escalating pension costs (projected to increase by 8.3 percentage points to reach 17.5% of GDP by 2070), and mounting demands for long-term care, which are expected to exert substantial upward pressure on government spending in the decades to come (see also European Commission, 2024).

weigh on competitiveness. In 2023, despite the decline in economic activity, employment rose by 2.2%, with a notable 3.3% increase in the financial sector. However, in the current juncture, the pace of job creation has slowed, and the shrinking vacancy rate points to a tightening labour market. According to Chamber of Commerce surveys (CC, 2023), more than half of employers cite scarcity of qualified workers as a primary barrier to economic growth and investment. Despite good overall results in adult education and training, participation of older workers and low-skilled people in learning programmes is low. The issue is compounded by a sizeable proportion of the workforce nearing retirement and a dependence on both cross-border (47% in 2023) and foreign-resident (27% in 2023) workers. Historically, the influx of younger cross-border and foreign-resident workers, attracted by the country's comparatively high wages and living

Box 1: **Luxembourg's competitiveness in brief**

Luxembourg's financial sector has driven the country to one of the highest levels of productivity in the EU. Its international financial centre accounts for over 30% of its GDP, 11% of employment and 20% of direct tax revenues annually, with even much larger indirect effects. The economy has greatly benefited from the sector's integration into global financial markets, with (mostly imported) intermediate inputs accounting for nearly 90% of its production, leading to an output per hour six times higher than that of the rest of the business economy.

However, competitiveness challenges remain:

- **the financial sector's value added per worker declined** by 15% between 2021 and 2023, with a cumulative decline of 30% since 2007, which reflects a diminished capacity to harness the benefits of the sector's integration into global financial markets (see also Annex 5);
- **Luxembourg's share of business investment in GDP is one of the lowest in the EU**, which weighs on Luxembourg's productivity and on its cost and non-cost competitiveness (see also Annex 12); and
- **shortages of workers**, one of the main barriers to investment, which could be further exacerbated by high house prices and road congestion, affecting Luxembourg's appeal as a workplace. Meanwhile, the recent multiple wage indexations due to high inflation have negatively affected firms' competitiveness, especially in the less productive non-financial business sectors and, if persistent, could deter greenfield investment and affect firms' relocation decisions.

Luxembourg faces shortages of skilled workers and skills mismatches, which

standards, has helped Luxembourg counteract workforce ageing. Nevertheless, this trend is waning, calling for strategies to cope with changes caused by an ageing population (LISER, 2023), including increasing the very low employment rate of older workers. Projections indicate a need for approximately 300 000 new workers, or a 64% increase, by 2030 (UEL, 2023). In response, new rules adopted in September 2023 aim to streamline the recruitment of non-EU nationals. The new government intends to continue developing a national skills strategy. There are still substantial difficulties related to the lack of affordable housing (see Annex 18), traffic congestion, and education (see Annex 15), hindering Luxembourg's ability to attract the necessary workers with the right skills, which is especially crucial for succeeding in the green and digital transitions (see also Annex 14).

Vulnerabilities relating to high house prices and high household debt have recently increased but overall seem to be contained and are expected to ease over the medium term. An in-depth review on housing under the macroeconomic imbalance procedure was carried out for Luxembourg in 2023 (European Commission, 2023). It concluded that there are no macroeconomic imbalances. As monetary policy tightened throughout 2023, financial risks increased in Luxembourg's real estate market and for more heavily indebted households, with lower incomes and variable-rate mortgages, who continue to face difficulties in meeting mortgage obligations because of the higher interest rates. A study using 2021 data found that around 30% of Luxembourg households could be considered financially vulnerable. However, indebted households in this group only account for 11% of the number of mortgage contracts and 9% of aggregate household debt ([2]). So far, there has been a decrease in the ratio between non-performing loans and total loans, which stood at 0.7% in 2023, compared with 1.2% a year earlier. It remains below the EU average. Meanwhile, house prices have declined markedly – by 9.1% in 2023 (OH, 2024). This has resulted in decreases in real terms, while government measures have helped to ease the financial burden of housing on vulnerable households.

Economic evidence suggests that Luxembourg's tax rules are used by companies to engage in aggressive tax planning. In 2022, Luxembourg continued to have the EU's highest stock of incoming and outgoing foreign direct investment (FDI) expressed as a percentage of GDP. Most of the FDI stock in Luxembourg (60% of inward flows and 60% of outward flows of FDI in 2022) is held through special purpose entities (SPEs). The large proportion of FDI stocks held by SPEs may be an indication of aggressive tax planning. Luxembourg is a major conduit of capital flows, the recipient of 16.8% of all dividends received by the EU-27, and the origin of 16.9% of all dividends paid by the EU-27 (2022). It is also the recipient of 34.2% of all interests received by the EU-27 and the origin of 27.2% of all interests paid by the EU-27 (2022). These flows are amongst the highest in the EU, and disproportionately high compared to the size of the country's economy. Of particular concern is the lack of withholding taxes on interest and on royalty payments to low- or zero-tax jurisdictions, that are not included in the EU list of non cooperative jurisdictions for tax purposes, or measures with equivalent effect.

([2]) Giordana and Ziegelmeyer, June 2023, *Household indebtedness and their vulnerability to rising interest rates*, BCL Working Papers, BCL.lu.

Box 2: **UN Sustainable Development Goals (SDGs)**

Luxembourg performs relatively well on several SDG indicators, although challenges remain in the area of environmental sustainability, where it is nonetheless improving (SDGs 2, 7, 12, 13). In this area, the country performs well on sustainable cities and communities (SDG 11). Luxembourg performs well on some SDG indicators related to fairness, such as good health and well-being (SDG 3), gender equality (SDG 5) and reduced inequalities (SDG 10). As regards SDGs on productivity, the country is moving away from the targets for quality education (SDG 4), decent work and economic growth (SDG 8) and industry, innovation and infrastructure (SDG 9). Finally, Luxembourg performs very well on SDG indicator 16 on macroeconomic stability.

Out of the 17 indicators, Luxembourg is performing below the EU average on five indicators. Besides those related to environmental sustainability highlighted above, Luxembourg is moving away from the targets for decent work and economic growth (SDG 8).

Overall, the social situation is good in Luxembourg, but inequalities persist between different segments of the population, as reflected by the risk of poverty and social exclusion. The Social Scoreboard underpinning the European Pillar of Social Rights highlights that the share of people at risk of poverty and social exclusion decreased in 2022 (19.4%), remaining below the EU average (21.6%). However, people not born in the EU are more likely to experience poverty (38.3%) and in-work poverty in Luxembourg (33.4%). The educational attainment and the composition and work-intensity ([3]) of the household are factors influencing the risk of poverty and in-work poverty (see Annex 14). Additionally, the impact of social transfers on poverty reduction decreased from 34.2% in 2021 to 33.7% in 2022 (below the EU average of 35%). In-work poverty remains especially high in Luxembourg (12.9%, against an EU average of 8.5%), highlighting the challenges still faced by specific groups in the labour market.

(3) Work intensity is defined by the ratio between the number of months that household members of working age (persons aged 18–64 years, with the exclusion of dependent children aged 18–24) worked during the income reference year and the total number of months that could theoretically have been worked by the same household members. For persons who declared that they worked part-time, the number of months worked in full-time equivalent roles is estimated on the basis of the number of hours usually worked at the time of the interview (Eurostat, 2022).

IMPLEMENTATION OF KEY REFORMS AND INVESTMENTS USING EU INSTRUMENTS

Funding from the Recovery and Resilience Facility (RRF) and cohesion policy funding is mutually reinforcing Luxembourg's efforts to boost its competitiveness and foster sustainable growth. In addition to the EUR 83 million of RRF funding described in Annex 3, cohesion policy provides Luxembourg with EUR 38.9 million for the 2021-2027 period. Combined support from these two instruments represented around 0.15% of the country's 2023 GDP, compared to an EU average of 5.38% (see Annex 4).

Under its recovery and resilience plan (RRP), Luxembourg has launched major policy measures that are expected to improve the country's competitiveness. In particular, the RRP envisages reforms in the areas of healthcare, innovation, sustainable transport, reskilling and upskilling, and housing. Luxembourg has also invested in lowering the administrative burden on people and businesses through a range of digitalisation measures. These include developing a mobile interface for administrative tasks, modernising employment agency operations to facilitate smoother job transitions and ensure workers' skills are aligned with labour market demand, and creating an online registry of health professionals to optimise staff deployment during emergencies and plan for future healthcare roles.

The implementation of Luxembourg's recovery and resilience plan is well underway. Luxembourg submitted one payment request, corresponding to 26 milestones and targets in the plan resulting in an overall disbursement of EUR 20.2 million on 16 June 2023. Beyond the payment request, the implementation of the plan is broadly on track (see Annex 3).

Cohesion policy funding helps tackle Luxembourg's growth and competitiveness challenges and to foster social and territorial cohesion. In the 2014-2020 cohesion policy programming period, support focused on energy efficiency, research, and social inclusion. In the current 2021-2027 programming period, cohesion policy will provide a further boost to Luxembourg's competitiveness, to the green and digital transition, and to social cohesion, improving people's living and working conditions. More than 10% of the cohesion policy allocation is dedicated to energy efficiency investments, targeting deep renovation of buildings. In 2021-2027, the European Regional Development Fund will finance equipment for research and innovation and further boost the creation of research jobs.

Boosting energy efficiency and renewable energy

Making effective use of various funding sources, Luxembourg has taken steps to improve the energy efficiency of its public transportation system and its residential and public buildings. Investments are planned to increase the country's renewable energy production capacity to 200 MWh/year. Luxembourg's Just Transition Fund allocation – totalling EUR 9.2 million – will be invested in the south of the country and will help reduce greenhouse gas emissions by improving the energy performance of housing, by increasing the number of environmentally friendly public transport vehicles, and by improving the energy efficiency of public buildings.

Moreover, EUR 1.7 million will promote lifelong learning to upskill and reskill employees in line with skills needs, and EUR 2.9 million will help disadvantaged groups, in particular via integrated pathways to work, including training and workshops for social and professional reintegration. The RRP skills reform, which analyses the situation and involves stakeholders, helps better target upskilling and reskilling investments. The unemployed people benefitted from 'FutureSkills' investment under the RRP, and then by 'Skills4Job' supported by the European Social Fund Plus.

Box 3: **Combined action for more impactful EU funds**

The RRP reform 'Naturpakt' creates a framework under which municipalities can receive financial support for measures to protect nature and prevent biodiversity loss. More than 80 municipalities have signed the 'Naturpakt' contract. Through the European Agricultural Fund for Rural Development, the strategic plan of the common agricultural policy supports various measures enabling farmers to improve biodiversity. A premium for sustainable and environmentally friendly agriculture and viticulture is granted to farmers who commit to fulfilling 24 conditions, including training, landscape upkeeping, and prohibitions of some phytosanitary products. Together, these projects help prevent biodiversity loss in Luxembourg.

In terms of mutually reinforcing measures, the RRP includes a reform that promotes electrification of public transport. As part of this reform, a new law specifies the minimum percentage of clean vehicles procured through public contracts. This applies to public buses and other vehicles. Luxembourg as a contracting authority plans to fully electrify the fleet of buses operated by the public transport operator (RGTR) by 2030. This reform is complemented by two European Regional Development Fund projects that help implement it: purchasing electric buses used for urban public transport and installing the charging infrastructure. One of these projects, which receives REACT-EU funding, concerns the regional RGTR network, and another one co-finances 13 buses and two charging stations for buses in the capital city.

Making the job market more accessible

To boost economic growth and maximise the productivity and competitiveness of Luxembourg's workers, the European Social Fund Plus will support access to employment for jobseekers. This initiative, with a budget of around EUR 4.7 million, will mostly focus on skills development.

Climate protection and biodiversity

The RRF and cohesion policy funds support measures that aim to protect the environment and make Luxembourg's society and economy more sustainable. Cohesion policy funds help bring about a greener and fairer Europe and achieve the UN Sustainable Development Goals (SDGs) in Luxembourg, in particular SDG 8 (Decent work and economic growth), SDG 1 (No poverty) and SDG 7 (Affordable and clean energy). Luxembourg's RRP puts a strong focus on the green transition. Specific measures include an investment of EUR 30.5 million to enlarge the network of charging points for electric vehicles across the country. The RRP also allocates EUR 6 million to the 'Naturpakt', under which municipalities can receive financial support for measures to protect nature and prevent biodiversity loss.

FURTHER PRIORITIES AHEAD

Luxembourg faces additional challenges related to the long-term sustainability of public finances, aggressive tax planning, house prices and household debt, inequality in education, and green transition. Tackling these challenges will help increase Luxembourg's long-term competitiveness and ensure the resilience of its economy. It will also help make further progress in achieving the UN Sustainable Development Goals.

It is important that the identified challenges are addressed at both national and local level to reduce local disparities and improve the administrative and investment capacity in a balanced way across the country.

Strengthening the long-term sustainability of public finances

Luxembourg's pension system, currently in a favourable position for the short to medium term, is facing significant long-term challenges due to demographic changes. The system operates on a pay-as-you-go basis, historically buoyed by surpluses from contributions made by young people settling in the country and cross-border workers. These surpluses have been saved in a reserve in an independent investment fund. Despite this prudent management, the system is projected to encounter financial strain (see also the 2024 ageing report), as pension spending is projected to exceed the income from contributions in the second half of the 2020s, with this deficit steadily widening subsequently. This imbalance can be largely attributed to an increasing number of pensioners per worker, a consequence of an ageing population, which leads to a higher old-age dependency ratio.

Without policy adjustments, the reserve designated to protect the pension system's financial health is projected to fall below the legal threshold by the early 2040s. This threshold is the minimum reserve amount required to avoid mandatory reforms to ensure the system remains operational. Projections suggest that once this limit is breached, the reserve will be depleted within 5 or 6 years. This timeframe leaves very little opportunity for a gradual, phased-in reform. This implies that more abrupt and potentially disruptive changes may be necessary to ensure the system's sustainability, with the looming increase in pension spending, which is expected to double, as a share of GDP, by 2070. This spike in expenditure puts at risk not just the financial sustainability of Luxembourg's pension system, but also its ability to maintain intergenerational fairness.

Addressing this challenge requires decisive action through a combination of several measures, including raising the effective retirement age. These measures would have to significantly counteract the financial pressures on the pension system by decreasing spending and stimulating economic growth. Encouraging longer working lives and increasing participation rates among older workers would help increase both the supply of workers and consumption levels, due to increased lifetime income. Increasing the employment rate among older workers would also require targeted activation measures. Starting reforms early would enable a smoother transition, gradually implementing changes to improve the pension system's financial resilience and intergenerational fairness.

The government is expected to propose potential avenues for the necessary reform in the current parliamentary term. The new government has acknowledged the relevance of the issue in its coalition agreement, which contains the priorities to be addressed in the current parliamentary term. It has launched a round of consultations with the main stakeholders, aiming to reach a consensus about a reform, which would help its future implementation. However, specific proposals are yet to be agreed with the main stakeholders before being submitted to Parliament.

To address fiscal challenges, independent fiscal institutions could be strengthened. In Luxembourg, the National Council of Public Finances (CNFP) analyses the reliability and compliance with the EU fiscal framework of the government's budgetary projections and the underlying macroeconomic scenarios published by the National Institute of Statistics (STATEC). The scope of its monitoring could be strengthened, in particular by improving its access to more detailed information beyond the aggregates published by STATEC and the budgetary legislative texts.

Tackling aggressive tax planning

Based on the available economic data, aggressive tax planning continues to be a challenge in Luxembourg. Tackling it is essential, since it distorts fair competition and constitutes an obstacle to a fair tax environment in the EU, with an impact on taxpayers and government finances. More than other Member States' tax system, Luxembourg's tax system continues to present certain aspects that can facilitate aggressive tax planning practices, such as the absence of withholding taxes or allowing transfer pricing mismatches (see Annex 19). Furthermore, Luxembourg has adopted limited measures to address this issue, particularly in comparison with other Member States facing similar challenges.

The lack of withholding taxes on outbound interest payments and on royalties from Luxembourg-based companies to non-EU jurisdictions, could still lead to little or no taxation. This will in particular be the case if these payments do not fall within the scope of Pillar 2 and are not taxed or taxed at a low level in the recipient jurisdiction. In 2021, Luxembourg adopted a non-deductibility measure ([4]) for interest and royalties paid to jurisdictions on the EU list of non-cooperative jurisdictions in tax matters. However, the scope of this measure is too narrow to address aggressive tax planning risks linked to outbound payments by Luxembourg. Currently, there is no measure in Luxembourg's tax system that sufficiently addresses the issue of non-deductibility of outbound payments of interest and royalties.

Recent and upcoming EU legislation on **minimum corporate taxation rates and harmonisation of transfer pricing rules should have a positive impact in Luxembourg.** Directive (EU) 2022/2523 (the 'Pillar 2 Directive'), in force since 1 January 2024, has introduced a minimum rate of effective taxation of 15% for multinationals active in EU Member States. By limiting the race to the bottom in corporate tax rates and lowering the incentive for businesses to shift profits to low-tax jurisdictions, it will help to address the outbound payment issue. However, the scope of these rules, which have been implemented in Luxembourg already, is limited to the largest multinationals (threshold of EUR 750 million of annual revenue) and there are certain sectoral exemptions. In this regard, in September 2023, the

([4]) For instance, Luxembourg tax system provides an exemption allowing securitisation entities to continue deducting from their tax base interests payable from intragroup borrowing, which violates anti-tax avoidance Directives.

Commission presented a proposal for a directive on transfer pricing, to harmonise transfer pricing rules in the EU and ensure a common approach to transfer pricing problems, which, if adopted, could contribute to eventually addressing the issue.

Addressing the persistent housing shortage and high residential real estate prices

Strong population growth combined with restricted supply have pushed up demand for housing over the years preceding the energy crisis. In 2023, historically high consumer prices and interest rates continued to exacerbate vulnerabilities relating to high house prices and high household debt, as was flagged in the 2023 in-depth review. Increased mortgage loans, supported by fiscal incentives, have further pushed up demand for housing over the years preceding the energy crisis, while supply has been restricted by the limited land available for construction and by land hoarding. The widening gap between housing demand and supply had resulted in strong house price increases with growing risks of house price overvaluation, and deteriorating affordability. The increasing lack of affordable housing further aggravates the risk of poverty for the most vulnerable groups. House prices started to decline in late 2022 and decreased by 9.1% in 2023), mainly driven by a fall in existing house prices, while the prices of newly built houses and land for construction have declined significantly less, and only since Q3-2023. The number of housing transactions and building permits has also declined sharply, impacting the real estate and construction sector.

A further sharp correction in house prices is not expected as incomes are holding up well and the supply shortage continues, with large developers reportedly holding back sales. However, the resulting activity slowdown had an impact on the construction sector, triggering a set of support measures to protect firms' liquidity. Household debt remains high in terms of disposable income, although it decreased in 2023, while mortgage borrowing continued its downward trend. Households' financial assets are also substantial, indebtedness increases towards the higher levels of income and wealth, and the banking sector is sound, which overall counteracts macro-financial risks. Luxembourg could take additional policy action to boost housing supply – including through the supply of affordable and social housing targeted to those most in need – for example by speeding up and prioritising the adoption and implementation of recent measures, including recurrent taxes to increase the supply of buildable land and non-occupied properties, combined with the ongoing reform of land-use planning In addition, reducing the mortgage interest deductibility, which was significantly raised again in the beginning of 2024, would reduce the fiscal incentives to borrow, which supports high house prices.

Addressing inequality in the education system

Pupils' basic skills and overall performance largely depend on their socio-economic and linguistic background. While Luxembourg did not participate in the latest round of PISA (Programme for International Student Assessment of the Organisation for Economic Co-operation and Development), the results of 2018 showed that the average skills levels at the age of 15 were significantly lower than the EU average (see Annex 15). The gap between disadvantaged students and their peers is bigger in Luxembourg than in any other EU country. Pupils learn to read and write in German and all subjects (except for French) are taught in German. This constitutes a very high demand for language skills in a country where only around 5% of first graders speak German and one in three speak Luxembourgish at home. To adapt its schooling to its diverse student population, in September 2022, Luxembourg launched a pilot project in four primary schools, where pupils can start learning first in French and then in German, and increased the number of European public schools with free access for pupils.

The green transition and fossil energy dependence

Luxembourg is expected to submit the REPowerEU chapter of its recovery and resilience plan, which should improve security of supply and foster affordable energy. As for other Member States, this specifically entails: (i) continuous action to reduce dependence on fossil fuels; (ii) taking measures to diversify away from Russian fuels; and (iii) continue action to reduce demand through more structural measures, such as energy efficiency and deploying renewables.

Energy dependence is a structural characteristic of Luxembourg's landlocked territory. Luxembourg imports 91% of its energy consumption. The country is highly reliant on fossil fuels, which accounted for 77% of the energy mix in 2022. The share of renewable energy in gross final energy consumption is growing but remains among the lowest in the EU. Luxembourg is continuing to make progress in deploying renewable energy production. The total installed capacity has increased by 13.5% in comparison to 2021, as described in Annex 7. Planned measures include legislation speeding up of permitting procedures for decarbonisation projects and purchase of renewable energy through statistical transfers.

Luxembourg maintains a reliable supply of electricity and natural gas, bolstered by its strategic partnerships and interconnections with neighbouring countries. The nation's current infrastructure meets its energy demands. However, anticipating future increases in electricity consumption, Luxembourg has laid out plans to strengthen its electricity grid and improve interconnections with Germany by 2040. Despite being engaged in regional cooperation, Luxembourg has not yet participated in any projects of common interest under the Trans-European Energy Network Regulation, offering potential for further integration into continental energy networks.

Luxembourg made significant progress in reaching the 2030 EU targets for energy efficiency. The best results are in the services sector, while the residential sector still needs to catch up. To fulfil its energy savings obligation, Luxembourg relies on the energy efficiency obligation scheme, but more action will be needed to achieve the 2021-2030 target.

Luxembourg took significant action to counteract the impact of energy price hikes and to support households. Any prolongation of the ongoing aid measures expiring in 2024 (under the *Solidaritéitspak)*, or any new action should be temporary and targeted, and should preserve the energy price signal. Aid measures should not hinder the green transition, promote greater energy consumption or increase inflation.

Luxembourg's transition to sustainable transport is progressing, and it must keep up the momentum. In 2022, 3.3% of passenger cars in Luxembourg were battery electric vehicles (above the EU average). In 2023, the country had 2 120 publicly accessible charging points, providing 1 charging point for every 13 e-vehicles, while the EU average is 1 charging point for every 10 e-vehicles. However, further investments are needed to increase the share of passenger and freight transport by rail, as road is used for 86% of passenger and freight transport (see Annex 6). The transport sector is Luxembourg's largest contributor to greenhouse gas emissions and remains key to decarbonisation. Luxembourg has higher vulnerabilities than the rest of the EU in respect of CO_2 emissions from road transport (see Annex 5).

While Luxembourg has a high recycling rate and eco-innovation, the performance of circular economy is affected by high waste generation, material footprint and import dependence (see Annex 9). Intensive agriculture, urban development and expanding transport infrastructure cause biodiversity loss. More action is needed on pollution control, targeting key sectors and further promoting the 'polluter pays' principle (see Annex 6).

On the green transition, in recent years, Luxembourg has experienced increased skills shortages in key sectors. These shortages are creating obstacles to the transition to a net-zero economy. Upskilling and reskilling programmes with a focus on the green transition increased in number. The Just Transition Fund includes investments in skills, especially in electric transport and in construction and sustainable renovation. However, skills mismatches persist, and shortages of workers keep growing. Therefore, additional support is needed to help Luxembourg reach its national target of at least 62.5% of all adults participating in education and training every year by 2030. Upskilling and reskilling workers for the green transition, including those who are most affected by the transition, and promoting inclusive labour markets are essential policies to speed up the transition to net-zero and ensure its fairness (see Annex 8).

Luxembourg's financial centre represents both a risk and an opportunity for Luxembourg, especially in relation to climate finance. The complexity of the global financial industry that is facilitated by Luxembourg's financial centre makes it challenging to adapt to the priorities of the green transition. Furthermore, large parts of the country's finance-based growth model depend on decisions taken by foreign financial institutions and investors, which might not be aligned with the priorities of the green transition or its inclusive approach. Without structural reorientation towards finance for sustainable development, the main driver of Luxembourg's economy remains vulnerable to climate risks: investments in stranded assets may become unsustainable in the long term and jeopardise future economic growth and competitiveness. Yet, the sheer size of the finance sector also represents an opportunity for Luxembourg to have a significant impact on climate action both nationally and abroad (OPC, 2023).

Productivity and business investment

Labour productivity in Luxembourg is extremely high, but growth is among the lowest in the EU. Eurostat figures show that labour productivity in Luxembourg is much higher than the EU average, although it is declining. Productivity growth has been weak over the past decade, in particular in financial services. Whereas labour productivity in ICT services has increased strongly over the past decade, Luxembourg's largest services sectors (finance and insurance) have seen their productivity decline. Both labour productivity and total factor productivity have grown slowly over the past decade, in particular compared to other EU countries.

Luxembourg is lagging behind in business investment, including in R&D, partly due to its sectoral composition. While the economy has shifted towards higher productivity sectors and the proportion of high-skilled workers is relatively high, the country is lagging behind in terms of business investment. In 2022, business investment represented 8.2% of GDP (see Annex 12). This share is among the lowest in the EU (EU average: 13.7%). Business expenditure on R&D has continued to decline and fell to 0.5% in 2022, against an EU average of 1.48%. While this is partly due to Luxembourg's strong focus on services, which is typically less research-intensive than the industrial sector, it nevertheless hampers Luxembourg's productivity gains.

Against the backdrop of geopolitical upheaval and turmoil in global financial markets, Luxembourg's financial centre appears resilient. Yet, data indicate that while nominal GDP remains robust (+2.3% in 2023), real GDP sends mixed signals (-1.1%). Furthermore, national income (GNI) seems not to have kept pace (-1.7%), suggesting a disconnect between the economic activity within the country and the income accruing to its residents. This discrepancy has widened over time, particularly since the global financial crisis, pointing to systemic changes in market structures or, alternatively, the potential effects of multinationals' activities on national statistics. The financial sector, despite contributing significantly to GDP, has seen a notable decline in productivity, which raises questions about the actual performance of Luxembourg's economy and the effectiveness of traditional economic metrics.

The decline in financial sector productivity also coincides with a widening gap between GDP and GNI. This gap is estimated at 30% of GDP. These developments might well indicate deeper structural shifts in global trade and financial networks or, alternatively, it could be an artefact of financial optimisation practices by multinationals (CNP, 2023). The uncertainty regarding these scenarios presents challenges in interpreting Luxembourg's economic health through standard productivity growth measures. Data suggest that while multinationals bolster GDP, their profit repatriation does not equally contribute to GNI, impacting domestic wealth distribution and exacerbating inequality, with a potential impact on productivity and long-term growth.

Preserving its status as a global financial hub while ensuring the domestic economy remains resilient and benefits its residents, constitutes a major challenge for Luxembourg. The continued decline in the financial sector's productivity points to diversification strategies to counteract potential risks associated with global trade and financial shifts. Taxation and investment policies could be recalibrated to incentivise the retention of profits and align GNI more closely with GDP. Additionally, developing more sophisticated economic indicators that can capture the true value generated in Luxembourg might be crucial to crafting policies that drive equitable economic growth and stability.

Box 4: **The mid-term review of cohesion policy funding for Luxembourg**

The mid-term review of cohesion policy funding is an opportunity to assess cohesion policy programmes and tackle emerging needs and challenges in EU Member States and their regions. Member States are reviewing each programme taking into account, among other things, the challenges identified in the European Semester, including in the 2024 country-specific recommendations. This review forms the basis for a proposal by the Member State for the definitive allocation of 15% of EU funding included in each programme.

Luxembourg has made some progress in implementing cohesion policy programmes and the European Pillar of Social Rights, but challenges remain as outlined in this report, including in Annexes 14 and 17. In particular, Luxembourg continues to have significant socio-economic disparities between cities, towns, suburbs and non-urban areas. Against this background, it remains important to continue to implement the planned priorities, with particular attention to: (i) the green and digital transitions; (ii) investments in skills to facilitate career transitions and professional mobility in line with labour market needs, with specific attention to older workers and people with low qualifications; (iii) activation and social integration of vulnerable people, in particular those with a migrant background; and (iv) the European Child Guarantee, in particular by taking measures promoting the integration of disadvantaged pupils through quality education and training.

Luxembourg could also benefit from the opportunities available under the Strategic Technologies for Europe Platform ([5]) initiative to support the transformation of industry, in particular by investing in strategic value chains like net-zero industry, decarbonisation of energy-intensive industries and digital innovation.

([5]) Regulation (EU) 2024/795)

KEY FINDINGS

Luxembourg's recovery and resilience plan (RRP) includes measures to tackle a series of structural challenges, in synergy with other EU funds, including cohesion policy funds:

- Measures to help **decarbonise transport** and support the electrification of the public transport fleet, and a financing scheme to expand the network of charging points for electric vehicles;

- **Digitalisation of the public administration**, including online solutions for people and businesses, as well as digitalisation of the health sector.

- A reform to develop **a national skills strategy**;

- Vocational training programmes to **address the skills mismatch** in the job market and to promote inclusive growth;

Continued efforts are key for a successful implementation of all the measures of Luxembourg's recovery and resilience plan, including the REPowerEU chapter once adopted, by August 2026.

Beyond the reforms and investments in the RRP and the cohesion policy programmes, Luxembourg would benefit from:

- **Improving the long-term sustainability of the pension system** to maintain sound government finances and fairness, in particular by increasing the rate of older people who are working or looking for a job;

- Strengthening action to **effectively tackle aggressive tax planning**, which would prevent distortion of competition between firms, treat EU taxpayers fairly and safeguard government finances;

- **Boosting productivity** by supporting business investment, in particular in research and innovation, and pursuing diversification strategies to counteract potential risks associated with global trade and financial shifts potentially affecting the financial sector's competitiveness;

- Reducing the impact of **pupils'** linguistic and socio-economic background on their **performance in education and basic skills**;

- **Addressing the persistent shortage of housing** – which is an obstacle to investment and growth in the medium term, and may become a competitive disadvantage for the economy – by increasing the housing supply, in particular by accelerating the adoption of a comprehensive land use policy and a property tax reform, and by prioritising the development of large-scale district projects on government-owned land, which will help reduce inequality and improve the attractiveness of the country for workers;

- Reducing reliance on fossil fuels and **accelerating the green transition**, in particular by promoting the skills needed for the green transition, investing in renewable energy, and promoting energy efficiency, especially in buildings (including the residential sector but also businesses and industry, for which the support schemes are rather limited) and transport; and tackling growing traffic congestion, a major challenge in Luxembourg with economic, social and environmental consequences.

ANNEXES

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This Annex assesses Luxembourg's progress on the Sustainable Development Goals (SDGs) along the four dimensions of competitive sustainability. The 17 SDGs and their related indicators provide a policy framework under the UN's 2030 Agenda for Sustainable Development. The aim is to end all forms of poverty, fight inequalities and tackle climate change and the environmental crisis, while ensuring that no one is left behind. The EU and its Member States are committed to this historic global framework agreement and to playing an active role in maximising progress on the SDGs. The graph below is based on the EU SDG indicator set developed to monitor progress on the SDGs in an EU context.

While Luxembourg is improving on the SDG indicators related to *environmental sustainability* (SDGs 2, 7, 12, 13) and is moving away from the targets for SDG 9 (Industry, innovation and infrastructure), it performs well only on SDG 11 (Sustainable cities and communities). Luxembourg has made progress in particular on organic farming as a percentage of utilised agricultural land. This edged up from 3.5% in 2016 to 5.2% in 2021 but remains below the EU average of 9.9% (SDG 2) (see also Annex 6). On SDG 7 (Affordable and clean energy), the share of renewable energy in gross final energy consumption more than doubled (from 6.2% in 2017 to 14.4% in 2022; EU average: 23.0%). In contrast, energy import dependency as a percentage of imports in gross available energy decreased (from 95.6% in 2017 to 91.3% in 2022) but remains above the EU average of 62.5%. Energy productivity, measured in euro per kilograms of oil equivalent (kgoe) (SDG 12), improved, increasing from EUR 11.6 per kgoe in 2017 to 14.7 in 2022 (well above the EU average of 9.3). Luxembourg also improved on net greenhouse gas emissions (SDG 13), decreasing from 19.5 tonnes per capita in 2017 to 14.4 tonnes in

Graph A1.1: **Progress towards the SDGs in Luxembourg**

For detailed datasets on the various SDGs, see the annual Eurostat report '[Sustainable development in the European Union]'; for details on extensive country-specific data on the short-term progress of Member States: [Key findings – Sustainable development indicators - Eurostat (europa.eu)]. A high status does not mean that a country is close to reaching a specific SDG, but signals that it is doing better than the EU on average. The progress score is an absolute measure based on the indicator trends over the past 5 years. The calculation does not take into account any target values as most EU policy targets are only valid for the aggregate EU level. Depending on data availability for each goal, not all 17 SDGs are shown for each country.
Source: Eurostat, latest update of 25 April 2024. Data refer mainly to the period 2017-2022 or 2018-2023. Data on SDGs may vary across the report and its annexes due to different cut-off dates.

2022. However, it is still above the EU average of 7.3 tonnes. The country further improved its performance on the recycling of municipal waste as a percentage of total waste generated (SDG 11) from 48.9% in 2017 to 54.6% in 2022, well above the EU average (48.6%) (see also Annex 9). Luxembourg's recovery and resilience plan (RRP) has the highest percentage of green measures (68.8%) of the 27 RRPs approved; these will help decarbonise transport in particular.

Luxembourg performs well on some SDG indicators related to *fairness* (SDGs 3, 5, 10), is improving on SDGs 7, and moving away from the targets for SDGs 1, 4 and 8. The percentage of people with good or very good self-perceived health aged 16 or over increased from 71.1% in 2017 to 74.4% in 2022 (EU average: 67.8%). On SDG 5 (Gender equality), Luxembourg improved in its gender employment gap (from 8.0% of those aged 20-64 in 2018 to 6.8% in 2023; EU average 10.2%). Also, positions held by women in senior management as a percentage of board members increased from 13.3% in 2018 to 23.5% in 2023 but remained below the EU average of 33.8%. The percentage of people at risk of poverty and social exclusion increased from 19.3% in 2017 to 19.4% in 2022 (EU average: 21.6%) and the percentage at risk of monetary poverty after social transfers went up from 16.4% in 2017 to 17.3% in 2022, now above the EU average of 16.5% (SDG 1 - No poverty). On SDG 4 (Quality education), tertiary educational attainment as a percentage of the population aged 25-64 jumped from 53.7% in 2018 to 60.2% in 2023, well above the EU average of 43.1%. However, the number of early leavers from education and training as a percentage of the population aged 18 to 24 increased from 6.3% in 2018 to 6.8% 2023 (EU average 9.5%). The RRP includes measures to strengthen the resilience of the health system, including by digitalising the sector.

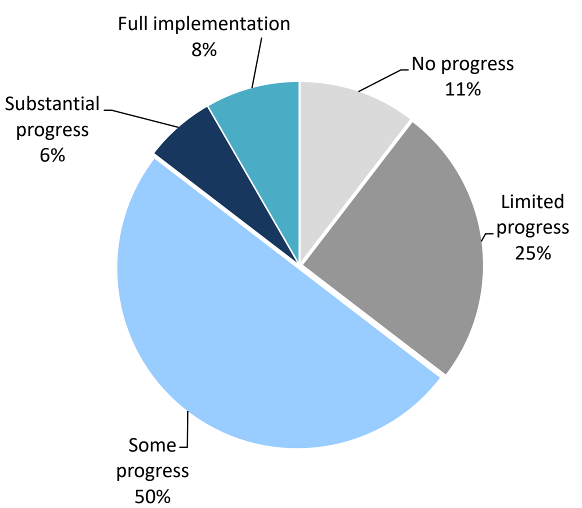
On *productivity*, Luxembourg performs well on SDG 9 but is moving away from the targets for SDGs 4 and 8. The share of households with a high-speed internet connection jumped from 57.2% in 2017 to 93.3% in 2022 (SDG 9), well above the EU average of 73.4%. On SDG 8 (Decent work and economic growth), real GDP per capita remains the highest in the EU, slightly decreasing from EUR 83 390 per capita in 2018 to EUR 83 320 in 2022 (EU average: EUR 28 940). The rate of young people not in employment, education or training increased from 7.5% in 2018 to 8.5% in 2023, although this remains below the EU average of 11.2%. Adults with at least basic digital skills decreased from 63.8% of individuals aged 16 to 74 to 60.1% (EU average: 55.6%) (SDG 4). The RRP envisages several reforms and investments to promote a data-based economy and the digitalisation of public administration. It also includes measures on improving skills, and on upskilling and reskilling to help people join the labour market. As part of the RRP, training under Future Skills targeted jobseekers, with special attention for those aged 45 and above.

Luxembourg performs very well on SDG 16 related to *macroeconomic stability*, but is moving away from the targets for SDGs 8 and 17. General government gross debt (SDG 17) increased from 20.9% of GDP in 2018 to 25.7% in 2023 but remains very low compared to the EU average of 81.7%. On the other hand, on SDG 8, the investment share of GDP decreased from 17.8% in 2017 to 17.5% in 2022, well below the EU average at 22.7%. Also, the employment rate of the population aged 20-64 went from 72.1% in 2018 to 74.8% in 2023, although it remained below the EU average: 75.3%). Finally, on SDG 16, the perceived independence of the justice system (very good and fairly good) increased from 71% of the population in 2018 to 76% in 2023, much higher than the EU average of 53%. Luxembourg's RRP includes measures to promote a transparent and fair economy. This includes making the anti-money laundering supervision of professionals that provide trust and company services more effective. Another measure, to increase the quality and transparency of the business register, will help the authorities better identify the ultimate beneficiaries of legal entities. This should contribute to deterring criminals from using these entities to launder illicit money.

As the SDGs form an overarching framework, any links to relevant SDGs are either explained or depicted with icons in the other annexes.

The Commission has assessed the 2019-2023 country-specific recommendations (CSRs) ([6]) addressed to Luxembourg as part of the European Semester. These recommendations concern a wide range of policy areas that are related to 14 of the 17 Sustainable Development Goals (SDGs) (see Annexes 1 and 3). The assessment considers the policy action taken by Luxembourg to date ([7]) and the commitments in its recovery and resilience plan (RRP) ([8]). At this stage of RRP implementation, 64% of the CSRs focusing on structural issues from 2019-2023 have recorded at least 'some progress', while 36% recorded 'limited progress' or 'no progress' (see Graph A2.1). As the RRP is implemented further, considerable progress in addressing structural CSRs is expected in the coming years.

Graph A2.1: **Luxembourg's progress on the 2019-2023 CSRs (2024 European Semester)**



Source: European Commission.

([6]) 2023 CSRs: EUR-Lex - 32023H0901(16) - EN - EUR-Lex (europa.eu)

2022 CSRs: EUR-Lex - 32022H0901(16) - EN - EUR-Lex (europa.eu)

2021 CSRs: EUR-Lex - 32021H0729(16) - EN - EUR-Lex (europa.eu)

2020 CSRs: EUR-Lex - 32020H0826(16) - EN - EUR-Lex (europa.eu)
2019 CSRs: EUR-Lex - 32019H0905(16) - EN - EUR-Lex (europa.eu)

([7]) Including policy action reported in the national reform programme and in Recovery and Resilience Facility (RRF) reporting (published twice a year, reporting on progress in implementing milestones and targets on the basis of the payment requests assessment).

([8]) Member States were asked to effectively address in their RRPs all or a significant subset of the relevant country-specific recommendations issued by the Council. The CSR assessment presented here considers the degree of implementation of the measures included in the RRP and of those carried out outside of the RRP at the time of assessment. Measures laid down in the Annex of the adopted Council Implementing Decision on approving the assessment of the RRP, which have not yet been adopted or implemented but considered credibly announced, in line with the CSR assessment methodology, warrant 'limited progress'. Once implemented, these measures can lead to 'some/substantial progress or full implementation', depending on their relevance.

Table A2.1: **Summary table on 2019-2023 CSRs**

Luxembourg	Assessment in May 2024*	RRP coverage of CSRs until 2026**	Relevant SDGs
2019 CSR 1	**Limited progress**		
Increase the employment rate of older workers by enhancing their employment opportunities and employability.	Limited Progress	Relevant RRP measures implemented as of 2021.	SDG 8
Improve the long-term sustainability of the pension system, including by further limiting early retirement.	No Progress		SDG 8
2019 CSR 2	**Limited progress**		
Reduce barriers to competition in regulated professional business services.	Limited Progress		SDG 9
2019 CSR 3	**Some progress**		
Focus economic policy related to investment on fostering digitalisation	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023 and 2024.	SDG 9
and innovation,	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023 and 2024.	SDG 9
stimulating skills development,	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022.	SDG 4
improving sustainable transport,	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023 and 2025.	SDG 11
and increasing housing supply, including by increasing incentives and lifting barriers to build.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023, 2024 and 2025.	SDG 8
2019 CSR 4	**Limited progress**		
Address features of the tax system that may facilitate aggressive tax planning, in particular by means of outbound payments.	Limited Progress		SDG 8, 16
2020 CSR 1	**Some progress**		
Take all necessary measures, in line with the general escape clause of the Stability and Growth Pact, to effectively address the COVID-19 pandemic, sustain the economy and support the ensuing recovery. When economic conditions allow, pursue fiscal policies aimed at achieving prudent medium-term fiscal positions and ensuring debt sustainability, while enhancing investment.	Not relevant anymore	Not applicable	SDG 8, 16
Improve the resilience of the health system by ensuring appropriate availability of health workers.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022 and 2025.	SDG 3
Accelerate reforms to improve the governance of the health system and e-health.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022 and 2025.	SDG 3
2020 CSR 2	**Substantial progress**		
Mitigate the employment impact of the COVID-19 crisis, with special consideration for people in a difficult labour market position.	Substantial Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022.	SDG 8
2020 CSR 3	**Some progress**		
Ensure effective implementation of measures supporting the liquidity of businesses, in particular SMEs and the selfemployed.	Full Implementation		SDG 8, 9
Front-load mature public investment projects [to foster the economic recovery]	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023 and 2024.	SDG 8, 16
and promote private investment to foster the economic recovery.	Limited Progress		SDG 8, 9
Focus investment on the green and digital transition, in particular on sustainable transport	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023 and 2025.	SDG 11
and buildings,	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023, 2024 and 2025.	SDG 7, 8
clean and efficient production and use of energy, contributing to a progressive decarbonisation of the economy.	Some Progress	Relevant RRP measures being planned as of 2022, 2023, 2024 and 2025.	SDG 7, 9, 13
Foster innovation [in particular in the business sector]	Some Progress	Relevant RRP measures being planned as of 2022 and 2023.	SDG 9
and digitalisation, in particular in the business sector.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023 and 2024.	SDG 9
2020 CSR 4	**Limited progress**		
Ensure effective supervision and enforcement of the anti-money laundering framework as regards professionals providing trust and company services, and investment services.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2023.	SDG 8, 16
Step up action to address features of the tax system that facilitate aggressive tax planning, in particular by means of outbound payments.	Limited Progress		SDG 8, 16

(Continued on the next page)

Table (continued)

2021 CSR 1	**Not relevant anymore**		
In 2022, pursue a supportive fiscal stance, including the impulse provided by the Recovery and Resilience Facility, and preserve nationally financed investment.	Not relevant anymore	Not applicable	SDG 8, 16
When economic conditions allow, pursue a fiscal policy aimed at achieving prudent medium-term fiscal positions and ensuring fiscal sustainability in the medium term.	Not relevant anymore	Not applicable	SDG 8, 16
At the same time, enhance investment to boost growth potential. Pay particular attention to the composition of public finances, on both the revenue and expenditure sides of the budget, and to the quality of budgetary measures in order to ensure a sustainable and inclusive recovery. Prioritise sustainable and growth-enhancing investment, in particular investment supporting the green and digital transition.	Not relevant anymore	Not applicable	SDG 8, 16
Give priority to fiscal structural reforms that will help provide financing for public policy priorities and contribute to the long-term sustainability of public finances, including, where relevant, by strengthening the coverage, adequacy and sustainability of health and social protection systems for all.	Not relevant anymore	Not applicable	SDG 8, 16
2022 CSR 1	**Some Progress**		
In 2023, ensure that the growth of nationally financed primary current expenditure is in line with an overall neutral policy stance, taking into account continued temporary and targeted support to households and firms most vulnerable to energy price hikes and to people fleeing Ukraine. Stand ready to adjust current spending to the evolving situation.	No Progress	Not applicable	SDG 8, 16
Expand public investment for the green and digital transitions, and for energy security taking into account the REPowerEU initiative, including by making use of the Recovery and Resilience Facility and other Union funds.	Full Implementation	Not applicable	SDG 8, 16
For the period beyond 2023, pursue a fiscal policy aimed at achieving prudent medium-term fiscal positions.	Full Implementation	Not applicable	SDG 8, 16
Improve the long-term sustainability of the pension system, in particular by limiting early retirement and by increasing the employment rate of older workers.	No Progress		SDG 8
Take action to effectively tackle aggressive tax planning, including by ensuring sufficient taxation of outbound payments of interests and royalties to zero and low-tax jurisdictions.	Limited Progress		SDG 8, 16
2022 CSR 2			
Proceed with the implementation of its recovery and resilience plan, in line with the milestones and targets included in the Council Implementing Decision of 13 July 2021.	RRP implementation is monitored by assessing RRP payment requests and analysing reports published twice a year on the achievement of the milestones and targets. These are to be reflected in the country reports.		
Submit the 2021-2027 cohesion policy programming documents with a view to finalising their negotiations with the Commission and subsequently starting their implementation.	Progress on the cohesion policy programming documents is monitored under the EU cohesion policy.		
2022 CSR 3	**Limited progress**		
Reduce the impact of inequalities on pupils' performance and promote equal opportunities for all students in the educational system.	Limited Progress		SDG 4, 8, 10
2022 CSR 4	**Some progress**		
Reduce overall reliance on fossil fuels	Some Progress	Relevant RRP measures being planned as of 2022, 2023, 2024 and 2025.	SDG 7, 9, 13
by accelerating the deployment of renewables,	Substantial Progress	Relevant RRP measures being planned as of 2022, 2023, 2024 and 2025.	SDG 7, 9, 13
electricity transmission capacity,	Some Progress		SDG 7, 9, 13
and investment in energy efficiency in both the residential and non-residential sectors.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022 and 2023.	SDG 7
Support municipalities in developing detailed local plans for the deployment of renewable energy, including wind power and photovoltaics, and for district heating and cooling systems.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022 and 2023.	SDG 7, 9, 10, 11, 13
Further promote electrification of transport and invest in public transport networks and infrastructures.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023 and 2025.	SDG 11

(Continued on the next page)

Table (continued)

2023 CSR 1	**Limited Progress**		
Wind down the emergency energy support measures in force, using the related savings to reduce the government deficit, as soon as possible in 2023 and 2024. Should renewed energy price increases necessitate new or continued support measures, ensure that these are targeted at protecting vulnerable households and firms, fiscally affordable, and preserve incentives for energy savings.	Limited Progress	Not applicable	SDG 8, 16
Ensure prudent fiscal policy, in particular by limiting the nominal increase in nationally financed net primary expenditure in 2024 to not more than 4.8%(1). (1) Which is estimated to correspond to an annual improvement in the structural budget balance of at least 0.3% of GDP for 2024, as described in recital 24.	No Progres	Not applicable	SDG 8, 16
Preserve nationally financed public investment and ensure the effective absorption of RRF grants and other EU funds, in particular to foster the green and digital transitions.	Some Progress	Not applicable	SDG 8, 16
For the period beyond 2024, continue to pursue a medium-term fiscal strategy of gradual and sustainable consolidation, combined with investments and reforms conducive to higher sustainable growth, to achieve a prudent medium-term fiscal position.	Full Implementation	Not applicable	SDG 8, 16
Reduce risks related to the housing market, in particular by reducing mortgage interest deductibility, and by taking measures to increase the supply of buildable land.	Limited Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023, 2024 and 2025.	SDG 8
Address the long-term sustainability of the pension system, in particular by limiting early retirement options and increasing the employment rate for older workers.	No Progress		SDG 8
Increase action to effectively tackle aggressive tax planning, in particular by ensuring sufficient taxation of outbound payments of interest and royalties to zero/low-tax jurisdictions.	Limited Progress		SDG 8, 10
2023 CSR 2			
Proceed with the steady implementation of its revised recovery and resilience plan and swiftly finalise the REPowerEU chapter with a view to rapidly starting the implementation thereof. Proceed with the swift implementation of cohesion policy programmes, in close complementarity and synergy with the recovery and resilience plan.	RRP implementation is monitored through the assessment of RRP payment requests and analysis of the bi-annual reporting on the achievement of the milestones and targets, to be reflected in the country reports. Progress with the cohesion policy is monitored in the context of the Cohesion Policy of the European Union.		
2023 CSR 3	**Limited Progress**		
Improve the performance of the school education system and promote equal opportunities for all students, in particular by adapting teaching to the needs of disadvantaged students and those from various linguistic backgrounds.	Limited Progress		SDG 4
2023 CSR 4	**Some Progress**		
Reduce reliance on fossil fuels	Limited Progress	Relevant RRP measures being planned as of 2022, 2023, 2024 and 2025.	SDG 7, 13
by accelerating the deployment of renewable energy, increasing electricity transmission capacity, easing permitting procedures and	Substantial Progress	Relevant RRP measures being planned as of 2022, 2023, 2024 and 2025.	SDG 7, 9, 13
investing in energy efficiency in both the residential and non-residential sectors.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022 and 2023.	SDG 7, 9, 13
Support municipalities in developing detailed local plans for deploying renewable energy, including wind power and photovoltaics, and for district heating and cooling systems.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022 and 2023.	SDG 7, 9, 13
Further promote the electrification of transport and invest in public transport networks and infrastructure.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022, 2023 and 2025.	SDG 7, 9, 13
Step up policy efforts aimed at the provision and acquisition of skills and competences needed for the green transition.	Some Progress	Relevant RRP measures being implemented as of 2021. Relevant RRP measures being planned as of 2022.	SDG 7, 4

Note:
* See footnote ([8]).
** RRP measures included in this table contribute to the implementation of CSRs. Nevertheless, additional measures outside the RRP may be necessary to fully implement CSRs and address their underlying challenges. Measures indicated as 'being implemented' are only those included in the RRF payment requests submitted and positively assessed by the European Commission.
Source: European Commission.

This Annex provides a snapshot of Luxembourg's implementation of its recovery and resilience plan (RRP), past the mid-way point of the Recovery and Resilience Facility's (RRF) lifetime. The RRF has proven central to the EU's recovery from the COVID-19 pandemic, helping speed up the twin green and digital transition, while adapting to geopolitical and economic developments, and strengthening resilience against future shocks. The RRF is also helping implement the UN Sustainable Development Goals and address the country-specific recommendations (see Annex 2).

The RRP paves the way for disbursing up to EUR 83 million in grants under the RRF over the 2021-2026 period, representing 0.1% of Luxembourg's GDP ([9]). As of mid-May 2024, EUR 32.37 billion has been disbursed to Luxembourg under the RRF.

Luxembourg still has EUR 50.7 million available in grants from the RRF. This will be disbursed after the assessment of the future fulfilment of the remaining 34 milestones and targets ([10]) included in the Council Implementing Decision ([11]) (CID), ahead of the 2026 deadline established for the RRF.

Luxembourg's progress in implementing its plan is recorded in the Recovery and Resilience Scoreboard ([12]). The scoreboard gives an overview of the progress made in implementing the RRF as a whole. Graph A3.1 shows the current state of play as reflected on the Scoreboard.

Luxembourg has submitted a REPowerEU chapter to be added to its RRP, to phase out its dependency on Russian fossil fuels, diversify its energy supplies and produce more clean energy in the coming years. The Commission is now assessing the chapter and once adopted, it will contribute to ensuring the supply of affordable, secure, and sustainable energy.

The plan has a strong focus on the green transition, dedicating 68.8% of the available funds to measures that support climate objectives and 29.6% of its total allocation to support the digital transition. It also retains a strong social dimension with social protection measures, especially related to affordable housing.

Table A3.1: **Key facts of the Luxembourgish RRP**

Initial plan CID adoption date	13 July 2021
Scope	Revised plan with REPowerEU chapter under assessment
Last major revision	17 January 2023
Total allocation	EUR 83 million in grants (0.1% of 2023 GDP)
Investments and reforms	12 investments and 8 reforms
Total number of milestones and targets	60
Fulfilled milestones and targets	26 (43.3% of total)

Source: RRF Scoreboard

With one payment request completed, Luxembourg's implementation of its RRP is well underway. The Commission gave a positive assessment of Luxembourg's payment request on 28 April 2023, taking into account the opinion of the Economic and Financial Committee. This led to EUR 20.2 million being disbursed in financial support on 16 June 2023 ([13]). The related 26 milestones and targets covered reforms and investments such as those related to the digitalisation of the public sector, for example with the development of the mobile application

(9) GDP information is based on 2023 data. Source: https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/index.html?lang=en

(10) A milestone or target is satisfactorily fulfilled once a Member State has provided evidence to the Commission that it has reached the milestone or target and the Commission has assessed it positively in an implementing decision.

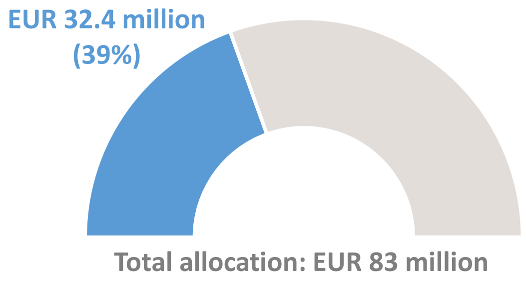
(11) https://data.consilium.europa.eu/doc/document/ST-10155-2021-ADD-1/en/pdf

(12) https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/country_overview.html

(13) When requested payments are disbursed, the pre-financing is cleared proportionally. The net amounts are quoted here.

'MyGuichet.lu', which also covers the entry into force of a legal framework setting a minimum percentage of clean vehicles in public procurement others in the areas of skills.

Graph A3.1: **Total grants disbursed under the RRF**



Note: This graph displays the amount of grants, including pre-financing, disbursed so far under the RRF. Grants are non-repayable financial contributions. The total amount of grants given to each Member State is determined by an allocation key and the total estimated cost of the respective RRP.
Source: RRF Scoreboard

As of 15 May 2024, Luxembourg is working towards its second payment request. Table A3.2 highlights some relevant measures achieved so far, and some that will be implemented before 2026 to keep making Luxembourg's economy greener, more digital, inclusive, and resilient.

Table A3.2: **Measures in Luxembourg's RRP**

Reforms and investments implemented
• "Gesondheetsdësch" • Housing Pact 2.0 to increase the supply of affordable housing • "FutureSkills"
Upcoming reforms and investments
• Investment in electric vehicle charging points • The "Naturpakt" program to protect biodiversity • Digitalisation of the health system

Source: FENIX

EU funding instruments provide considerable resources for recovery and growth to the EU Member States. In addition to the EUR 82.7 million of Recovery and Resilience Facility (RRF) funding described in Annex 3, EU cohesion policy funds ([14]) provide EUR 38.9 million to Luxembourg for the 2021-2027 period ([15]). Support from these two instruments combined represents around 0.15% of the country's 2023 GDP, compared to the EU average of 5.38% of GDP ([16]). Cohesion policy supports regional development, economic, social and territorial convergence, and competitiveness through long-term investment in line with EU priorities and with national and regional strategies.

During the 2014-2020 programming period, cohesion policy funds boosted Luxembourg's competitiveness, with tangible achievements notably in energy efficiency, research and social inclusion. Over the whole period, which financed investments until December 2023, cohesion policy funds ([17]) had made EUR 182.4 million available to Luxembourg ([18]), of which EUR 153.4 million has been disbursed since March 2020, when the COVID-19 pandemic began ([19]). The achievements of cohesion policy funds over the programming period included the creation of 107 full-time equivalent jobs for researchers working in research infrastructure facilities, improved cooperation between 111 businesses and research institutions and a reduction in the primary energy consumption of public buildings of 321 300 Kw/Year. During the same period, over 70 000 people participated in initiatives funded by the European Social Fund (ESF) in Luxembourg, including some 7 300 migrants. It funded support measures to help the most vulnerable, notably to integrate support services for disadvantaged people and to develop cooperation and partnerships with the business community with a view to sustainable professional integration.

In the current programming period, cohesion policy will provide a further boost to Luxembourg's competitiveness, to the green and digital transition as well as to social cohesion, improving the living and working conditions of Luxembourg's people. In 2021-2027, the European Regional Development Fund (ERDF) will finance equipment for research and innovation and further boost the creation of researcher jobs. Investments are planned to create additional renewable energy production capacity to reach 200 MWh/year. The Just Transition Fund will invest in the south of the country and will contribute to reducing greenhouse gas emissions in that area by improving the energy performance of housing and by increasing the capacity of environmentally friendly rolling stock for public transport.

The European Social Fund Plus (ESF+) will help jobseekers access employment by investing around EUR 4.7 million in Luxembourg, mostly in skills development. It allocates EUR 1.7 million to promote lifelong learning to upskill and reskill employees to meet skills needs. EUR 2.9 million will provide support for disadvantaged groups, notably by investing in integrated pathways to work, including training and workshops for social and professional reintegration. With this work, cohesion policy substantially contributes to achieving the UN Sustainable Development Goals (SDGs) in Luxembourg, in particular SDG 8 (Decent work and economic growth), SDG 1 (No poverty) and SDG 7 (Affordable and clean energy).

Through combined action, cohesion policy and the recovery and resilience plan (RRP) have a mutually reinforcing impact in Luxembourg. For instance, Luxembourg's RRP plan for the 'decarbonisation of transport' includes a reform to promote electrification of the fleet of

([14]) In 2021-2027, cohesion policy funds include the European Regional Development Fund and the European Social Fund Plus.

([15]) European territorial cooperation (ETC) programmes are excluded from the figure. In 2021-2027, the total investment, including national financing, amounts to EUR 90.2 million.

([16]) RRF funding includes both grants and loans, where applicable. The EU average is calculated for cohesion policy funds excluding ETC programmes. GDP figures are based on Eurostat data for 2022.

([17]) In 2014-2020, cohesion policy funds included the European Regional Development Fund and the European Social Fund. REACT-EU allocations are included but ETC programmes are excluded.

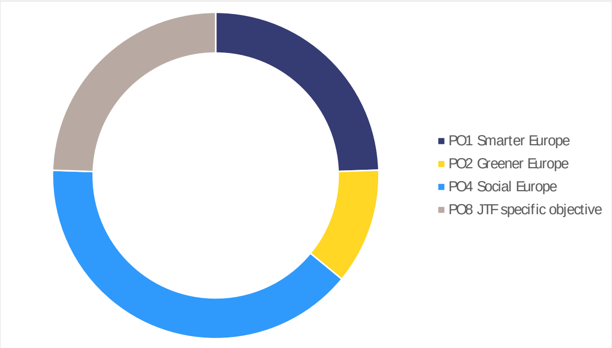
([18]) In 2014-2020, the total investment, including national financing, amounted to EUR 230.4 million.

([19]) Cut-off date: 14 May 2024.

contracting authorities and entities, and of public transport. Under this reform, a new law specifies the minimum share of clean vehicles procured by public contract. This applies to public buses and certain other vehicles. Luxembourg State as a contracting authority plans to fully electrify the bus fleet operated by the public transport operator RGTR by 2030. This reform is complemented by two ERDF projects that help implement it: one to purchase electric buses used for urban public transport and one to instal the infrastructure. One project under REACT-EU concerns the regional RGTR network, and another co-finances 13 buses and 2 charging stations for Luxembourg city buses. Luxembourg's RRP component on skilling, reskilling and upskilling includes a national skills reform to better target investment under the ESF+ to increase the availability of skilled workers. The 'FutureSkills' investment under the RRP has complemented projects to provide support for the unemployed under the ESF. It was followed by 'Skills4Job" supported by the ESF+ since 2023.

The contribution of cohesion policy and RRP funding by different policy objectives is illustrated by Graphs A4.1 and A4.2.

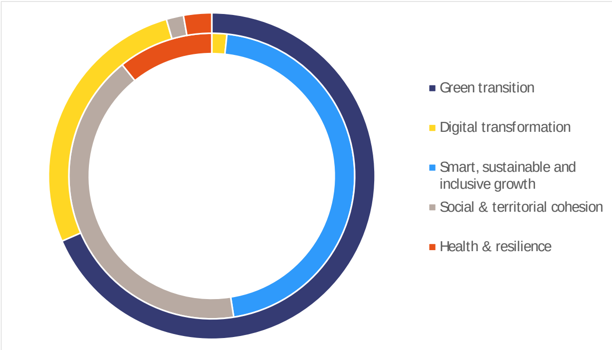
Graph A4.1: **Distribution of cohesion policy funding across policy objectives in Luxembourg**



Source: European Commission

The Technical Support Instrument (TSI) helps Luxembourg invest in its public administration and create a better enabling environment for EU and national investment. The TSI has funded projects in Luxembourg to design and implement growth-enhancing reforms since 2018. The support provided to Luxembourg in 2023 helped identify links between people management policies and public-sector performance. This enables the public authorities to build capacity to design and implement staff surveys and to strengthen the links between evidence (survey results and other data) and civil service reforms. The project was not linked to the RRP, but it contributed to building the capacity of the public administration and so it had an indirect and positive impact on RRP implementation. Luxembourg also receives funding from several other EU instruments, including those listed in Table A4.1.

Graph A4.2: **Distribution of RRF funding by pillar in Luxembourg**



(1) Each RRP measure helps achieve the aims of two of the six policy pillars of the RRF. The primary contribution is shown in the outer circle while the secondary contribution is shown in the inner circle. Each contribution represents 100% of the RRF funds. Therefore, the total contribution to all pillars displayed on this chart amounts to 200% of the RRF funds allocated to Luxembourg.
Source: European Commission

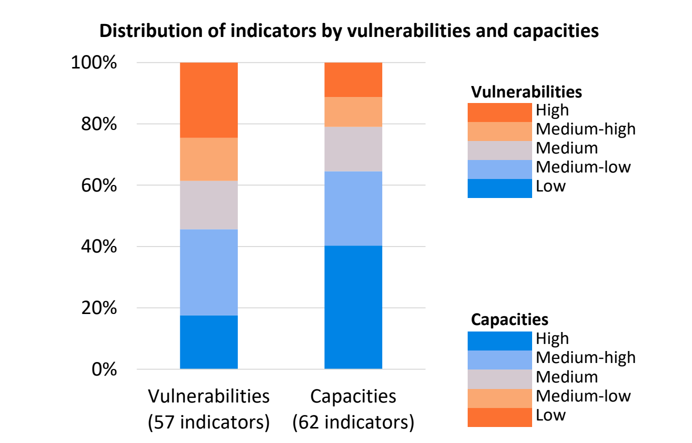
Table A4.1: **Support from EU instruments in Luxembourg**

EU grants		
	Amount 2014-2020 (EUR million)	Amount 2021-2027 (EUR million)
Cohesion policy	182.40	38.9
RRF grants (1)	-	82.7
Public sector loan facility (grant component) (2)	-	0.7
Common agricultural policy (3)	400	225
EMFF/EMFAF (4)	-	-
Connecting Europe Facility (5)	51.5	6.5
Horizon 2020 / Horizon Europe (6)	201.6	151.1
LIFE programme (7)	4.6	6.8
EU guarantees		
	EU Guarantee (EUR million)	Volume of operations (EUR million)
European Fund for Strategic Investment 2015-2020 (8)	29.6	111.8
InvestEU 2021-2027 (9)	9.3	9.3

(1) RRF implementation period is 2021-2026.
(2) The public sector loan facility's programming period is 2021-2025 and the amount reflects the national share in its grant component reserved until the end of the period.
(3) Common agricultural policy programming periods are 2014-2022 and 2023-2027.
(4) EMFF – European Maritime and Fisheries Fund, EMFAF – European Maritime, Fisheries and Aquaculture Fund.
(5) Data on the Connecting Europe Facility covers transport and energy and has a cut-off date of 15 May 2024.
(6) Data on Horizon Europe (2021-2027) has a cut-off date of 13 May 2024.
(7) 2021-2027 data on the LIFE programme has a cut-off date of 15 May 2024.
(8) The amount of the EU guarantee signed under the EFSI Infrastructure and Innovation Window was derived based on the signed amount of the operations and the average internal multiplier, as reported by the EIB (cut-off date is 31 December 2023).
(9) The amount of the EU guarantee and of the volume of operations signed under InvestEU includes the EU compartment as well as the Member State compartments (cut-off date is 31 December 2023).
Source: European Commission

Table A5.1: **Resilience indices across dimensions for Luxembourg and the EU-27**

Dimension		LU 2023 RDB	LU 2024 RDB	EU-27 2024 RDB
Overall resilience	Vulnerabilities			
	Capacities			
Social and economic	Vulnerabilities			
	Capacities			
Green	Vulnerabilities			
	Capacities			
Digital	Vulnerabilities			
	Capacities			
Geopolitical	Vulnerabilities			
	Capacities			



(1) The synthetic indices aggregate the relative resilience situation of countries across all considered indicators. For an indicator, each country's relative situation in the latest available year is compared with the collection of values of that indicator for all Member States and all years in the reference period.
Source: Resilience Dashboards - version spring 2024, data up to 2022

This Annex uses the Commission's resilience dashboards (RDB) (20) to show Luxembourg's relative resilience capacities and vulnerabilities (21) that may be of relevance for societal, economic, digital and green transformations, and for dealing with future shocks and geopolitical challenges. (22)

According to the RDB's set of resilience indicators, Luxembourg has high resilience capacities and medium resilience vulnerabilities overall, with no major changes since 2023 RDB. Only Luxembourg's green and geopolitical vulnerabilities have improved. Above 60% of vulnerability indicators are medium to low, and close to 80% of capacity indicators are medium to high.

In the social and economic dimension, Luxembourg has medium-high resilience, with some very weak vulnerability indicators. The variation in academic performance explained by students' socio-economic status, the specialisation of the economy and the non-financial corporation debt to GDP ratio, are the highest in the EU, and on the capacity side, intangible investment is the lowest in the EU.

In the green dimension, Luxembourg has higher vulnerabilities than the rest of the EU, but better capacities. Despite a slight improvement in green vulnerabilities from high to medium-high level, the country maintains higher vulnerabilities than the rest of the EU in CO_2 emissions in road transport, GHG emissions per capita, its consumption footprint per capita, and its waste generation rate (see also Annex 9). In terms of capacities, Luxembourg is behind the rest of the EU in terms of renewable energy in final energy consumption and national environmental protection expenditures, but it performs well in terms of CO_2 absorption by forests, insured losses from extreme climate events, and resource productivity.

In the digital dimension, capacities remain medium-high on par with the EU average and vulnerabilities remained below the EU average (medium-low). Luxembourg outperforms other EU countries in terms of the collaborative economy and the value of e-commerce sales. It is also among the top 5 EU

(20) Https://ec.europa.eu/info/strategy/strategic-planning/strategic-foresight/2020-strategic-foresight-report/resilience-dashboards_en. Resilience is defined as the ability not only to withstand and cope with challenges but also to undergo transitions, in a sustainable, fair, and democratic manner. 2020 Strategic Foresight Report: *Charting the course towards a more resilient Europe* (COM(2020) 493).

(21) Vulnerabilities describe features that can exacerbate the negative impact of crises and transitions, or obstacles that may hinder the achievement of long-term strategic goals, while capacities refer to enablers or abilities to cope with crises and structural changes and to manage transitions.

(22) This Annex is linked to Annex 1 on SDGs, Annex 6 on the green deal, Annex 8 on the fair transition to climate neutrality, Annex 9 on resource productivity, efficiency and circularity, Annex 10 on the digital transition and Annex 14 on the European pillar of social rights.

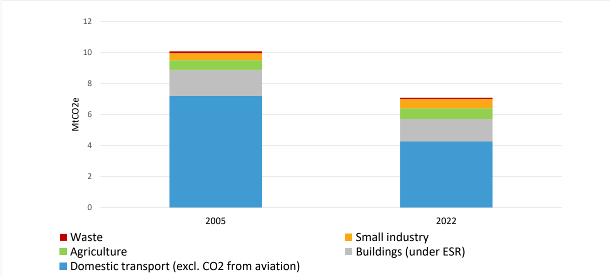
countries in terms of cybersecurity, but it has a high number of cybersecurity incidents experienced by individuals. The expenditure in research and development in information and communication technology (ICT) sector business, and master graduates in ICT are still below the EU average.

Luxembourg's geopolitical vulnerabilities stay in the medium-high range, while capacities remained high. Of particular concern are indicators such as Luxembourg's import dependence in energy materials, its concentration of value chain partners, and its military expenditure below 2% of GDP. Luxembourg's high capacities are reflected in several trade indicators, with some remaining concerns about forward participation in global value chains (GVC) and armed forces personnel.

Luxembourg has made progress in the green transition, with more action needed in several areas, including on its energy efficiency target, on biodiversity and on ecosystem protection. This Annex provides a snapshot of climate, energy, and environmental aspects of the transition in Luxembourg ([23]).

Luxembourg's draft updated national energy and climate plan (NECP) provides a wealth of information on the investment needs and funding sources to achieve its 2030 climate and energy targets. The plan details the investment needs, with a yearly breakdown of investment needed over the next decade in transport, energy production, buildings and industry. It estimates the cumulative overall additional investment needs to fund the transition between 2023-30 for the energy sector, transport, industry, and buildings ([24]).

Graph A6.1: **Greenhouse gas emissions from the effort sharing sectors in Mt CO2eq, 2005-2022**



Source: European Environment Agency

Luxembourg is projected to reach its 2030 effort sharing target, provided it adopts and implements the additional measures planned ([25]). Luxembourg's 2022 greenhouse gas emissions from these sectors are expected to come in at 30% below 2005 levels. The additional policies planned in Luxembourg's draft updated NECP are projected to reduce these emissions by 57.8% from 2005 levels. This results in reductions of 7.8 percentage points beyond Luxembourg's effort sharing target, a 50% reduction. Current policies are projected to reduce its effort sharing emissions by 35.1% from 2005 levels by 2030 ([26]). This highlights the importance of implementing the full range of policies and measures in the draft updated NECP. Luxembourg's commitment to achieve climate neutrality by 2050 is enshrined in legislation ([27]).

(23) This Annex is complemented by Annex 7 on energy transition and competitiveness, Annex 8 on the fair transition to climate neutrality, Annex 9 on resource efficiency, circularity, and productivity, and relevant topics in other annexes to this country report.

(24) See the Commission's (2023) [assessment of the draft national energy and climate plan of Luxembourg.]

(25) The national greenhouse gas emission reduction target is laid down in Regulation (EU) 2023/857 (the Effort Sharing Regulation). The aim is to align action in the sectors concerned with the objective to reach the EU-level economy-wide target of greenhouse gas reductions of at least 55% compared to 1990 levels. The target also applies to the sectors outside the current EU Emissions Trading System, notably buildings (heating and cooling), road transport, agriculture, waste, and small industry (known as the effort sharing sectors).

(26) The effort sharing emissions for 2022 are based on approximated inventory data. The final data will be established in 2027 after a comprehensive review. Projections on the impact of current policies ('with existing measures', WEM) and additional policies ('with additional measures', WAM) as per Luxembourg's draft updated NECP.

(27) Climate Law of 15 December 2020.

There is scope for increasing Luxembourg target for energy efficiency in its final updated NECP [28]. Its energy efficiency contribution of 3.5 Mtoe in primary energy consumption and 3.05 Mtoe in final energy consumption for 2030 set in the draft updated NECP are less ambitious than the contribution required under the Energy Efficiency Directive. Luxembourg's renewable energy contribution set in its draft updated NECP, 37% by 2023, is in line with the required contribution.

Luxembourg's transition to sustainable transport is taking off, and it must keep up the momentum [29]. In 2023, 5.6% of its car passenger fleet were battery electric vehicles, one of the highest shares in the EU. In 2023, it had 2 120 publicly accessible charging points, providing one charging point for every 13 e-vehicles (EU average 1:10). 97% of its rail network is electrified - the highest share in the EU – but only 4% and 7% of passenger and freight transport respectively is by rail. Roads are used for 86% of passenger and freight transport.

Luxembourg's actions to increase carbon removals through land use, land-use change and forestry (LULUCF) are becoming more ambitious. Luxembourg achieves net carbon removals through effective forest management. To reach its 2030 LULUCF target, additional carbon removals of 27 kt CO2eq are needed [30]. The country is currently on track to meet the target [31].

Luxembourg has relatively well-developed institutional arrangements for climate adaptation. Climate change affects many sectors in Luxembourg, including agriculture, forestry, water management and health. Climate hazards may give rise to floods, droughts and heatwaves, with adverse effects on health and changes in the vegetation period, impacting wheat crops, winegrowing and other sectors. Luxembourg's climate protection gap [32] is low. Luxembourg's national adaptation strategy and plan (2018-2023) covers all relevant climate risks and links its vulnerabilities and risks with actions [33]. Luxembourg is currently updating the strategy and plan in line with its climate law (from 2020), and sets binding requirements for planning, implementing and governing adaptation measures. Stakeholders are involved locally via the climate and nature pact.

The ecological and chemical status of Luxembourg's water bodies is still cause for concern. The efficient use of water resources can be measured by water productivity [34]. In 2021, Luxembourg generated EUR 2 339 per cubic meter of water abstracted, among the highest water productivity rate in the EU. Although water scarcity and productivity are not major issues in Luxembourg, concerns remain over water quality. In 2020, only 2.7% of all surface water bodies were in a good ecological status and none achieved a good chemical status [35]. 50% of groundwater bodies also failed to achieve a good chemical

(28) The EU target set out in the revised Renewable Energy Directive is to have 42.5% of gross final energy consumption coming from renewable energy sources by 2030, with the aspiration to reach 45%. The formula in Annex I to Directive (EU) 2023/1791 sets the indicative national contribution for Luxembourg at 2.8 Mtoe for primary energy consumption. The Commission communicated a corrected national contribution of 2.80 Mtoe in final energy consumption for 2030 in accordance with Article 4(5) of the Energy Efficiency Directive to increase the contribution towards the Union's binding energy efficiency target. See the Commission Recommendation of 18.12.2023 to Luxembourg.

(29) Unless otherwise indicated, data in this section refer to 2021. See European Commission, 2023, EU transport in figures, transport.ec.europa.eu.

(30) National LULUCF targets of the Member States in line with Regulation (EU) 2023/839.

(31) Projections submitted in Luxembourg's draft updated national energy and climate plan, 2023.

(32) On the climate protection gap, see the annotations to Table A6.1.

(33) See the Commission's 2023 assessment and recommendation on Luxembourg's progress on climate adaptation.

(34) Measured as GDP over total fresh surface water abstracted in cubic meters.

(35) According to the 2nd river basin management plan (RBMP) data. Data from the 3rd RBMP is not available yet.

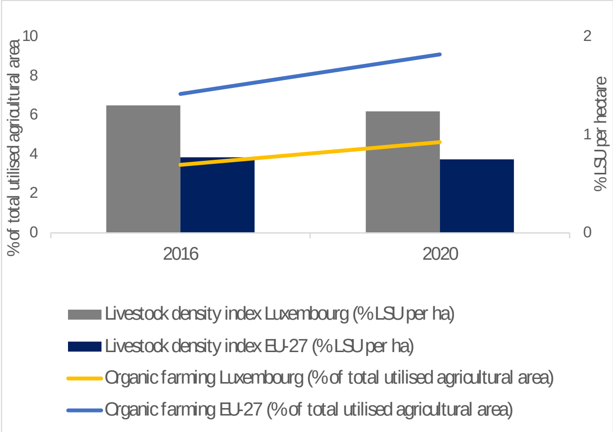
status. This includes water bodies failing due to substances behaving as ubiquitous persistent, bio-accumulative, and toxic substances (PBTs).

There is scope to improve nature protection and conservation in Luxembourg. In 2021, Luxembourg had the highest share of land protected areas in the EU (55.8). However, the share of habitats and species in an unfavourable/bad conservation status increased between 2012 and 2018 ([36]). Over 50% of forests are in a poor to bad status ([37]). Intensive agriculture, urban development and increasing transport infrastructures cause biodiversity loss. The common farmland bird index declined from 115 in 2011 to 80 in 2020. Following several complaints, an EU pilot project started in 2021 to monitor the loss of fragile grassland habitats that bring protected birds close to extinction.

Intensive agriculture has a major impact on ecosystems, biodiversity, and air quality. Between 2015 and 2023, the value of the agricultural sector's annual output fluctuated between EUR 400-470 million and reached EUR 440 million in 2023. The share of land under organic farming remained low at 5.2% of total utilised agricultural area in 2021 ([38]). Luxembourg is far from the objective of at least 20% of agricultural land under organic farming by 2025. Conservation tillage practices, which increase soil organic carbon, covered 31% of tillable area in Luxembourg in 2016.

Luxembourg's livestock density index was 1.24%, well above the EU average of 0.75% ([39]). Intensive poultry and pig farming was the sector that put the highest burden on the environment in terms of ammonia emissions into the air. In 2022, ammonia releases into the air were 862.4% higher than 2007 levels ([40]). The agricultural sector was responsible for generating 86.7 % of all ammonia emissions in 2021. Food waste production also remains relatively high and there is scope to improve the composting and digestion rate of food waste.

Graph A6.2: **Changes in livestock density and organic farming**



Livestock unit (LSU)/ha of UAA: it measures the stock of animals (cattle, sheep, goats, equidae, pigs, poultry and rabbits) converted in LSUs per hectare of UAA.
Source: Eurostat

Adopting extensive agriculture practices and reducing the use of pesticides and nutrients would help reduce pollution. A very high number of surface waters and groundwaters are found to be eutrophic ([41]). Luxembourg is one of the Member States that faces the greatest challenges in tackling nutrient pollution from agriculture ([42]) – 77% of the nutrient flux comes from agriculture. Based on the best available information on soil health issues at Member State level used in the impact assessment for the Soil Monitoring Law ([43]), 41% of Luxembourg's soil could be

(36) According to the report on the conservation status of habitats and species covered by Article 17 of the Habitats Directive in 2013-2018. Against the EU average of 15% and 28%.

(37) European Environment Agency, Forest information system for Europe.

(38) Against the EU average of 9.1% in 2020. 2021 data is not available.

(39) In 2020.

(40) Air releases (europa.eu).

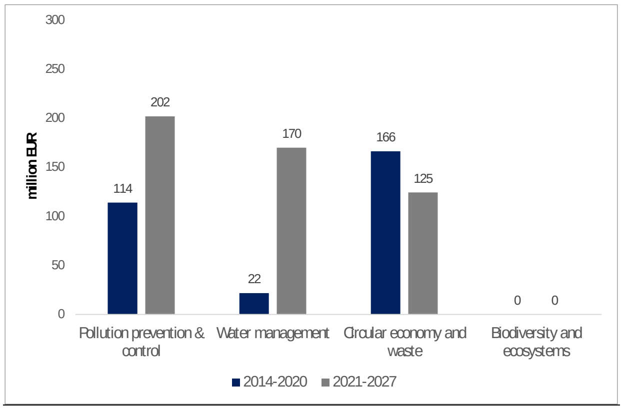
(41) Nitrate in groundwater (europa.eu) Luxembourg has a high share of groundwater monitoring stations – 20% - that record nitrate concentrations above 50 mg/l, many of which show an increasing trend.

(42) 2022 Environmental Implementation Review - Luxembourg, based on the implementation report for the Nitrates Directive.

(43) SWD 417 final of 5.7.2023 - impact assessment for the Directive of the European Parliament and of the Council on Soil Monitoring and Resilience (Soil Monitoring Law), (see p. 10, pp. 189-190, pp. 835-845).

considered as unhealthy ([44]). Nitrogen excess affects 86% of agricultural land, while soil erosion affects 87% of cropland. The agricultural sector contributed 0.2% to GDP ([45]) but generated 6.2% of all greenhouse gas emissions in 2021, below the EU average of 10.7%.

Graph A6.3: **Environmental investment gap, annual average**



The numbers are computed by the European Commission based on the latest internal reports, Eurostat, EIB and national data sources.
Source: European Commission

Luxembourg would benefit from investing more in sustainable water management and pollution prevention and control. Over the 2014-2020 period, the environmental investment gap per year was estimated to be at least EUR 269 million, equivalent to 0.5% of GDP ([46]). The gap is estimated to be slightly increasing over the 2021-2027 period at EUR 497 million per year. There remains an opportunity to increase funding, in particular for pollution prevention and control (EUR 202 million per year) and sustainable water management (EUR 170 million per year).

(44) However, not all soil degradation processes could be quantified for all land uses. This number simply indicates an order of magnitude.

(45) Agriculture contributed 1.6% of GDP in Europe.

(46) Below the EU average of 0.8%.

Table A6.1: **Indicators tracking progress on the European Green Deal from a macroeconomic perspective**

							Target	Distance	
		2005	2019	2020	2021	2022	2030	WEM	WAM
Progress to climate and energy policy targets									
Greenhouse gas emission reductions in effort sharing sectors (1)	Mt CO_{2eq}, %, pp	10 116.2	-11%	-9%	-20%	-30%	-50%	-15	8
Net greenhouse gas removals from LULUCF (2)	Kt CO2eq	-566.000	-364.000	-448.000	-605.000	-648.000	-403	n/a	n/a
Share of energy from renewable sources (1) (3)	%	1%	7%	12%	12%	14%	37%	-	-
Energy efficiency: primary energy consumption (3)	Mtoe	4.8	4.5	3.9	4.2	3.8	2.8		
Energy efficiency: final energy consumption (3)	Mtoe	4.5	4.4	3.8	4.1	3.7	2.8		
							EU-27		Projected
		2018	2019	2020	2021	2022	2021	2022	2030
Green transition: mobility									
Greenhouse gas emissions: road transport	Mt CO2e	-	-	-	4.9	4.3	769.0	786.6	2.3
Share of zero-emission vehicles in new registrations (4)	%	0.9	1.8	5.6	10.6	15.8	9	12.1	n/a
Number of publicly accessible AC/DC charging points		-	-	1074	1045	2365	299178	446956	n/a
Share of electrified railways	%	96.7%	96.7%	96.7%	96.7%	-	56.1%	-	n/a
Green transition: buildings									
Greenhouse gas emissions: buildings	Mt CO2e	-	-	-	1.7	1.4	537.0	486.7	0.9
Final energy consumption in buildings	2015=100	106.1%	108.5%	109.8%	114.3%	100.5%	104.0%	97.2%	
Climate adaptation									
Climate protection gap (5)	score 1-4	-	-	1.6	1.0	0.9	1.5	1.5	n/a
		2018	2019	2020	2021	2022	2020	2021	2022
State of the environment									
Water | Water exploitation index (WEI+) (1) (6)	% of renewable freshwater	0.5	0.5	-	-	-	3.6	-	-
Circular economy | Material footprint (7)	tonnes per person	28.1	27.2	24.7	27.3	23.7	14.2	14.8	14.9
Pollution | Years of life lost due to air pollution by PM2.5 (8)	per 100.000 inhabitants	177	290	130	140	-	545	584	-
Biodiversity | Habitats in good conservation status (9)	%	32.1					14.7		
Common farmland bird index (10)	2000=100	77	80	-	-	-	78	-	-
Green transition: agri-food sector									
Organic farming	% of total utilised agricultural area	4.39	4.42	4.63	5.19	-	9.1	-	-
Nitrates in groundwater	mg NO_3/litre	-	-	-	-	-	20.42	-	-
Food waste per capita	Kg per capita			147	131	-	130	131	-
Share of soil in poor health (11)	%					41			41
Soil organic matter in agricultural land (12)	Mt per ha	5	-	-	-	-	7 904	-	-

Sources: (1) Member States' emission data for 2019 and 2020 are in global warming potential (GWP) values from the 4th Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC). Member States' 2005 base year emissions under Regulation (EU) 2018/842, emissions data for 2021 and 2022, and 2030 projections are in GWP values from the 5th Assessment Report (AR5) of the IPCC. 2021 data are based on the final inventory reports, 2022 data are based on approximated inventory reports and European Environmental Agency's calculation of effort sharing emissions. The final data for 2021 and 2022 will be established after a comprehensive review in 2027. The 2030 target is in percentage change of the 2005 base year emissions. Distance to target is the gap between the 2030 target and projected effort sharing emissions with existing measures (WEM) and with additional measures (WAM), in percentage change from the 2005 base year emissions. The measures included for the 2030 emission projections reflect the state of play as reported in Member States' draft updated national energy and climate plans or, if unavailable, as reported by 15 March 2023 as per Regulation 2018/1999. (2) Net removals are expressed in negative figures, net emissions in positive figures. Reported data are from the 2024 greenhouse gas inventory submission. 2030 value of net greenhouse gas removals as in Regulation (EU) 2023/839 – Annex IIa. (3) The 2030 national objectives for renewable energy and energy efficiency are indicative national contributions, in line with Regulation (EU) 2018/1999 (the Governance Regulation), the EU-level 2030 renewable energy target set out in Directive EU/2018/2001 amended by Directive EU/2023/2413 (the revised Renewable Energy Directive) – 42.5% of gross final energy consumption with the aspiration to reach 45% –, and the formula in Annex I to Directive (EU) 2023/1791 (the Energy Efficiency Directive). (4) Passenger battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV). (5) The climate protection gap refers to the share of non-insured economic losses caused by climate-related disasters, based on modelling of the risk from floods, wildfires, windstorms, and the insurance penetration rate. Scale: 0 (no protection gap) –4 (very high gap) (European Insurance and Occupational Pensions Authority, 2022). (6) Total water consumption in renewable freshwater resources available for a territory and period. (7) Material extractions for consumption and investment. (8) Years of potential life lost through premature death due to exposure to particulate matter with a diameter of less than 2.5 micrometres. (9) Share of the number of records under Art. 17 of Council Directive 92/43/EEC (the Habitats Directive) for 2013-2018. (10) Multi-species index measuring changes in population abundances of farmland bird species. (11) Source: annex 12 of the Commission's proposal for a soil monitoring law, SWD (2023) 417 final. (12) Estimates of organic carbon content in arable land.

This Annex ([47]) sets out Luxembourg's progress and challenges in accelerating the net-zero energy transition while bolstering the EU's competitiveness in the clean energy sector ([48]). It considers measures and targets put forward in the draft updated National Energy and Climate Plans (NECP) for 2030 ([49]).

Luxembourg has continued its significant progress in renewables deployment and in the implementation of energy efficiency measures. It remains a highly interconnected country for electricity and gas. However, energy dependency, in particular for fossil fuels, remains an issue.

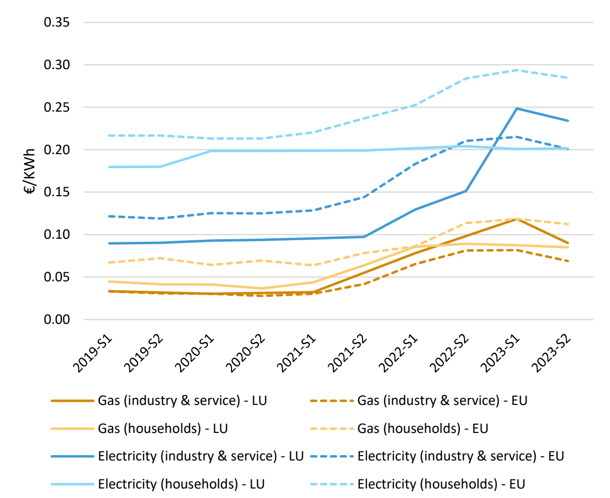
Unlike the prevailing trends across the EU, energy retail prices remained stable in Luxembourg in 2023, showing little or no difference with 2022. In the second half of 2023, average household gas prices reached EUR 85/MWh (a drop of 5% compared to 2022, when they were at EUR 89/kWh), while average household electricity prices were at EUR 0.20/kWh (1% decrease compared to 2022).

For the industrial and services sector, both gas and electricity average prices peaked in the first half (S1) of 2023 and decreased in the second half of 2023 (S2). According to the latest data, the gas/industry service price was EUR 0.09/kWh in S2 2023, an increase of 13% in comparison to S1 2022. The industry service/electricity price reached EUR 0.90/kWh in S1 2023, an increase of 90% over S1 2022.

Luxembourg adopted several support measures, mostly untargeted, to cushion the impact of energy price inflation on households and businesses. It introduced a state contribution measure to stabilize energy prices for residential customers at their average level of 2022. Different subsidy levels apply to the various energy carriers, and are applicable automatically to all residential customers. The measures are expected to be phased out at the end of 2024.

Energy dependency is still an issue in Luxembourg. The country is very reliant on fossil fuels, as they accounted for 77% of the energy mix in 2022. This, combined with the fact that it has almost no national energy production, translates into a very high energy import dependency (91% in 2022). In relative terms, electricity prices for non-household consumers have increased significantly compared to the US, Japan, and the UK, thus potentially affecting the international competitiveness of energy-intensive industries in Luxembourg.

Graph A7.1: **Luxembourg´s energy retail prices for households and industry & service**



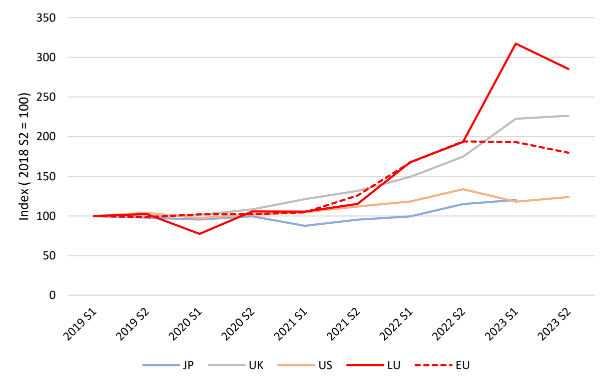
(1) For industry, consumption bands are I3 for gas and IC for electricity, which refer to medium-sized consumers and provide an insight into affordability
(2) For households, the consumption bands are D2 for gas and DC for electricity
(3) Industry prices are shown without VAT and other recoverable taxes/levies/fees as non-household consumers are usually able to recover VAT and some other taxes
Source: Eurostat

([47]) It is complemented by Annex 6 as the European Green Deal focuses on the clean energy transition and by Annex 8 on the action taken to protect the most vulnerable groups, complementing ongoing efforts under the European Green Deal, REPowerEU and European Green Deal Industrial Plan.

([48]) In line with the Green Deal Industrial Plan and the Net-Zero Industry Act

([49]) Luxembourg submitted its draft updated NECP in July 2023. The Commission issued an assessment and country-specific recommendations on 18 December 2023. Commission Recommendation, Assessment (SWD) and Factsheet of the draft updated National Energy and Climate Plan of Luxembourg - European Commission (europa.eu)

Graph A7.2:**Trends in electricity prices for non-household consumers (EU and foreign partners)**



(1) For Eurostat data (EU and LU), the band consumption is ID referring to large-sized consumers with an annual consumption of between 2 000 MWh and 20 000 MWh, such as in electricity intensive manufacturing sectors, and gives an insight into international competitiveness
(2) JP = Japan
Source: Eurostat, IEA

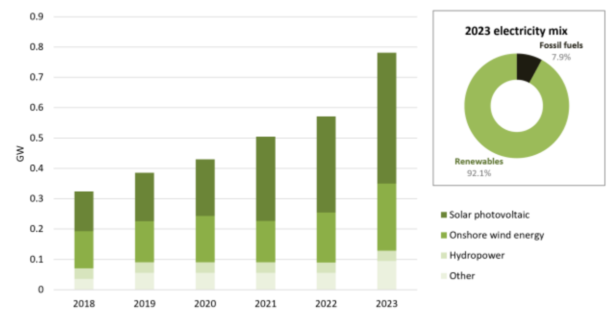
The importance of natural gas is relatively moderate in Luxembourg's energy system; in 2022 it accounted for 15% of gross available energy and for 4% of gross electricity production ([50]). Luxembourg is fully dependent on imports for its gas consumption and it shares a common market area with Belgium. Most of the gas it consumes comes by pipeline from Norway and the Netherlands and transits through Belgium. It also consumes LNG delivered at the Belgian port of Zeebrugge. Luxembourg does not have any gas storage capacity, nor solidarity arrangements with other Member States.

Overall, Luxembourg has a high level of security of gas supply, and it aims to further increase it, mainly through energy efficiency measures. These are expected to result in a decrease in gas consumption by 2030. Luxembourg also managed to reduce its gas demand between August 2022 and December 2023 by 27% in comparison with the average of the previous five years. Annual consumption amounted to 0.6 bcm in 2022 (against 0.8 bcm in 2021).

As for the security of its electricity supply, there were no adequacy issues recorded during the first half of 2023 according to ENTSO-E analysis ([51]), nor are there any expected for winter 2023/24. An expansion in electricity produced from renewable energy sources is generally set to enable Luxembourg to reduce its dependency on electricity imports, in parallel to an almost full phasing-out of gas-fired capacity by 2024.

As regards the acceleration of renewables deployment, the total installed capacity in 2023 was 782 MW, increasing by 13.5% compared to 2021. The production of energy from renewable sources is projected to increase from 314 GWh to 1 034 GWh for wind energy and 160 GWh to 1 112 GWh for solar photovoltaics in the period 2021 to 2030. Luxembourg furthermore aims to acquire 3700 GWh of renewable energy through statistical transfers and the Renewable Energy Financing Mechanism in 2030. These international cooperating measures would lead to the complete decarbonization of Luxembourg's electricity sector by 2035. Luxembourg has planned to revise legislation that will allow the speeding up of permitting procedures for decarbonization projects.

Graph A7.3: **Luxembourg's installed renewable capacity (left) and electricity generation mix (right)**



(1) "Other" includes solid biofuels, renewable municipal waste and biogas
Source: IRENA, Ember

Luxembourg's share of renewables in heating and cooling grew by 2.5% points from 2021 to 2022 (from 12.9% to 15.4%) and is projected to grow to 40.3% in 2030, according to their draft updated NECP. Approximately 3 000 heat pumps are in operation in the residential

([50]) Eurostat.

([51]) This framework assesses issues such as the potential for reducing emissions, stability, flexibility, capital and operating costs, mitigation of loss of power over long-distance transmission and integration of renewable energy into existing systems.

sector. Heating with a heat pump is cheaper than heating with a fossil fuel boiler, as long as electricity costs the end-user less than three times the price of gas. In Luxembourg the residential electricity costs the end user 2.3 times more than the price of gas. Although the contribution of heat pumps to the total renewables share in heating and cooling will increase, biomass use will remain the predominant contributor to the decarbonization of the heating and cooling sector.

Luxembourg is highly interconnected in terms of both power and gas and is highly dependent on its neighbours to meet its energy needs. In anticipation of growing renewable generation and power demand, the grid operator is planning to further develop the high voltage grid and improve interconnections, with Germany in particular, between now and 2040. According to the national transmission systems operator (TSO) about 75% of the total import and transmission capacity is already used during peak import. The TSO sees a need to both increase and modernize the electrical energy import transmission capacities. Even if Luxembourg is involved in various forms of regional energy co-operation in the EU, it is not involved in any Projects of Common Interest under the TEN-E regulation as of today.

Consumer empowerment in the electricity and gas markets is significant, with the deployment of smart meters having reached almost 100% in 2022. Luxembourg has also transposed the provisions on renewable energy communities, particularly focusing on facilitating shared self-production and consumption for renewable electricity production owned by the community ([52]). It increased subsidies and the VAT rate by 3% in January 2023 for all new self-consumption photovoltaic installations. Switching rates in electricity were very low, below 1%.

Luxembourg demonstrated significant progress in reaching the 2030 EU targets for energy efficiency. In 2022, it had a primary energy consumption of 3.8 Mtoe, a 9.3% decrease compared to 2021, and a 14.1% decrease compared to 2012. It had final energy consumption of 3.7 Mtoe, a 9.5% decrease compared to 2021, and a 11.9% decrease compared to 2012. In 2023, the best results came from the services sector, which decreased its final energy consumption by 18.5%, and the least from the residential sector, which decreased its final energy consumption by 5.0%.

Luxembourg has implemented a series of energy efficiency measures with the support of several EU funds. However, most of the schemes are addressed at buildings; schemes for businesses and industry are rather limited. Luxembourg's EUR 88.4 million recovery and resilience plan (RRP) focuses on the decarbonization of the transport sector by promoting low/zero-emission vehicles and establishing alternative fuel infrastructure. Under cohesion policy, more than 10% of the overall funding allocated to Luxembourg covers energy efficiency investment, targeting deep renovations in buildings. To fulfil its energy savings obligation, Luxemburg relies on the Energy Efficiency Obligation Scheme, but more efforts might be required to achieve 2021-2030 target.

Most of the schemes on energy efficiency are still grant-based and the use of financial instruments is still very limited. One of the most important is a grant scheme for efficient new residential buildings and renovation of residential buildings (2022-2025) - PRIMe House, in 2022 renamed Klimabonus.

Luxembourg's effort in the residential sector to achieve a meaningful contribution to its 2030 reduction target for energy consumption by buildings is still insufficient. Residential final energy consumption has remained stable since 2015, while the national Long Term Renovation Strategy envisages a reduction in building energy consumption of 36% by 2030.

Luxembourg has developed an energy renovation strategy which focusses on the worst-performing residential buildings, accompanied by a comprehensive set of economic, regulatory, information, fiscal and education measures. A national body supporting energy renovation, decarbonization and the implementation of photovoltaic

([52]) Luxembourg - REScoop

installations for residential buildings is planned.

Luxembourg reports that 3% of its households are energy poor. Without the measures put in place in 2022, this figure is estimated to be 4.1%. According to the Energy Poverty Advisory Hub (EPAH), in 2022 the share of households with an inability to heat their homes sufficiently was among the lowest in the EU, amounting to 2.1%, and the share of arrears on utility bills in 2022 was 4.4%, below the EU average (6.9%). In 2023, the bottom three income deciles of the population spent an average of 6.4% of their budget on energy, well below the EU average of 10.0% ([53]). While Luxembourg has no legal definition of energy poverty, nor a specific strategy, it has a number of social and energy-related measures targeting energy poverty. Households unable to pay their energy bills can apply for social assistance. In addition, targeted programmes ('Klimabonus, Topup social Klimabonus) create incentives and provide subsidies to switch to renewables, and these target low-income households.

Luxembourg's ambitions for the energy transition also include decarbonization by means of hydrogen. Renewable hydrogen can play a role in the integration of energy sectors in the long term. Initially, however, its use will be limited to sectors that are difficult to decarbonize by direct electrification, such as heavy industry.

Luxembourg lacks manufacturing capacity for clean technologies and has historically relied on imports for renewable energy deployment. However, promising initiatives have recently emerged, especially in the PV and battery sector. A solar panel manufacturing factory came online in late 2023. The facility has a maximum rated output of 100 MW a year (nearly 200 000 panels). Full capacity is expected to be achieved by 2026 with production levels projected to remain below 100 000 panels per year until that time. Some lithium-sulphur batteries related ventures are also implementing their activities in Luxembourg, to conduct R&D activities and eventually industrial pilots.

Despite positive signs in its innovation system, Luxembourg still lags behind other EU countries. The latest research and innovation (R&I) trends are promising, yet private R&D spending on Energy Union priorities in Luxembourg (0.06% as a share of GDP), primarily focused on investment in renewables (68%), remains notably lower than the EU average. Venture capital investment in Luxembourg has exhibited positive trends, witnessing EUR 8.5 million invested in climate tech firms in 2023, predominantly in the energy (generation and grid tech) sector. However, this only constitutes 5% of VC investment in Luxembourg, falling short of the EU's overall figure of 24% of VC investment in energy firms. Luxembourg's innovation landscape is evolving, but concerted efforts are required to bridge the gap and align with the EU's ambitious goals in the research and innovation sector.

([53]) Economic and distributional effects of higher energy prices on households in the EU : - Publications Office of the EU (europa.eu).

Table A7.1: **Key Energy Indicators**

ENERGY DEPENDNCE

	Luxembourg				EU			
	2019	2020	2021	2022	2019	2020	2021	2022
Import Dependency [%]	**95.0%**	**92.3%**	**92.4%**	**91.3%**	**60.5%**	**57.5%**	**55.5%**	**62.5%**
of Solid fossil fuels	93.1%	112.3%	97.4%	101.5%	43.3%	35.8%	37.3%	45.8%
of Oil and petroleum products	100.4%	99.9%	99.9%	99.7%	96.7%	96.8%	91.7%	97.7%
of Natural Gas	100.0%	100.0%	100.0%	100.0%	89.7%	83.6%	83.6%	97.6%
Dependency from Russian Fossil Fuels [%]								
of Natural Gas	11.7%	23.3%	18.7%	0.0%	39.7%	41.3%	41.1%	21.0%
of Crude Oil	0.0%	0.0%	0.0%	0.0%	28.8%	26.7%	26.4%	19.5%
of Hard Coal	7.3%	7.1%	6.3%	4.3%	43.5%	49.1%	47.4%	21.5%

DIVERSIFICATION OF GAS SUPPLIES

	2016	2017	2018	2019	2020	2021	2022
Gas Consumption (in bcm)	**0.8**	**0.8**	**0.8**	**0.8**	**0.7**	**0.8**	**0.6**
Gas Consumption year-on-year change [%]	-8.1%	-2.3%	-0.8%	-0.2%	-9.4%	7.3%	-22.2%
Gas Imports - by type (in bcm)	**0.8**	**0.8**	**0.8**	**0.8**	**0.7**	**0.8**	**0.6**
Gas imports - pipeline	0.8	0.8	0.8	0.8	0.7	0.8	0.6
Gas imports - LNG	0.0	0.0	0.0	0.0	0.0	0.0	-
Gas Imports - by main source supplier (in bcm) (1)							
Norway	0.5	0.2	0.1	0.1	0.2	0.3	0.2
United Kingdom	-	0.2	0.1	0.1	0.1	0.0	0.1
Belgium	-	0.0	0.1	0.3	0.1	0.1	0.1
Russia	0.2	0.1	0.2	0.1	0.2	0.1	0.0

	2019	2020	2021	2022	2023
LNG Terminals - storage capacity m3 LNG					
Number of LNG Terminals	0	0	0	0	0
LNG Storage capacity (m3 LNG)	0	0	0	0	0
Underground Storage					
Number of storage facilities	0	0	0	0	0
Technical Capacity (bcm)	0.0	0.0	0.0	0.0	0.0

ELECTRICITY/ENERGY

	2016	2017	2018	2019	2020	2021	2022	2023
Gross Electricity Production (GWh)	**2 198**	**2 235**	**2 200**	**1 908**	**2 234**	**2 211**	**2 238**	-
Combustible Fuels	468	470	490	547	628	632	526	-
Nuclear	0	0	0	0	0	0	0	-
Hydro	1 528	1 422	1 337	949	1 094	1 085	1 124	-
Wind	101	235	255	281	351	314	312	-
Solar	100	108	119	130	161	180	276	
Geothermal	0	0	0	0	0	0	0	-
Other Sources	-0	-0	0	0	0	0	0	-
Gross Electricity Production [%]								
Combustible Fuels	21.3%	21.0%	22.3%	28.7%	28.1%	28.6%	23.5%	-
Nuclear	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-
Hydro	69.5%	63.6%	60.8%	49.7%	49.0%	49.1%	50.2%	-
Wind	4.6%	10.5%	11.6%	14.7%	15.7%	14.2%	14.0%	-
Solar PV	4.6%	4.9%	5.4%	6.8%	7.2%	8.1%	12.3%	-
Geothermal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-
Other Sources	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-
Net Imports of Electricity (GWh)	**6 299**	**6 178**	**6 161**	**5 879**	**5 465**	**5 721**	**5 507**	-
As a % of electricity available for final consumption	98.9%	96.6%	95.4%	91.9%	89.3%	89.5%	89.4%	-
Electricity Interconnection [%]	**-**	**-**	**58.4%**	**58.2%**	**55.2%**	**168.4%**	**163.5%**	**166.3%**
Share of renewable energy consumption - by sector [%]								
Electricity	6.7%	8.1%	9.1%	10.9%	13.9%	14.2%	15.9%	-
Heating/cooling	7.1%	7.5%	8.4%	8.7%	12.6%	12.9%	15.4%	-
Transport	6.0%	6.5%	6.6%	7.7%	12.6%	8.0%	8.7%	-
Overall	5.4%	6.2%	8.9%	7.0%	11.7%	11.7%	14.4%	-

CLEAN ENERGY

	2019	2020	2021	2022	2023
VC investments in climate tech start-ups and scale-ups (EUR Mln)	**7.25**	**12.00**	**-**	**18.67**	**8.50**
as a % of total VC investments (2) in Malta	4.6%	7.1%	-	1.6%	5.1%
Research & Innovation spending in Energy Union R&i priorites					
Public R&I (EUR mln)	-	-	-	-	-
Public R&I (% GDP)	-	-	-	-	-
Private R&I (EUR mln)	61.3	38.3	-	-	-
Private R&I (% GDP)	0.10%	0.06%	-	-	-

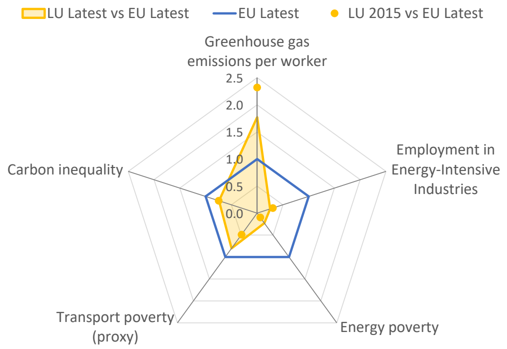
(1) The ranking of the main suppliers is based on the latest available figures (for 2022)
(2) Venture Capital investment includes Venture Capital deals (all stages), Small M&A deals and Private Equity (PE) growth deals (for companies that have previously been part of the portfolio of a VC investment firm or have received Angel or Seed funding).
Source: Eurostat, Gas Infrastructure Europe, JRC elaboration based on PitchBook data (03/2024), JRC SETIS (2024)

ANNEX 8: FAIR TRANSITION TO CLIMATE NEUTRALITY

This Annex monitors Luxembourg's progress in ensuring a fair transition towards climate neutrality and environmental sustainability, particularly for workers and households in vulnerable situations. Luxembourg's green economy is expanding. Between 2015 and 2021, total jobs in the environmental goods and services increased significantly, by 127.8% (to around 26 000) (EU: 18.2%), reaching 8.5% of total employment (EU: 2.7%). Also between 2015 and 2022, the greenhouse gas emission intensity of Luxembourg's workforce (see Graph A8.1 and Table A8.1) declined from 33.2 to 25.4 tonnes per worker, still well above the EU average (14.3 tonnes per worker in 2022) ([54]), indicating a positive trend in the green transition. To ensure a fair green transition in line with the Council Recommendation of 2022 on ensuring a fair transition towards climate neutrality ([55]), Luxembourg has increased its efforts to upskill and reskill workers in declining and transforming sectors. However, labour shortages persist, which could potentially result in a bottleneck in the green transition. The reforms and investments under the recovery and resilience plan (RRP) contribute to a fair green transition, complementing the territorial just transition plans and actions supported by the European Social Fund Plus (ESF+).

Employment in Luxembourg's sectors that are most affected by the green transition increased. In 2022, employment in Luxembourg's energy-intensive industries comprised 0.9% of total employment (EU: 3.5%). The job vacancy rate in construction (see Graph A8.2), a key sector for the green transition, is lower than the EU average (1% vs 3.6% in EU in 2023), although this contrasts with the perception of small and medium-sized enterprises (SMEs) in the sector, as 80% agreed that skills shortages are a challenge ([56]). According to the European Labour Authority (ELA) ([57]), labour shortages were reported in 2023 for a number of occupations that required specific skills or knowledge for the green transition ([58]), including insulation workers, civil engineers and mechanical engineering technicians.

Graph A8.1: **Fair transition challenges in Luxembourg**



Source: Eurostat, EU Labour Force Survey, EMPL-JRC GD-AMEDI/AMEDI+ and DISCO(H) projects (see Table A8.1).

Upskilling and reskilling in declining and transforming sectors increased, but risks of skills mismatches persist, while labour shortages are growing. In Luxembourg, 61% of the SMEs think that the skills required for greening business activities are becoming more important (EU: 42%) ([56]). If Luxembourg matches its projected contribution to the EU's 2030 renewable energy target, between 300 and 1 100 additional skilled workers will be needed for the deployment of wind and solar energy, which may require an investment in skills of EUR 3.6-4.5 million ([59]). Under the RRP, an action plan to promote continuing vocational training aims to help workers and jobseekers improve their employability.

(54) Workforce-related calculations are based on the EU Labour Force Survey. Note, in the 2023 country report for Luxembourg, such indicators were calculated based on employment statistics in the national accounts. This may result in limited comparability across the two reports.

(55) Council Recommendation of 16 June 2022 on ensuring a fair transition towards climate neutrality (2022/C 243/04) covers employment, skills, tax-benefit and social protection systems, essential services and housing.

(56) Eurobarometer on skills shortages, recruitment, and retention strategies in small and medium-sized enterprises.

(57) Based on the European Labour Authority 2024 EURES Report on labour shortages and surpluses 2023, i.e., data submitted by the EURES National Coordination Offices.

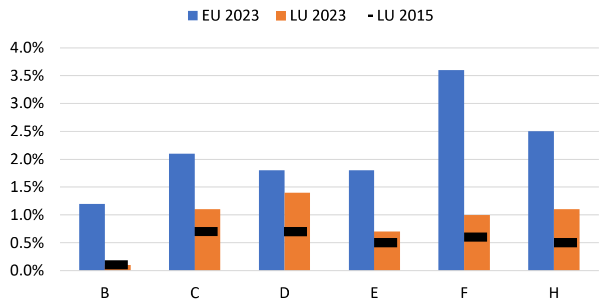
(58) Skills and knowledge requirements are based on the European Skills Competences and Occupations (ESCO) taxonomy on skills for the green transition.

(59) EMPL-JRC AMEDI+ project.

Investments under the Just Transition Fund support training to provide workers with new skills for sectors instrumental in the green transition, especially in the field of electro-mobility and in construction and sustainable renovation, in particular on aspects of health and energy efficiency. For example, the 'operation of strategic importance' (Transition énergétique artisanat+) organises 500 days of training to develop employees' skills for the energy transition (2023-2025). 16.5% of ESF+ funding contributes to increasing i) green skills and jobs with training measures for jobseekers and workers, and ii) projects to help pupils and students discover green jobs and acquire relevant new skills.

Energy poverty indicators have slightly worsened in recent years in Luxembourg but remain well below the EU average. The share of the population unable to keep their homes adequately warm increased from 0.9% in 2015 to 2.1% in 2022, remaining well below the EU average (9.3%) ([60]). However, the indicator decreased by 0.4 percentage points between 2021 and 2022, despite energy price increases due to supply constraints caused by the COVID-19 pandemic and Russia's war of aggression against Ukraine. This improvement was attributed to emergency measures implemented in Luxembourg as well as programmes to switch to renewables and increase energy efficiency, targeting low-income households. However, 5.4% of the population at risk of poverty (AROP) (EU: 20.1%) and 2.2% of lower middle-income households (in deciles 4-5) (EU: 11.6%) were affected in 2022. On the other hand, in January 2023, 29.8% of the population at risk of poverty spent a considerable proportion of their budget (more than 6%) on private transport fuels (EU: 37.1%) ([61]).

Graph A8.2: **Job vacancy rate in transforming sectors and mining and quarrying**



B - Mining and quarrying
C - Manufacturing
D - Electricity, gas, steam and air conditioning supply
E - Water supply; sewerage, waste management and remediation activities
F - Construction
H - Transportation and storage
Source: Eurostat jvs_a_rate_r2.

Consumption footprint inequality remains a critical issue leading to environmental inequalities in Luxembourg. In 2021, the consumption footprint for 20% of the population with the highest income was 2.0 times higher than the footprint of the poorest 20% ([62]) (EU: 1.8). For both groups, the consumption footprint is highest for food and housing. The average levels of air pollution in 2021 stood below the EU average (7.4 vs 11.4 µg/m3 PM2.5), and all regions were below critical levels of air pollution ([63]). However, there have been an estimated 77 premature deaths annually due to exposure to air pollution ([64]).

([60]) Energy poverty is a multi-dimensional concept. The indicator used focuses on an outcome of energy poverty. Further indicators are available at the Energy Poverty Advisory Hub.

([61]) Affordability of private transport fuels is one key dimension of transport poverty. The indicator has been developed in the context of the EMPL-JRC GD-AMEDI/AMEDI+ projects. Methodology explained in Economic and distributional effects of higher energy prices on households in the EU.

([62]) Developed in the context of the EMPL-JRC DISCO(H) project. Methodology explained in Joint Research Centre, 2024. Carbon and environmental footprint inequality of household consumption in the EU. JRC137520. The EU average refers to EU27 without Italy (household income data not available for IT in the HBS).

([63]) Two times higher than the recommendations in the WHO Air Quality Guidelines (annual exposure of 5µg/m3).

([64]) EEA - Air Quality Health Risk Assessment

Table A8.1: **Key indicators for a fair transition in Luxembourg**

Indicator	Description	LU 2015	LU	EU
GHG per worker	Greenhouse gas emissions per worker – CO_2 equivalent tonnes	33.2	25.4 (2022)	14.3 (2022)
Employment EII	Employment share in energy-intensive industries, including mining and quarrying (NACE B), chemicals (C20), minerals (C23), metals (C24) and automotive (C29)	1.1%	0.9% (2022)	3.5% (2022)
Energy poverty	Share of the total population living in a household unable to keep its home adequately warm	0.9%	2.1% (2022)	9.3% (2022)
Transport poverty (proxy)	Estimated share of the AROP population that spends over 6% of expenditure on fuels for personal transport	18.2%	29.8% (2023)	37.1% (2023)
Carbon inequality	Ratio between the consumption footprint of the top 20% vs bottom 20% of the income distribution	2.0	2.0 (2021)	2.7 (2021)

Source: Eurostat (env_ac_ainah_r2, lfsa_egan2d, ilc_mdes01), EU Labour Force Survey (break in time series in 2021), EMPL-JRC GD-AMEDI/AMEDI+ and DISCO(H) projects.

Luxembourg's economy and labour market appear to be less affected by the challenges stemming from the green transition due to its economy's structure. This is reflected in the country's relatively low carbon-intensive economy and currently resilient labour market characterised by the predominance of the tertiary sector. However, further efforts are needed to target sectors, groups and develop appropriate employment measures to facilitate the retention of workers, the return to work and job-to-job transitions. Luxembourg plans to introduce a new training programme for workers, including for the green economy, as well as for boosting skills needed for green jobs. Luxembourg has in place measures to support access to finance and business creation by groups underrepresented in the labour market ([65]).

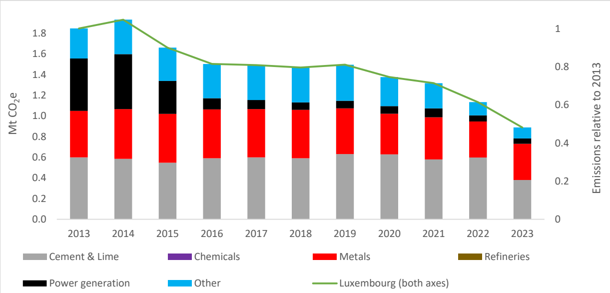
([65]) Based on the monitoring review of the Council Recommendation on ensuring a fair transition towards climate neutrality, which took place in October 2023.

ANNEX 9: RESOURCE PRODUCTIVITY, EFFICIENCY AND CIRCULARITY

The green transition of industry and the built environment, in particular decarbonisation, resource efficiency and circularity, is essential to boost Luxembourg's competitiveness (66). In this regard, priorities for Luxembourg are the use of circular materials in industry and construction.

Luxembourg's circular economy transition is insufficient to achieve the EU Circular Economy Action Plan goals. In 2022, Luxembourg's material footprint was among the EU's highest with 23.67 tonnes per capita (67). In 2020, waste production per capita remained well above the EU average with 14.6 tonnes per capita (68). Measures targeting the highest levels of the waste hierarchy could significantly reduce environmental impacts. The key policies and measures set out in Luxembourg's national energy and climate plan recognise the circular economy's role in decarbonisation, mainly in relation to waste and late stages of the product life cycle. Design, reusability, skills, and training, however, are not mentioned. The plan also addresses the importance of circularity in the 2020 building renovation strategy, in particular for public stakeholders.

Graph A9.1: **ETS emissions by sector since 2013**



Source: European Commission

Between 2019 and 2023, greenhouse gas emissions from the sectors covered by the EU emissions trading system (ETS) in Luxembourg (69) declined by 41%, speeding up the trend of 2013-2019, which saw a reduction of almost 21%. In 2023, 43% of the greenhouse gases emitted by Luxembourg's ETS installations came from cement and lime production, 39% came from the metals industry, and 12% from other industries. Between 2013 and 2023, greenhouse gas emissions from the metals industry decreased by 22%, while in 'other industries' (glass production) they declined by 62%. With emissions broadly stable between 2013 and 2022, cement and lime production saw a steep decline in 2023, by 36%. In 2023, power generation accounted for only 6% of greenhouse gas emissions (EU average: 57%), following big reductions in 2014-2016.

There is room for Luxembourg's industry to improve its resource efficiency and environmental impact. Luxembourg's industry has a significant impact on air quality and is the main source of emission for several pollutants (70). The cost of air emission from industry totalled almost EUR 0.5 billion in 2021. Luxembourg's circular material use rate dropped significantly from 10.7% in 2018 to 5.2% in 2022, below the EU average. Luxembourg's dependence on imports is the highest of all EU countries. In 2022, Luxembourg relied on imports for 89.7% of materials used (71), highly exposing the country to market disruptions. Moreover, Luxembourg's consumption footprint is historically among the highest of the EU (72). Food consumption is the activity with the highest consumption impact on the

(66) See also Annexes 6, 7 and 12.

(67) Versus an EU average of 14.896 tonnes per capita.

(68) Versus an EU average of 4.8 tonnes per capita (Waste statistics - Statistics Explained (europa.eu)).

(69) This analysis excludes air travel. For more details and the data sources, see Weitzel, M; van der Vorst, C. (2024), Uneven progress in reducing emissions in the EU ETS, JRC Science for policy brief, JRC138215, Joint Research Centre.

(70) Manufacturing and extractive industry contributed in 2021 to 76.7% of SO_2, 55.9% of NMVOC, and 33.6% of PM2.5 emissions. Luxembourg – air pollution country fact sheet — European Environment Agency (europa.eu)

(71) Versus an EU average of 22.4% (Statistics | Eurostat (europa.eu)).

(72) Totalling 1.7 points of impact per capita in 2021, above the EU average of 0.95 points (Consumption footprints for EU countries in 2010 and 2021 — European Environment Agency (europa.eu)).

Table A9.1: **Circularity indicators**

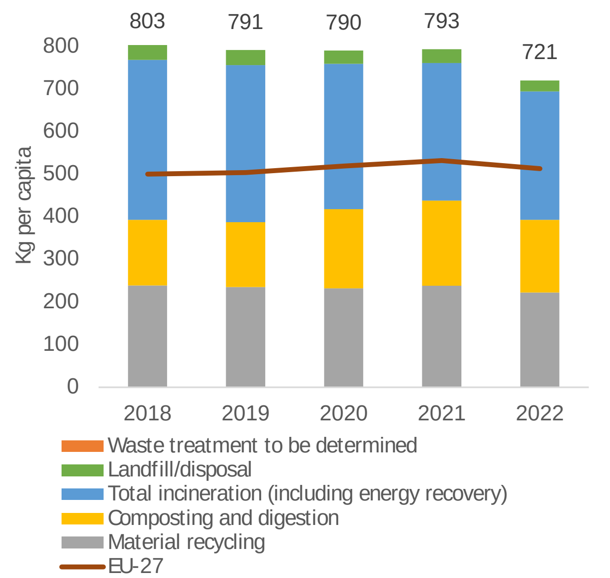
	2018	2019	2020	2021	2022	2023	EU-27	Latest year
Industry								
Resource productivity (purchasing power standard (PPS) per kilogram)	3.4	3.4	3.5	3.5	4.0	-	2.5	2022
Circular material use rate (%)	10.7	9.0	9.6	4.1	5.2	-	11.5	2022
Eco-innovation index (2013=100)	172.0	175.5	174.7	173.1	179.0	-	121.5	2022
Recycling of plastic packaging (%)	32.3	33.4	34.7	39.5	-	-	40.7	2021
Cost of air emissions from industry (EUR bn)	0.5	0.5	0.5	0.5	-	-	352.7	2021
Built environment								
Recovery rate from construction and demolition waste (%)	98.0	-	99.0	88.1	-	-	89.0	2020
Soil sealing index (base year = 2006)	104.4	-	-	-	-	-	103.4	2018
Non-residential floor area (m^2 per capita)	17.8	17.7	17.6	-	-	-	18.0	2020
Waste backfilled (%)	0.5	-	9.6	-	4.6	-	9.9	2020

Source: Eurostat, European Environment Agency

environment, before transport (73). By contrast, resource productivity has increased in the last few years and Luxembourg achieved the second-highest score in the EU (74) in 2022.

Strong eco-innovation performance has helped to develop a highly competitive environmental goods industry. The 2022 Eco-Innovation Scoreboard listed Luxembourg among the eco-innovation leaders, with a score of 179. The country totalled 6 EU Ecolabel licences and 6 products with the EU Ecolabel in 2023.

Graph A9.2: **Treatment of municipal waste**



Source: Eurostat

Luxembourg's significant progress in waste management is dampened by a high waste generation. In 2022, the country generated more municipal waste than the EU average (75), with 721 kg per person, but the recycling rate stood at 54.5% of municipal waste. The country is considered on track to achieve both the 2025 target for packaging waste and the 2025 target for municipal waste. However, Luxembourg is at risk of missing the plastic packaging recycling average (76), with a rate of 39.5% in 2021. Moreover, the share of incinerated municipal waste is significantly high, with more than 41.7% in 2021.

Despite some positive trends, there is still room to improve resource efficiency in the building sector. The residential and non-residential floor areas slightly decreased, respectively, to 54 m^2 and 17.6 m^2 per capita in 2020, just below the EU. However, Luxembourg's soil sealing index remains above the EU average. In 2020, Luxembourg published a long-term renovation plan to decarbonise the building stock, including circular economy concepts for sustainable construction.

Construction and demolition waste management can also be improved in Luxembourg. Since 2010, waste generated from construction and demolition activities per capita increased significantly (75). The recovery rate decreased in 2021, below the EU average. Some major companies in the construction

(73) 43% and 23%, respectively (Consumption Footprint Platform | EPLCA (europa.eu)).

(74) E.g. almost 4 purchasing power standards per kilogram.

(75) Of 513 kg per person (Statistics | Eurostat (europa.eu)).

(76) Of 54.4 m^2 per capita (EU Building Stock Observatory - Factsheets (europa.eu)).

sector are reporting on circular economy activities. However, a more comprehensive approach beyond the decarbonisation dimension is lacking.

Digital transformation is key to ensuring a resilient and competitive economy. In line with the Digital Decade Policy Programme, and in particular with the targets in that Programme for digital transformation by 2030, this Annex describes Luxembourg's performance on digital skills, digital infrastructure/connectivity and the digitalisation of businesses and public services. Where relevant, it makes reference to progress on implementing the Recovery and Resilience Plan (RRP). Luxembourg allocates 29.6% of its total RRP budget to digital (EUR 24.47 million) ([77]). Under Cohesion Policy, an additional EUR 6.8 million (18% of the country's total Cohesion Policy funding) is allocated to the country's digital transformation ([78]).

The Digital Decade Policy Programme sets out a pathway for EU's successful digital transformation by 2030. Luxembourg's national roadmap outlines the actions it intends to take to reach the objectives and targets at national level. The first Report on the State of the Digital Decade highlighted the need to accelerate and deepen the collective efforts to reach the EU-wide targets and objectives ([79]). Among others, a digitally skilled population increases the development and adoption of digital technologies and leads to productivity gains and new business models. It also leads to higher inclusion and participation in an environment increasingly shaped by the digital transformation ([80]). Digital technologies, infrastructure and tools all play a role in addressing the current structural challenges, including strategic dependencies, cybersecurity and climate change.

Luxembourg performs very well in terms of advanced digital skills, having a large share of ICT specialists in the workforce. While the percentage of individuals employed as ICT specialists is very high (8.0%) compared to the EU average (4.8%), the share of businesses reporting hard-to-fill vacancies for jobs requiring ICT specialist skills is well above the EU average (71% compared to 63%), showing the labour market's increasing need for ICT specialists. In terms of population (aged between 16 and 74) having at least basic digital skills, the country scores above the EU average (60% compared with 56%), but a slight decrease has been observed since 2021.

Luxembourg is among the EU leaders in digital infrastructure/connectivity. It scores considerably above the EU average for very high capacity network (VHCN) coverage. In 2023, overall 5G coverage stood at 100%, also well above the EU average.

Digital technologies are well integrated into business activities. Luxembourg performs at the EU average (58%) in terms of basic digital intensity of small and medium-sized enterprises (SMEs). For adoption of the three advanced digital technologies monitored in the Digital Decade, enterprises score slightly below the EU average, with 52% of enterprises using either cloud computing services, big data or artificial intelligence (EU average: 55%). In 2022, 4.3% of enterprises in Luxembourg reported ICT service outage due to cyberattacks (e.g. ransomware attacks, denial of service attacks). Over the same year, 19.4% of enterprises developed or reviewed their ICT security policy within the previous 12 months.

Luxembourg scores well on digital public services. The country performs considerably above the EU average in digital public services –for both citizens and businesses. The country implements multiple initiatives and programmes to further digitalise the public sector. A national electronic identification (eID) scheme is in place, which has been notified under the eIDAS Regulation. A national

([77]) The share of financial allocations that contribute to digital objectives has been calculated using Annex VII to the Recovery and Resilience Facility Regulation.

([78]) This amount includes all investment specifically aimed at or substantially contributing to digital transformation in the 2021-2027 Cohesion Policy programming period. The source funds are the European Regional Development Fund, the Cohesion Fund, the European Social Fund Plus, and the Just Transition Fund.

([79]) European Commission (2023): Report on the state of the Digital Decade 2023, [2023 Report on the state of the Digital Decade | Shaping Europe's digital future (europa.eu)](europa.eu).

([80]) See for example OECD (2019): OECD Economic Outlook, Digitalisation and productivity: A story of complementarities, [OECD Economic Outlook, Volume 2019 Issue 1 | OECD iLibrary (oecd-ilibrary.org)](oecd-ilibrary.org) and OECD (2019): Going Digital: Shaping Policies, Improving Lives – Summary, https://www.oecd.org/digital/going-digital-synthesis-summary.pdf.

Table A10.1: **Key Digital Decade targets monitored by the Digital Economy and Society Index indicators**

	Luxembourg 2022	Luxembourg 2023	Luxembourg 2024	EU 2024	Digital Decade target by 2030 (EU)
Digital skills					
At least basic digital skills	**64%**	**64%**	**60%**	**56%**	**80%**
% individuals	2021	2021	2023	2023	2030
ICT specialists (1)	**6.7%**	**7.7%**	**8.0%**	**4.8%**	**20 million**
% individuals in employment aged 15-74	2021	2022	2023	2023	2030
Digital infrastructure/connectivity					
Fixed very high capacity network (VHCN) coverage	**93%**	**93%**	**95%**	**79%**	**100%**
% households	2021	2022	2023	2023	2030
Fibre to the premises (FTTP) coverage (2)	**75%**	**76%**	**79%**	**64%**	**-**
% households	2021	2022	2023	2023	
Overall 5G coverage	**13%**	**93%**	**100%**	**89%**	**100%**
% populated areas	2021	2022	2023	2023	2030
Digitalisation of businesses					
SMEs with at least a basic level of digital intensity	**54%**	**NA**	**58%**	**58%**	**90%**
% SMEs	2021		2023	2023	2030
Data analytics	**NA**	**NA**	**32%**	**33%**	**-**
% enterprises			2023	2023	
Cloud	**29%**	**29%**	**33%**	**39%**	**-**
% enterprises	2021	2021	2023	2023	
Artificial intelligence	**13%**	**13%**	**14%**	**8%**	**-**
% enterprises	2021	2021	2023	2023	
AI or cloud or data analytics (3)	**NA**	**NA**	**52%**	**55%**	**75%**
% enterprises			2023	2023	2030
Digitalisation of public services					
Digital public services for citizens	**93**	**95**	**95**	**79**	**100**
Score (0 to 100)	2021	2022	2023	2023	2030
Digital public services for businesses	**97**	**97**	**97**	**85**	**100**
Score (0 to 100)	2021	2022	2023	2023	2030
Access to e-health records	**NA**	**67**	**76**	**79**	**100**
Score (0 to 100)		2022	2023	2023	2030

(1) The 20 million target represents about 10% of total employment.
(2) The fibre to the premises coverage indicator is included separately as its evolution will also be monitored separately and taken into consideration when interpreting VHCN coverage data in the Digital Decade.

(3) At least 75% of EU enterprises have taken up one or more of the following, in line with their business operations: (i) cloud computing services; (ii) big data; (iii) artificial intelligence.
Source: Digital Economy and Society Index

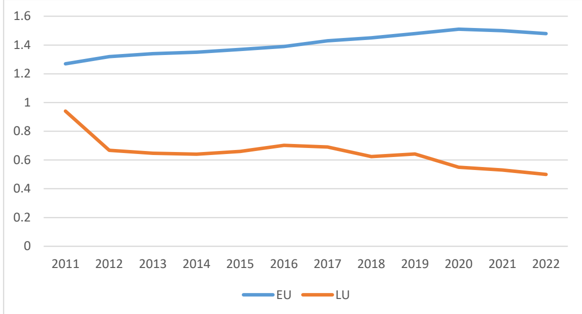
electronic wallet is under development enabling users to manage and present digital versions of official documents on their smartphones. The country has also started to implement some RRP measures to modernise and digitalise public services and to provide e-health services.

This Annex provides a general overview of the performance of Luxembourg's research and innovation system, which is essential for delivering the twin transition and ensuring long-term competitiveness.

Luxembourg is a 'strong innovator', but its performance decreased relative to the EU average. According to the 2023 edition of the European Innovation Scoreboard ([81]), its innovation performance has decreased by 1.5 percentage points since 2016, at a lower rate than the EU's (8.5pp). However, its overall performance remains above the EU average (117.2%). Luxembourg's relative strengths notably include the share of international scientific co-publications or foreign doctorate students, reflecting the quality and attractiveness of Luxembourg's public research system which has become a pole of attraction for excellent researchers.

Luxembourg has been unable to raise its R&D intensity, which has been on a declining trend over the past two decades. Low and declining R&D intensity, in 2022 representing 77% from the 2016 value (0.98% in 2022 compared to 1.27% in 2016), remains a challenge, holding back the much-needed diversification of the economy. While public expenditure on R&D (relative to GDP) has remained stagnant (at 0.48% in 2022) in recent years, business R&D intensity has continued to decline, falling to 0.50% in 2022 (graph A 1.1.1). This is weighing on Luxembourg's competitiveness, as reflected for example in the fact that Luxembourg lost seven places compared with last year and is now ranked the 20th most competitive country in the world according to the IMD World Competitiveness Ranking 2023 ([82]).

Graph A11.1: **Business expenditure on R&D as % of GDP, 2011-2022**



Source: Eurostat

Public support for business innovation remains very low. Over the last few years Luxembourg has continued implementing measures aimed at fostering business innovation, for example through the 'Fit 4' performance programmes targeting 210 start-ups and small and medium-sized enterprises in 2022, where new components such as Sustainability and Innovation HealthTech Market have been added ([83]). However, public support for business innovation is still marginal (0.037% of GDP in 2019, compared to an EU average of 0.204%). Luxembourg does not provide indirect support to R&D in the form of tax credits, unlike most OECD and EU countries. The government allocates only 25% of its R&D budget to specific projects, including those with private partners, the remaining 75% being for institutions. Only 6% of business R&D is funded by government ([84]). The government recently announced an increase in research funding of nearly EUR 300 million, reaching a total of EUR 1.7 billion for 2022-2025 ([85]), but that amount is for public institutions only. Luxembourg could fund more innovation projects in partnership with businesses to generate more private research and innovation. This is key to increasing productivity (see Annex 12).

([81]) European Innovation Scoreboard (EIS) 2023: https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-lu.pdf. The EIS provides a comparative analysis of innovation performance in EU countries, including the relative strengths and weaknesses of their national innovation systems (also compared to the EU average).

([82]) World Competitiveness Index 2023 https://imd.cld.bz/IMD-World-Competitiveness-Booklet-2023/37/.

([83]) Luxinnovation, annual report, 2022. https://www.luxinnovation.lu/wp-content/uploads/sites/3/2023/04/luxinnovation-rapport-annuel-2022-web.pdf.

([84]) OECD Economic Surveys: Luxembourg 2022 | READ online (oecd-ilibrary.org).

([85]) Luxembourg to invest EUR 1.7 billion in research and higher education – researchluxembourg.

Table A11.1: **Key innovation indicators**

Luxembourg	2010	2015	2020	2021	2022	EU average (1)
Key indicators						
R&D intensity (GERD as % of GDP)	1.42	1.25	1.06	1.04	0.98	2.24
Public expenditure on R&D as % of GDP	0.48	0.59	0.52	0.51	0.48	0.73
Business enterprise expenditure on R&D (BERD) as % of GDP	0.94	0.66	0.54	0.53	0.5	1.48
Quality of the R&I system						
Scientific publications of the country within the top 10% most cited publications worldwide as % of total publications of the country	13.7	12.6	13.58	:	:	9.6
PCT patent applications per billion GDP (in PPS)	1.6	1.7	2.19	:	:	3.4
Academia-business cooperation						
Public-private scientific co-publications as % of total publications	9.4	8.9	10.6	13.4	13.4	7.6
Public expenditure on R&D financed by business enterprise (national) as % of GDP	0.008	0.007	0.012	0.013	:	0.054
Human capital and skills availability						
New graduates in science & engineering per thousand pop. aged 25-34	:	1.9	2.5	2.7	:	16.9
Public support for business enterprise expenditure on R&D (BERD)						
Total public sector support for BERD as % of GDP	:	0.052	:	:	:	0.204
Business enterprise expenditure on R&D (BERD) financed by the public sector (national and abroad) as % of GDP	:	0.052	:	:	:	0.1
R&D tax incentives: foregone revenues as % of GDP	:	:	:	:	:	:
Green innovation						
Share of environment-related patents in total patent applications filed under PCT (%)	17	11.9	15.9	:	:	14.7
Finance for innovation and economic renewal						
Venture capital (market statistics) as % of GDP	0.035	0.011	0.036	0.042	0.123	0.085
Employment share of high growth enterprises measured in employment (%)	:	10.3	11.9	:	:	12.51

(1) EU average for the latest available year or the year with the largest number of country data.
Source: Eurostat, OECD, DG JRC, Science-Metrix (Scopus database and EPO's Patent Statistical Database), Invest EU

Despite the high quality of Luxembourg's public research system, linkages with the business sector remain underexploited ([86]). Science-business linkages remain weak, as evidenced by the low share of public expenditure on R&D financed by businesses (0.01% in 2021, compared to an EU average of 0.054%). The Luxembourg recovery and resilience plan (RRP) does not contain specific measures to address this challenge. However, the plan does feature substantial support for the development of quantum communication infrastructure, which is expected to help Luxembourg accumulate key research and innovation (R&I) capabilities in this field while providing possible opportunities for cooperation between research labs and businesses.

The shortage of skilled workers has worsened, accentuating the mismatch between available skills and the profiles required on the market. The gap between the profiles available and the skills that the economy needs persists, due to the difficulties which the national education system has in training the talents that companies need and due to companies' strong dependence on highly qualified people from abroad ([87]).

([86]) Through the national PEARL programme, EUR 4 million were allocated in 2023 to develop quantum computing, while through the national programme BRIDGE, Luxembourg launched specific calls for industry partnerships between public research institutions and national or international companies as well as thematic calls.

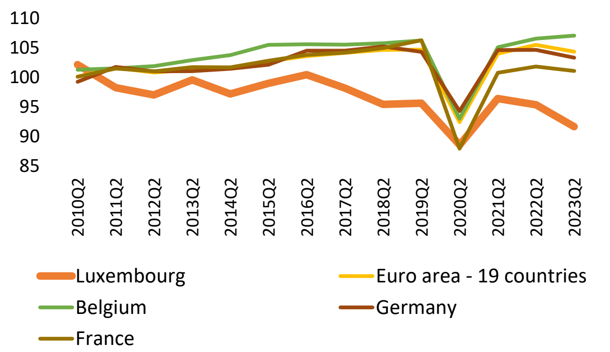
([87]) https://www.cc.lu/fileadmin/user_upload/tx_ccnews/Publications_2021_Eco_News_Flash_N__6__Ecosysteme_d_innovation.pdf.

Luxembourg has a competitive economy and is well integrated into the single market for services. According to the Institute for Management Development ([88]), Luxembourg is the 20th most competitive economy in the world, a good position despite dropping seven places compared to the year before. This drop is mainly due to the deterioration of Luxembourg's performance in international investment and its domestic economy, with a fall in GDP and investments. However, it remains a top performer in attracting talent and maintains a strong position in international investment and trade. Its single market integration is the highest in the EU, with exports and imports of goods and services representing 113% of its GDP (EU average 43%) (see Table A12.1). This is mainly explained by Luxembourg's specialisation in services, in particular financial services: in 2022, exports and imports of services represented 87% of GDP, far ahead of the EU average (12%), while exports and imports of goods only represented 26% of GDP, which was slightly below the EU average (29%) ([89]).

Since 2022, firms have faced an unfavourable economic climate and a sharp increase in labour costs, which weigh on investment and competitiveness. Geopolitical tensions, rising interest rates, high prices and inflation, high labour costs and labour shortages have harmed firms' trust in the economic outlook. In particular, the increase in labour costs constitutes a major challenge for 64% of Luxembourgish firms ([90]). All these factors weigh on investment: 21% of firms plan to reduce their investments in the coming months, in particular those active in the construction, hospitality and manufacturing sectors ([91]).

Although still one of the highest in the EU, Luxembourg's labour productivity has been stagnating over the last two decades. When looking at labour productivity levels measured as GDP per hour worked, Luxembourg has one of the highest levels in the EU. When analysing labour productivity in terms of growth rates, the situation looks less positive. Graph A12.1 shows that since 2010, Luxembourg's labour productivity has evolved less favourably than that of the euro area and its neighbouring countries ([92]). In 2023, it is forecast to decrease by 3.3%, against a decrease of 0.7% in the EU ([93]). Differences across sectors are significant, both in terms of levels and growth. Labour productivity in the information and communication sector has declined sharply since 2017 ([94]). Since 2018, labour productivity per person in industry has decreased on average by nearly 0.5% per year, while it has increased by 1.6% on average in the EU ([95]).

Graph A12.1: **Labour productivity (GDP per person employed, index 2010=100)**



Source: Eurostat

Low productivity gains are partly explained by low business investment, including in research and innovation. In 2022, business investment represented 8.2% of GDP in Luxembourg against 13.7% in the EU. This is among the lowest in the EU ([96]) and in the OECD ([97]). In 2023, investment in equipment grew less in Luxembourg than in the rest of

([88]) Institute for Management Development, World Competitiveness Ranking 2023 – Luxembourg, 6/2023.

([89]) Eurostat, bop_c6_a

([90]) Luxembourgish Chamber of Commerce, baromètre de l'économie 2nd semester 2023.

([91]) Ibid.

([92]) Eurostat, NAMA_10_LP_A21.

([93]) European Commission, Spring 2024 forecasts- statistical annex, 15/5/2024.

([94]) Conseil national de la productivité, rapport annuel 2021-2022, 12/2022, p.18.

([95]) Eurostat, NAMA_10_LP_A21.

([96]) Eurostat, SDG_08_11

([97]) OECD, Economic Surveys: Luxembourg 2022, 17/11/2022.

the EU (3.4% against 4.2%) ([98]). Business expenditure on R&D has continued to decline and fell to 0.50% in 2022 against 1.48% in the EU ([99]), while non-R&D innovation expenditure is still far below the EU average despite some improvement. Investment in intangible assets is significantly below the EU aggregate, driven by weak investment in both R&D and software. The Innovation Scoreboard ([100]) highlights government support for business R&D as a relative weakness. Public support for business innovation is in fact still low (0.037% of GDP in 2019, compared to an EU average of 0.197%). Luxembourg has implemented measures to boost business innovation, such as the 'Fit 4' performance programmes. However, it could fund more innovation projects in partnerships between the public research system and businesses (see Annex 11).

The lack of skilled staff is seen as the main long-term barrier to business investment. The availability of skilled staff is the most cited long-term barrier to investment by Luxembourgish firms (91% vs 81% in the EU) ([101]). Despite the high number of cross-border workers (47% of the workforce), firms, especially small and medium-sized enterprises (SMEs), face skills shortages, particularly machine operators, craft and skilled trade workers ([102]). Labour shortages are particularly high in the construction sector (see Annex 14). The other most cited barriers to investment are energy costs (84% vs 83%) and uncertainty about the future (82% vs 78%). Labour regulations are referred to more frequently by Luxembourgish firms than by other EU firms (67% vs 60%), while business regulations are mentioned less than in the rest of the EU (57% vs 61%). Despite the rise in interest rates, access to finance remains good for both loans and equity ([103]) and does not constitute a barrier to investment for most firms. On late payments, the situation is less favourable: the share of SMEs that experienced late payments reached nearly 70% in 2023, significantly above the EU average (49%).

Entrepreneurship is insufficiently developed. Luxembourg only ranks 39th out of 47 countries for total early-stage entrepreneurial activity ([104]). The business birth rate is rather low (8.6% vs 10.7% in the EU in 2021) ([105]). Starting a business, while possible to do online, remains a cumbersome procedure ([106]). Entrepreneurs' fear of failure is among the highest in the EU. To modernise the right of establishment and stimulate entrepreneurship, Luxembourg amended the law governing access to occupations in craft trades, business and industry and to certain liberal professions in 2023 ([107]). The law provides among other things for the digitalisation of some procedures to start a business, the promotion of the right to start a second business after bankruptcy, the simplification of the requirements relating to the holder of the business licence and business transfers, and the facilitation of access to certain craft professions (see below). However, this law contains restrictions, as pointed out by the Luxembourgish Chamber of Commerce ([108]).

Tackling structural weaknesses, including restrictive regulations in services, would improve productivity. According to the national productivity board ([109]), investments in digitalisation, research and innovation,

([98]) European Commission, Spring 2024 forecasts- statistical annex, 15/5/2024.

([99]) European Commission, Eurostat, RD_E_BERDPFR2

([100]) European Commission, Innovation Scoreboard 2023, Luxembourg, 6/2023.

([101]) European Investment Bank, EIB Investment Survey 2023, 10/2023.

([102]) European Commission, Flash Eurobarometer 529, 9/2023.

([103]) EIF SME Access to Finance Index.

([104]) Global Entrepreneurship Monitor 2023, 2/2023, pp. 142-143.

([105]) Eurostat, birthrate, 2021.

([106]) OECD Economic Surveys: Luxembourg 2022, 17/11/2022.

([107]) Loi du 26 juillet 2023 portant modification de la loi modifiée du 2 septembre 2011 réglementant l'accès aux professions d'artisan, de commerçant, d'industriel ainsi qu'à certaines professions libérales..

([108]) Réforme du droit d'établissement : la Chambre de Commerce juge les efforts de modernisation insuffisants, 13/7/2023.

([109]) Conseil national de la productivité, Rapport annuel 2022-2023, 12/2023 reskilling and improvement of managerial skills, as well as adaptation of the regulatory framework to strengthen competition, are key to improving productivity (see also the analyses in Annexes 10, 11, 14 and below). Professional licensing rules in Luxembourg are in fact among the most restrictive in the OECD. Making professional regulations less restrictive could increase GDP per capita by 0.6% over 5 years ([110]). Compared to other EU Member States, regulatory restrictions remain particularly high for architects, civil engineers, accountants and tax advisers, lawyers and estate agents ([111]). The fragmented system that regulates civil engineers hinders the free movement of professionals, and the rules that spread responsibility over different categories of professionals in the same area of activity affect the proportionality and efficiency of service provision. The law governing access to occupations in craft trades, business and industry and to certain liberal professions deregulated several craft professions such as photographer or knitter, for which a professional qualification is therefore no longer necessary. In the retail sector, the regulatory environment for both establishing and operating shops has significantly improved since 2018 ([112]). However, territorial supply constraints still affect consumer choice and prices. In 2022, food prices in Luxembourg were among the highest in the EU ([113]).

Luxembourg's administration performs well on single market indicators. The country has shortened the time taken to transpose single market directives into national law. It needs 10.1 months to transpose directives (EU average 18.3 months) ([114]). Its transposition deficit was 1% (EU average 0.7%). On single market infringements, Luxembourg performs well: it has been among the Member States with the fewest cases since 2010. However, the duration of infringement proceedings is increasing and now exceeds the EU average. Luxembourg solved 83.0% of the 24 cases it handled as lead centre, below the EU average of 88.3%. Businesses' access to public procurement remains satisfactory, and the share of single bids is slightly below the EU average.

Luxembourg is in the intermediate stage of implementing the components needed to connect to the 'Once-Only' Technical System (OOTS) ([115]). As part of the Single Digital Gateway Regulation ([116]), the system will enable the automated cross-border exchange of evidence between competent authorities, improving online access to information, administrative procedures and assistance within the EU. The onboarding of Luxembourg's competent authorities is crucial for the system to function smoothly and to reduce administrative burden.

([110]) OECD, Economic surveys: Luxembourg 2022, 17/11/2022.

([111]) European Commission, Communication on updating the reform recommendations for regulation in professional services, COM (2021)385, 9/7/2021.

([112]) European Commission, 2022 update of the Retail Restrictiveness Indicator

([113]) Eurostat, Comparative price levels of consumer goods and services for 2022

([114]) European Commission, Single Market Scoreboard . See also Table A12.1.

([115]) Implementing Regulation (EU) 2022/1463

([116]) Regulation (EU) 2018/1724

Table A12.1: **Single Market and Industry**

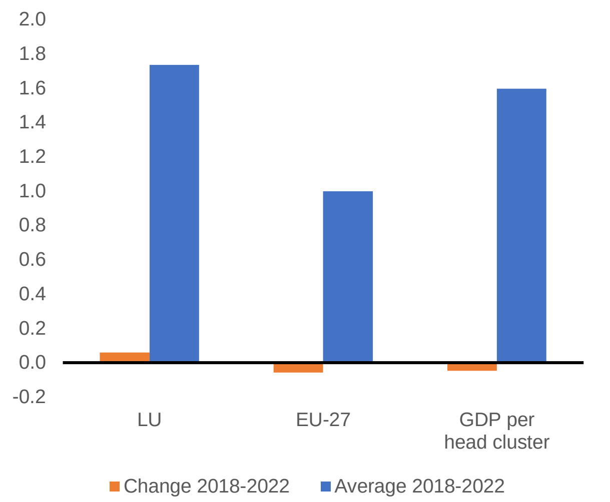
POLICY AREA	INDICATOR NAME	2019	2020	2021	2022	2023	EU27 average*
Luxembourg							
HEADLINE INDICATORS							
Economic Structure	Net Private investment, level of private capital stock, net of depreciation, % GDP[1]	4.2	2.2	4.6	3.2	2.8	**3.8**
	Net Public investment, level of public capital stock, net of depreciation, % GDP[1]	1.8	2.2	1.7	1.5	1.9	**1.2**
	Real labour productivity per person in industry (% yoy)[2]	10.4	-2	2.8	-11.7	6.3	**-1.24**
Cost competitiveness	Nominal unit labour cost in industry (% yoy)[2]	-8.1	0.9	2.7	17.8	0.9	**9.83**
SINGLE MARKET							
Single Market integration	EU Trade integration, % (Average intra-EU imports + average intra EU exports)/GDP[2]	112.5	109.6	117.3	116.8	112.8	**42.9**
Compliance	Transposition deficit, % of all directives not transposed[3]	0.6	1.9	1.8	1.5	1	**0.7**
	Conformity deficit, % of all directives transposed incorrectly[3]	0.7	0.9	0.8	0.8	0.5	**1.1**
	SOLVIT, % resolution rate per country[3]	50.0	93.8	76.9	80.0	83.0	**88.3**
	Number of pending infringement proceedings[3]	11	11	18	13	10	**25.9**
Restrictions	EEA Services Trade Restrictiveness Index[4]	0.07	0.07	0.07	0.07	0.07	**0.05**
Public procurement	Single bids, % of total contractors[3]	17	20	18	23	27	**28.6**
	Direct Awards, %[3]	3	8	6	6	4	**8.1**
ECONOMIC STRUCTURE							
Shortages	Material Shortage (industry), firms facing constraints, %[5]	5.3	4.6	18.3	14.2	10.7	**17.2**
	Labour Shortage using survey data (industry), firms facing constraints, %[5]	6.5	12.0	16.4	27.0	19.6	**23.3**
	Vacancy rate, % of vacant posts to all available ones (vacant + occupied)[2]	1.9	1.8	2.3	3.1	2.3	**2.5**
Strategic dependencies	Concentration in selected raw materials, Import concentration index based on a basket of critical raw materials[6]	0.17	0.15	0.16	0.18	0.19	**0.22**
	Installed renewables electricity capacity, % of total electricity produced[2]	0.9	0.9	0.9	0.9		**50**
BUSINESS ENVIRONMENT - SMEs							
Investment obstacles	Impact of regulation on long-term investment, % of firms reporting business regulation as major obstacle[7]	11.0	10.4	12.3	10.0	15.0	**22.2**
Business demography	Bankruptcies, Index (2015=100)[2]	125.7	104.4	117.0	104.7	105.1	**105.6**
	Business registrations, Index (2015=100)[2]	113.1	104.0	112.5	96.7	107.9	**120.2**
Late payments	Payment gap - corporates B2B, difference in days between offered and actual payment[8]	-	-	-	-	-	**15**
	Payment gap - public sector, difference in days between offered and actual payment[8]	-	-	-	-	-	**16**
	Share of SMEs experiencing late payments in past 6 months, %[9]	49.3	39.1	68.7	53.2	69.6	**48.7**
Access to finance	EIF Access to finance index - Loan, Composite: SME external financing over last 6 months, index values between 0 and 1[10]	0.72	0.49	0.89	0.70	-	**0.49**
	EIF Access to finance index - Equity, Composite: VC/GDP, IPO/GDP, SMEs using equity, index values between 0 and 1[10]	0.19	0.11	0.41	0.37	-	**0.17**

Source: (1) AMECO, (2) Eurostat, (3) Single Market Scoreboard, (4) OECD, (5) ECFIN BCS, (6) COMEXT and Commission calculations, (7) EIB Investment Survey, (8) Intrum Payment Report, (9) SAFE survey, (10) EIF SME Access to Finance Index.

* Own Commission calculations for the EU27 average

Luxembourg's public administration is essential for providing services and carrying out reforms. Perceived government effectiveness in Luxembourg remains one of the highest in the EU and has slightly improved compared to previous years (Graph A13.1). The new coalition government formed in 2023 announced public administration reforms focused on service provision. These will be carried out through initiatives on modernisation and attractiveness of the civil service, digitalisation and process simplification, and improvement of the legal framework for local authorities ([117]).

Graph A13.1: **Government effectiveness**



Average value over 2018-2022 and change over 2018-2022.
The GDP per head bar shows the mean value of the government effectiveness indicator for the group of EU countries belonging to the same GDP per head cluster as Luxembourg (EU countries are ranked in terms of their GDP per head and grouped into three equally sized clusters).
Source: Worldwide Governance Indicators

Overall, Luxembourg is one of the top performers in e-government (Table A13.1). Planned measures under the recovery and resilience plan include the digitalisation of public services so that more people and businesses have access. The new government has also announced other initiatives to develop a digital wallet for safe online identification, access to official documents and secure storage.

Regulatory governance faces several challenges. *Ex ante* impact assessments are carried out for all new laws, but only included as a short annex to draft bills. *Ex post* assessments are neither done systematically nor publicly available. There are no new initiatives to evaluate the quality of laws and regulations. The government is taking steps to make future legislation digital-ready, proactively examining the compatibility of new laws with digital requirements and avoiding additional costs and administrative burden ([118]).

Civil servants in Luxembourg are young compared to the EU average. However, gender parity in senior civil service positions is still one of the lowest in the EU although it recovered from its lowest point in 2022 (Graph A13.2c). The share of civil servants with higher education is also below the EU average (Table A13.1). One of the country's strategic objectives is to be an attractive employer as set out in the 2022-2024 work programme of the Centre for Personnel Management and Organisation of the State ([119]). In that respect, an employer brand content strategy was created and was followed by a campaign to promote government jobs in 2023. According to the latest Adult Education Survey, participation in lifelong learning in the public administration and average instruction hours by participants are also below the EU average (Graph A13.2a-b). To promote learning, the National Institute for Public Administration is working on the GovCampus programme, which will introduce new digital solutions for managing training and promoting skills development in the public sector ([120]).

To address fiscal challenges, the independent fiscal institution could be strengthened. The National Council of Public Finances (CNFP)'s monitoring could be reinforced, in particular by improving its access to more detailed

([117]) Accord de coalition 2023-2028, gouvernement.lu.

([118]) European Commission, DG REFORM, Public administration and governance: Luxembourg, Publications Office of the EU, 2024 (forthcoming).

([119]) Ministry of Civil Service, Luxembourg, gouvernement.lu.

([120]) European Commission, DG REFORM, Public administration and governance: Luxembourg, Publications Office of the EU, 2024 (forthcoming).

Table A13.1: **Public administration indicators**

LU	Indicator ([1])	2019	2020	2021	2022	2023	EU-27([2])
E-government and open government data							
1	Share of internet users within the last year that used a public authority website or app	n/a	n/a	n/a	90.9	89.4	75.0
2	E-government benchmark overall score ([3])	n/a	84.3	87.1	88.8	89.6	75.8
3	Open data and portal maturity index	0.6	0.6	0.7	0.7	0.8	0.8
Educational attainment level, adult learning, gender parity and ageing							
4	Share of public administration employees with higher education (levels 5-8, %)	35.4	38.5	42.9 (b)	41.8	42.7	52.9
5	Participation rate of public administration employees in adult learning (%)	20.8	14.9	17.7 (b)	18.8 (u)	14.2	17.9
6	Gender parity in senior civil service positions ([4])	42.8	48.4	43.8	53.4	42.6	9.2
7	Ratio of 25-49 to 50-64 year olds in NACE sector O	2.5	2.7	2.8 (b)	3.3	3.5	1.5
Public financial management							
8	Medium-term budgetary framework index	0.7	0.8	0.8	0.8	n/a	0.7
9	Strength of fiscal rules index	0.7	0.8	0.8	0.8	n/a	1.4
Evidence-based policy making							
10	Regulatory governance	n/a	n/a	1.43	n/a	n/a	1.7

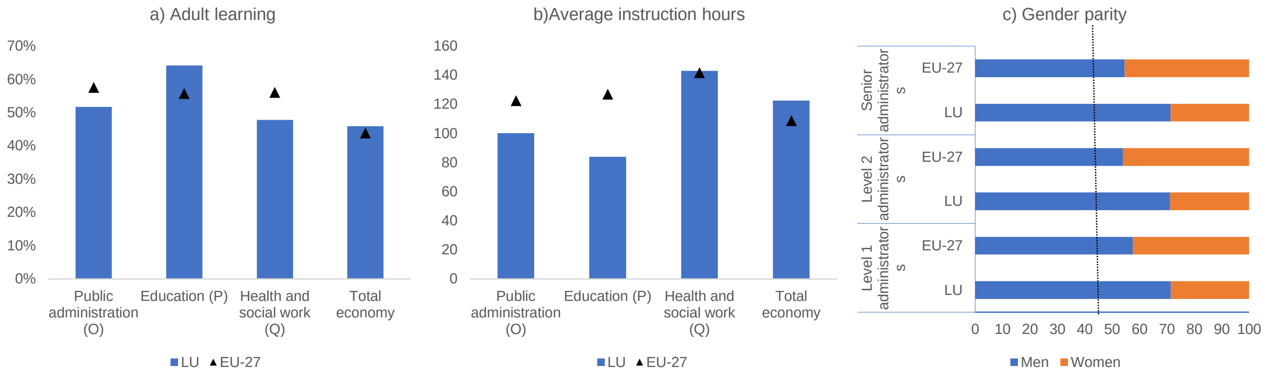
([1]) High values denote a good performance, except for indicator # 6. ([2]) 2023 value. If unavailable, the latest value available is shown. ([3]) Measures the user centricity (including for cross-border services) and transparency of digital public services as well as the existence of key enablers for the provision of those services. ([4]) Defined as the absolute value of the difference between the percentage of men and women in senior civil service positions.
Flags: (b) break in time series; (d) definition differs; (u) low reliability.
Source: E-government activities of individuals via websites, Eurostat (# 1); E-government benchmark report (# 2); Open data maturity report (# 3); Labour Force Survey, Eurostat (# 4, 5, 7); European Institute for Gender Equality (# 6); Fiscal Governance Database (# 8, 9); OECD Indicators of Regulatory Policy and Governance (# 10).

information beyond the aggregates published by STATEC and the budgetary legislative texts.

The justice system performs efficiently, although the digitalisation of justice is lagging behind other EU countries ([121]). The efficiency of civil justice continues to be high although the length of proceedings is significantly longer at second and third instances despite improvements (in 2022, 182 days at first instance, 464 days at second instance and 216 days at third instance). However, digitalisation of the system needs improvement. There are still very few digital solutions available to initiate and follow proceedings in civil, commercial and administrative cases. On judicial independence, no systemic deficiencies have been reported.

([121])For a more detailed analysis, see the 2024 EU Justice Scoreboard and the 2024 Rule of Law Report (forthcoming).

Graph A13.2: **Adult education: a) participation rate in job-related employer-sponsored education and training (left side); b) average instruction hours spent by participants in education and training by sector (centre); c) share of women and men in management positions in the public administration**



Source: Eurostat, Adult Education Survey (charts a and b); European Institute for Gender Equality (chart c)

ANNEX 14: EMPLOYMENT, SKILLS AND SOCIAL POLICY CHALLENGES IN LIGHT OF THE EUROPEAN PILLAR OF SOCIAL RIGHTS

The European Pillar of Social Rights is the compass for upward convergence towards better working and living conditions in the EU. This Annex provides an overview of Luxembourg's progress in implementing the Pillar's 20 principles and the EU headline and national targets for 2030 on employment, skills and poverty reduction.

Table A14.1: **Social Scoreboard for Luxembourg**

Policy area	Headline indicator	
Equal opportunities and access to the labour market	Adult participation in learning (during the last 12 months, excl. guided on the job training, % of the population aged 25-64, 2022)	45.2
	Early leavers from education and training (% of the population aged 18-24, 2023)	6.8
	Share of individuals who have basic or above basic overall digital skills (% of the population aged 16-74, 2023)	60.1
	Young people not in employment, education or training (% of the population aged 15-29, 2023)	8.5
	Gender employment gap (percentage points, population aged 20-64, 2023)	6.8
	Income quintile ratio (S80/S20, 2022)	4.5
Dynamic labour markets and fair working conditions	Employment rate (% of the population aged 20-64, 2023)	74.8
	Unemployment rate (% of the active population aged 15-74, 2023)	5.2
	Long term unemployment (% of the active population aged 15-74, 2023)	1.7
	Gross disposable household income (GDHI) per capita growth (index, 2008=100, 2022)	111.2
Social protection and inclusion	At risk of poverty or social exclusion (AROPE) rate (% of the total population, 2022)	19.4
	At risk of poverty or social exclusion (AROPE) rate for children (% of the population aged 0-17, 2022)	24
	Impact of social transfers (other than pensions) on poverty reduction (% reduction of AROP, 2022)	33.72
	Disability employment gap (percentage points, population aged 20-64, 2022)	8.5
	Housing cost overburden (% of the total population, 2022)	15.2
	Children aged less than 3 years in formal childcare (% of the under 3-years-old population, 2022)	54.7
	Self-reported unmet need for medical care (% of the population aged 16+, 2022)	0.5

Critical situation | To watch | Weak but improving | Good but to monitor | On average | Better than average | Best performers

Update of 25 April2023. Members States are categorised based on the Social Scoreboard according to a methodology agreed with the EMCO and SPC Committees. Please consult the Annex of the Joint Employment Report 2024 for details on the methodology.
Source: Eurostat

Luxembourg's labour market proved resilient in 2022 but weakened in 2023 due to a slowdown in economic activity, notably in the financial, trade and construction sectors. As a result, the total number of job vacancies fell by 40% in 2023 according to the public employment service [122]. This was mirrored by a slight increase in the unemployment rate from 4.6% (Q4-2022) to 5.4% (Q4-2023), the highest level for over two years. According to national data, the biggest increases in unemployment were recorded among the most qualified jobseekers (university graduates) and young people under 30. The long-term unemployment rate has also started to rise slowly. Moreover, there are challenges for specific groups. Despite an increase of 7 percentage points (pps) since 2016, the employment rate of older workers (aged 55-64) remains the lowest in the EU (46.3% in 2023 against an EU average of 63.9%). At the same time, the employment rate of low-skilled people continued to improve (reaching 62% in 2023). The employment gap between people born in or outside the EU reached 7.8 pps in 2023 and the unemployment rate differential between those two categories is still significant (8.9 pps in 2023). The overall employment rate remained stable in 2023 (74.8%, as in 2022), slightly below the EU average. Addressing these challenges will help Luxembourg reach its employment rate target of 77.6% by 2030 and improve the sustainability of public finances. The European Social Fund Plus (ESF+) supports measures to strengthen active labour market policies, with a focus on digital skills and jobs, targeting young people, low-skilled people, the long-term unemployed, women and people aged over 45.

Luxembourg faces labour shortages. Although the job vacancy rate was 1.9% in Q2-2023, which is below the EU average (2.7%), in October 2023 a high proportion of employers (16% in industry and 49% in construction) reported that labour shortages were a factor limiting their production. The rate is especially high in construction, almost double the EU average (27%), but it is below the EU average for industry (22%). Compared to pre-pandemic levels, labour shortages more than tripled in industry and more than doubled in construction.

Despite Luxembourg's overall strong performance on skills, mismatches are higher than the EU average and might contribute to labour shortages in a context of low unemployment. In 2022, the mismatch across

(122) https://adem.public.lu/en/actualites/adem/2023/12/cc-2023-11.html

all skills levels amounted to 23.8% (EU: 20.2%). Among small and medium-sized enterprises, 80% find it difficult to find workers with the right skills and 58% to keep skilled workers ([123]). Labour shortages and skills mismatches, along with other challenges, also undermine Luxembourg's potential to invest and improve its economic competitiveness (see Annex 12). Participation in adult learning over the previous 12 months rose to 45.2% in 2022, 2.6 pps up from 2016 and well above the EU average (39.5%). In 2023, Luxembourg surpassed the EU average of 55.5% of individuals aged 16-74 with at least basic digital skills (60.1%). Participation of adults in learning is still remarkable for unemployed people at 42.3% in 2022 (vs. EU: 29.2%) but lags for older workers (27.4% vs. EU: 29.4) and people with a low level of qualifications (24.2 vs. 25.1%). Although, according to Eurostat, exposure to work-based learning of recent vocational education and training (VET) graduates was lower than the EU average in 2022 (33.7% vs. EU: 60.1%), the employment rate of VET graduates (ISCED 3-4) was well above the EU average (92.1% vs. EU: 77.4%). To address these challenges, the government, together with social partners, conducted sectoral studies on trends in future professions and skill requirements, and on the creation of a national skills strategy (included as a reform in the recovery and resilience plan). This was followed by the Skills Plang bill introduced in June 2023. As of September 2023, Luxembourg simplified access to skilled jobs (IT, healthcare, engineering, finance and business support and certain building trades) for non-EU nationals. The ESF+ supports measures promoting lifelong learning in connection with skills needs. Those measures are expected to help Luxembourg reach the national target of at least 62.5% of all adults participating in education and training every year by 2030.

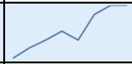
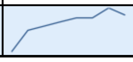
The educational performance of pupils is closely linked to their socio-economic status and linguistic background. Based on the latest available data ([124]), the average levels of pupils' performance were significantly lower than the EU average in reading, mathematics, and science. Moreover, the gap between advantaged and disadvantaged students remains the largest in the EU. The rate of early leavers from education and training (6.8%) is below the EU-level target, showing a strong correlation with generally excellent repetition (see Annex 15). The ESF+ supports measures to improve education and training and career guidance, fight early school leaving, and boost the integration of young refugees and migrants into the school system.

Some groups remain more exposed to poverty and social exclusion than the rest of the population. While the share of people at risk of poverty or social exclusion (AROPE) is below the EU average and falling (from 21.1% in 2021 to 19.4% in 2022), 38.3% of people not born in the EU were AROPE, 26 pps higher than the share of people born in Luxembourg. The risk of poverty or social exclusion among children was at 24% in 2022, close to the EU average. 54.7% of children under 3 years of age benefited from childcare in 2022, well above the EU average (35.7%). However, inequalities persist for the most vulnerable groups, mirroring those in the labour market. Regarding childhood education and care, the enrolment gap between children AROPE and those not at a risk was 24.9 pps in 2022 (21.6 pps in 2021).

(123) https://europa.eu/eurobarometer/surveys/detail/2994 (September 2023).

(124) As measured by the OECD Programme for International Student Assessment (PISA); reference data from 2018 as Luxembourg did not participate in the latest 2022 study.

Table A14.2: **Situation of Luxembourg on 2030 employment, skills and poverty reduction targets**

Indicators	Latest data	Trend (2016-2022)	2030 target	EU target
Employment (%)	74.8 (2023)		77.6	78
Adult learning[1] (%)	45.2 (2022)		62.5	60
Poverty reduction[2] (thousands)	2 (2022)		-4	-15,000

(1) Adult Education Survey, adults in learning in the past 12 months, special extraction excl. guided on-the-job training.
(2) Change in the number of persons at risk of poverty or social exclusion (AROPE), reference year 2019.
Source: Eurostat, DG EMPL.

In-work poverty remains high in Luxembourg. There is a positive correlation between the in-work poverty rate in Luxembourg (12.9% vs. EU: 8.5% in 2022) and a low level of educational attainment, having dependent children, living in a household with low work intensity or being a foreigner a rate of 33.4% for non-EU born vs. EU: 19.9%). Single parent families are the type of household most exposed to economic precariousness ([125]). In 2022, the housing cost overburden rose to 15.2% ([126]) (EU: 8.7%). This phenomenon is mainly driven by population growth, a limited housing supply and a high level of income disparity in Luxembourg city. Although almost all household types are affected, the increasing lack of affordable housing aggravates the risk of poverty in lower income groups. The government proposed several measures in 2024 to increase the supply of affordable housing. The impacts of these measures on the most vulnerable will need to be assessed. Measures under the ESF+ will help further reduce poverty by assisting people from vulnerable groups to find jobs or training, and by dedicating 6% of the resources of the ESF+ to tackling child poverty. This will help Luxembourg to achieve its national target of lifting at least 4 000 people, including 1 300 children, out of poverty by 2030.

(125) STATEC Rapport Travail et Cohésion Sociale 2023 p. 96.

(126) Break in time series from 2020 to 2022.

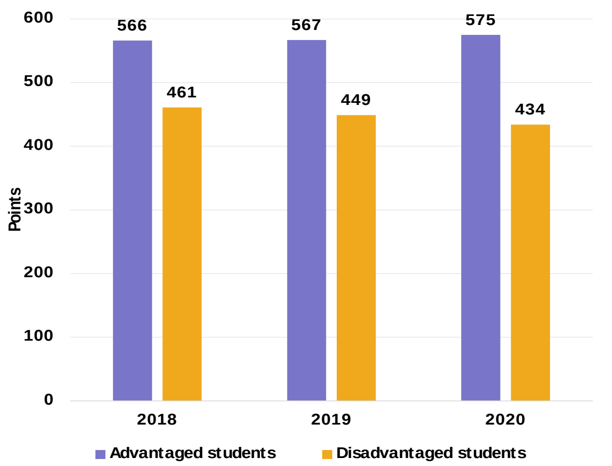
This Annex outlines the main challenges of Luxembourg's education and training system based on the 2023 Education and Training Monitor and the 2022 OECD Programme for International Student Assessment (PISA) results.

Teachers' working conditions are favourable, yet teaching positions are difficult to fill. High salaries, good job security, small classes and few teaching hours make teaching interesting for young people. Entering the profession, however, is difficult: applicants for tenure are selected from graduates in education studies via open competition where subject knowledge is tested. In addition, teachers must be proficient in the three national languages. In response to teacher shortages, the University of Luxembourg has extended its offer of education programmes.

From the age of 3, participation in early childhood education and care (ECEC) is below the EU average. 88.9% of children from the age of 3 participate in ECEC, below the EU average (92.5%) and the EU-level target (96%) for 2030. Despite activities to familiarise children aged 1 to 4 with Luxembourgish and French, a recent study (127) shows that the impact of participation in ECEC on early literacy is small, and insignificant on mathematics. The study calls for the promotion of German in ECEC to prepare children better for primary education and to align language policies in ECEC and later schooling.

Pupils' performance is strongly linked to their socio-economic status and linguistic background. In 2018 (128), Luxembourg's average competence levels, as measured by the OECD Programme for International Student Assessment (PISA), were significantly lower than the EU average in all three areas tested. The score gap between advantaged and disadvantaged students was the largest one observed across all EU countries. The national competence tests show that, at the time of starting school, pupils have the essential basic skills to begin acquiring literacy, even though significant differences in these initial skills could be identified (129). However, by the time pupils start year 3 in primary school, aged 8, the skills gap widens. Pupils' performance in German reading comprehension and maths falls noticeably, particularly the performance of pupils from a disadvantaged background or of those whose first language is neither German nor Luxembourgish. In September 2022, Luxembourg launched a pilot project in four primary school classes, where pupils start learning first in French, then continue in German. If extended to more schools, this approach could help improve the performance of pupils whose first language is French. Furthermore, the number of European public schools has increased to six. Pupils in these schools can choose between English, French or German as main tuition language. The option of teaching through one main language may substantially improve pupils' learning outcomes, who struggle with the trilingual system. As of 2022-2023, Luxembourg offers pupils free school meals and after-school facilities.

Graph A15.1: **Changes in writing comprehension in German in year 3 of primary school, depending on socio-economic status between 2018 and 2020**



Source: LUCET 2021. Note: Pupils' achievements are standardised so that the mean value of the respective reference cohort is always 500 and the standard deviation 100 (Fischbach et al., 2014)

(127) Luxembourg Centre for Educational Testing: Early Childhood Education and Care in Luxembourg

(128) Luxembourg did not participate in the 2022 PISA survey.

(129) Hornung et al. (2021) In: University of Luxembourg, Luxembourg Centre for Educational Testing: Bildungsbericht

Table A15.1: **EU-level targets and other contextual indicators under the European Education Area strategic framework**

Indicator			Target	2012 Luxembourg	2012 EU-27	2018 Luxembourg	2018 EU-27	2023 Luxembourg	2023 EU-27
[1]Participation in early childhood education (age 3+)			**96%**	**89.9% [2013]**	**91.8% [2013]**	**87.2%**	**92.2%**	**88.9% [2021]**	**92.5% [2021,d]**
[2]Low-achieving 15-year-olds in:		**Reading**	**< 15%**	**22.2%**	**18.0%**	**29.3%**	**22.5%**	**: [0]**	**26.2% [2022]**
		Mathematics	**< 15%**	**24.3%**	**22.1%**	**27.2%**	**22.9%**	**: [0]**	**29.5% [2022]**
		Science	**< 15%**	**22.2%**	**16.8%**	**26.8%**	**22.3%**	**: [0]**	**24.2% [2022]**
Early leavers from education and training (age 18-24)	**[3]Total**		**< 9 %**	**8.1%**	**12.6%**	**6.3%**	**10.5%**	**6.8% [u]**	**9.5%**
	[3] By gender	*Men*		10.7%	14.5%	6.8%	12.1%	8.5% [u]	11.3%
		Women		5.5%	10.6%	5.9%	8.7%	: [u]	7.7%
	[4] By degree of urbanisation	*Cities*		9.8% [b]	11.2%	: [u]	9.4%	: [u]	8.6%
		Rural areas		6.9% [bu]	14.0%	4.9% [u]	11.0%	: [u]	9.9%
	[5] By country of birth	*Native*		7.1%	11.3%	6.5%	9.2%	7.2% [u]	8.2%
		EU-born		11.5% [u]	26.2%	5.0% [u]	22.4%	: [u]	21.0%
		Non EU-born		: [u]	30.1%	: [u]	23.0%	: [u]	21.6%
[6]Socio-economic gap (percentage points)				**36.3**	**:**	**37.5**	**29.5**	**: [2022]**	**37.2 [2022]**
[7]Exposure of VET graduates to work-based learning			**≥ 60% (2025)**	**:**	**:**	**:**	**:**	**34.5%**	**64.5%**
Tertiary educational attainment (age 25-34)	**[8]Total**		**45%**	**49.9%**	**34.1%**	**53.7%**	**38.7%**	**60.2%**	**43.1%**
	[8] By gender	*Men*		47.8%	29.1%	49.5%	33.3%	55.7%	37.6%
		Women		52.0%	39.2%	57.9%	44.2%	65.0%	48.8%
	[9] By degree of urbanisation	*Cities*		64.7% [b]	43.5%	79.0%	49.0%	89.2%	53.3%
		Rural areas		41.8% [b]	24.8%	45.8%	27.7%	53.2%	31.7%
	[10] By country of birth	*Native*		43.2%	35.4%	47.6%	39.7%	54.3%	44.2%
		EU-born		56.9%	29.3%	58.8%	36.7%	67.0%	40.2%
		Non EU-born		51.0%	24.2%	55.1%	31.0%	60.3%	37.1%
[11]Participation in adult learning (age 25-64)			**≥ 47% (2025)**	**:**	**:**	**42.6% [2016]**	**37.4% [2016]**	**45.2% [2022]**	**39.5% [2022]**
[12]Share of school teachers (ISCED 1-3) who are 55 years or over				**11.8% [2013]**	**22.7% [2013]**	**11.6%**	**23.8%**	**9.9% [2021]**	**24.5% [2021]**

Notes: b = break in time series; d = definition differs; e = estimated; p = provisional; u = low reliability; : = data not available.
Source: 1,3,4,5,7,8,9,10,12=Eurostat; 11= Eurostat, Adult Education Survey; 2,6=OECD, PISA.

The rate of early leavers from education and training (ELET) (6.8%) is already below the EU-level target (below 9%). In 2020-2021, 80% of pupils who dropped out had repeated a year at least once ([130]). The repetition rate remains high: by the end of primary education (age 12), 21% of pupils will have repeated at least one school year ([131]). Across the different secondary education sectors, most young people dropped out of vocational education and training (VET) (38%) or the second cycle of general secondary education (enseignement secondaire général) (23%). In 2019-2020, 55% of early school leavers were of foreign nationality while they only made up 33% of the school population ([132]). To reduce early school leaving and youth unemployment, the compulsory school age was raised from 16 to 18 in 2023, to be in force as of 2026-2027.

The tertiary educational attainment rate is among the highest in the EU, with 60.2% of the population aged 25-34 holding a tertiary degree (EU 43.1%). The rate is significantly higher among the migrant population (67.2%, compared with 52.7% of people born in Luxembourg). This is close to the level before the COVID-19 pandemic. Overall participation in VET and in lifelong learning activities is high (see Annex 14).

([130]) Ministère de l'Éducation nationale, de l'Enfance et de la Jeunesse: jeunes décrocheurs et jeunes inactifs au Luxembourg 2021/2022

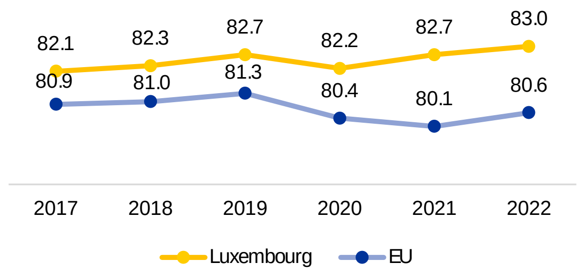
([131]) Ministère de l'Éducation nationale, de l'Enfance et de la Jeunesse: Enseignement fondamental - Statistiques globales et analyse des résultats scolaires 2020-2021

([132]) Le fonctionnement du système d'intégration et ses acteurs au Grand-Duché de Luxembourg

A healthy population and an effective, accessible and resilient health system are prerequisites for a sustainable economy and society. This Annex provides a snapshot of population health and the health system in Luxembourg.

Life expectancy in Luxembourg is above the EU average and has rebounded after falling slightly in 2020 at the onset of the COVID-19 pandemic. Luxembourg fares comparatively well in avoiding deaths from treatable causes. In 2021, cancers and diseases of the circulatory system ('cardiovascular diseases') were the leading causes of death, followed by COVID-19.

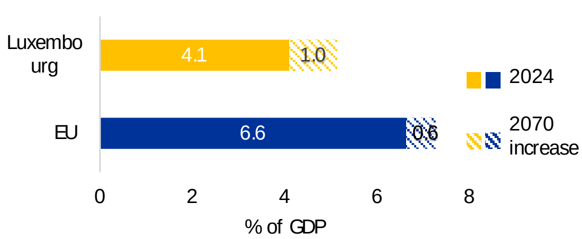
Graph A16.1: **Life expectancy at birth, years**



Source: Eurostat

Health spending relative to GDP in Luxembourg was below the EU average in 2021. However, this is partly due to data comparability issues regarding Luxembourg's GDP ([133]). In 2021, total health spending as a proportion of GDP decreased slightly to 5.7% (from 5.8% in 2020), but in real terms total health spending increased by around 10% compared to 2020. Provisional data suggest that in 2022 total health spending fell back to 5.5% of GDP. Health spending per capita in Luxembourg is among the highest in the EU. Public expenditure on health as a proportion of total health spending is also among the highest in the EU at 86%, above the EU average of 81.1%. Consequently, the share of out-of-pocket spending for health in Luxembourg is among the lowest in the EU. Based on the age profile of the Luxembourgish population, public expenditure on health is projected to increase by 1.0 percentage points (pps) of GDP by 2070, compared to 0.6 pps for the EU overall (see Graph 16.2 and Annex 21).

Graph A16.2: **Projected increase in public expenditure on healthcare over 2024-2070**



Baseline scenario
Source: European Commission / EPC (2024)

In 2021, spending on prevention in Luxembourg amounted to 6.6% of total spending on healthcare, compared to 6.0% for the EU overall. Between 2019 and 2021, spending on prevention in Luxembourg increased by around 168%, compared to a 106% increase for the EU overall. Proportionally, budget shares for prevention across the EU increased most for emergency response, disease detection and immunisation programmes. In Luxembourg, the main factors explaining the increase in the spending on preventive care in 2021 are early disease detection, immunisation measures, epidemiological surveillance and risk and disease control programmes. Provisional data for 2022 indicate a stark drop to 4.7% of total health spending going to preventive care. Heavy drinking continues to be a major public health issue in Luxembourg and will require more attention in prevention and health promotion measures.

Luxembourg faces a shortage of doctors. There were 3 practising doctors per 1 000 population in Luxembourg in 2021 (against an EU average of 4.1) and the increase since 2010 is small. Luxembourg's health system strongly depends on staff who are resident in neighbouring countries, making it particularly vulnerable in crises that necessitate border closures. This concerns two thirds of nurses

([133]) A significant proportion of GDP in Luxembourg consists of profits from foreign-owned companies which are repatriated. Gross national income can be used as an alternative measure of the domestic economy in Luxembourg.

Table A16.1: **Key health indicators**

	2018	2019	2020	2021	2022	EU average (latest year)
Treatable mortality per 100 000 population (mortality avoidable through optimal quality healthcare)	68.5	63.6	60.3	54.7	NA	93.3 (2021)
Cancer mortality per 100 000 population	225.8	219.3	203.1	203.4	NA	235.4 (2021)
Current expenditure on health, % GDP	5.3	5.5	5.8	5.7	5.5	10.9 (2021)
Public share of health expenditure, % of current health expenditure	84.1	85.0	86.5	86.0	NA	81.1 (2021)
Spending on prevention, % of current health expenditure	2.2	2.5	5.3	6.6	4.7	6.0 (2021)
Available hospital beds per 100 000 population	451	426	419	414	NA	525 (2021)
Doctors per 1 000 population	3.0*	3.0*	3.0*	3.0*	NA	4.1 (2021)*
Nurses per 1 000 population	11.7**	11.7**	11.7**	11.7**	NA	7.9 (2021)
Total consumption of antibacterials for systemic use, daily defined dose per 1 000 inhabitants per day ***	22.1	22.1	16.1	15.9	19.1	19.4 (2022)

Note: The EU average is weighted for all indicators except for doctors and nurses per 1 000 population, for which the EU simple average is used. Doctors' density data refer to practising doctors in all countries except Greece, Portugal (licensed to practise) and Slovakia (professionally active). Nurses' density data refer to practising nurses in all countries except Ireland, France, Portugal, Slovakia (professionally active) and Greece (hospital only).
Source: Eurostat Database; except: * OECD, ** Joint Questionnaire on non-monetary healthcare statistics, *** ECDC, **** Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach.

and half of doctors practising in Luxembourg. The age structure adds to the challenge: in 2017, 43.4% of doctors were aged 55 or over, with 54.4% of practising general practitioners and 60% of specialists over the age of 50. The low density of doctors is mostly due to the absence of medical training in the country before 2021, when the first national bachelor's degree in medical science was launched. In contrast, the density of nurses in Luxembourg is one of the highest in the EU (at approximately 11.7 nurses per 1 000 population, compared to an EU average of 7.9). To increase the attractiveness and domestic supply of nurses, the government introduced four bachelor's degrees in nursing, starting in September 2023. These degrees are an alternative to the existing vocational nursing diploma, which requires 2 years of training, and open up possibilities for further training and career opportunities in nursing. Additionally, new bachelor's degrees will be launched for professionals who have already graduated in general nursing. Finally, the government set up public campaigns in December 2022 to increase the attractiveness of health professions.

The health strategy included in the recovery and resilience plan (RRP) aims to address staff shortages by decreasing reliance on foreign health professionals. Furthermore, the *Gesondheetsdësch* reform launched in February 2020 laid the foundations for the new national health plan. Another reform by 2025 will trigger policy changes to make health professions more attractive to residents, implement skill-mix approaches, expand training opportunities, and put in place new academic programmes for nurses, in addition to the general medicine faculty, which was opened in 2021. Under the RRP, investments worth EUR 1.2 million (1.4% of the RRP's total value) will help improve telemedicine and will set up an electronic register of health professionals. In May 2023, additional national funding was granted for developing and implementing a national digitalisation strategy, including electronic health records. Together, these measures may help Luxembourg overcome a slow uptake of digital health solutions. For example, the number of individuals accessing personal health records online in Luxembourg is below the EU average, indicating a lagging uptake of e-health and overall health systems digitalisation.

ANNEX 17: ECONOMIC AND SOCIAL PERFORMANCE AT REGIONAL LEVEL

Annex 17 showcases the economic and social regional dynamics in Luxembourg. It provides an analysis of economic, social and territorial cohesion in Luxembourg and assesses emerging investment and subnational reform needs to stimulate economic growth, social development and competitiveness in the country.

Luxembourg has been the EU Member State with the highest GDP per capita for the last decades. In 2022, the level amounted to 257% of the EU average, but 9 percentage points (pp.) below the level of 2021. Real GDP increased by an average yearly rate of 2.6% between 2013 and 2022, faster than the EU average of 1.6%. However, real GDP per capita only grew by 0.5% in the same period, compared to an increase in the EU of 1.4% per year. This is partly due to a higher-than-average population growth (2% per year compared to 0.2% in the EU) between 2013 and 2021 because of both positive natural change (+0.35%) and positive net migration (causing a yearly increase of 1.6%).

Labour productivity remains much higher than in the rest of the EU, standing at 161% of the EU average in 2022. Between 2013 and 2022, however, it dropped by 0.3% per year on average, against a growth rate of 0.7% in the EU. Compared to the EU average, productivity is highest in the financial sector with 47.7% of the total labour productivity. Luxembourg also had one of the highest values in the EU Regional Competitiveness Index 2.0 (125.1).

Within Luxembourg, socio-economic disparities between types of territories remain significant. They tend to be worse in towns and suburbs where in 2022, the unemployment rate stood at 5.2% (-1pp. compared to 2021), against a percentage of 4.8% in cities (4.8%, -0.3pp. from 2021) and rural areas (3.9%, -0.4pp. from 2021). In 2022, the share of people aged 25-64 with a tertiary degree was also lower in towns and suburbs (45.0%) and rural areas (46.5%) than in cities (77.2%) and the national average (52.3%). The percentage of NEETs ([134]) was also higher in towns and suburbs and rural areas (Table 1), and the share of early leavers from education and training has been in recent years higher in towns and suburbs than on average in Luxembourg. The share of the population at-risk-of-poverty or social exclusion in 2022 was also highest in towns and suburbs, but it declined compared to the previous year. It stood at 21.7% (-3pp from 2021) while it fell sharply in cities (15.4%, -5.2pp) and instead rose in rural areas (18.6%, +2.3pp).

Luxembourg is one of the EU Member States that reduced the most of its greenhouse gas (GHG) emissions, with a drop in their per capita level of 60.9% between 1990 and 2022. However, the country's GHG emissions (13 t CO_2 equivalent per capita in 2022) are still much higher than the GHG emissions in the EU in 2022 (8 t CO_2 equivalent per capita). According to the Luxembourg authorities, the GHG emission quotas have been exceeded in 2021 in three sectors: (i) energy and manufacturing, industries, construction, (ii) residential and tertiary buildings and (iii) waste and wastewater treatment. The targets for 2030 are to reduce greenhouse gas emissions by 57.8% compared to 2005 (as set out in the Climate Act and the revised draft national energy and climate plan).

In 2022 the share of renewable energy in gross final energy consumption was 14.4% (EU average: 23%). The revised draft national energy and climate plan for Luxembourg from July 2023 forecasts a share of 37% in 2030.

([134])NEETs are defined as young people (aged 15–34) neither in employment nor in education and training. It is measured as % of total population aged 15-34.

Table A17.1: **Main socio-economic indicators by degree of urbanisation, Luxembourg, 2022**

Luxembourg (2022)	Cities	Towns and suburbs	Rural areas
Unemplyment rate (%)	4.8	5.2	3.9
Population (aged 25-64) with tertiary education (%)	77.2	45.0	46.5
NEET (%)	6.1	8.8	6.0
AROPE (%)	15.4	21.7	18.6

Source: Eurostat, EDGAR database

Cohesion policy investment priorities in Luxembourg focus mainly on supporting the country's green and digital transition. The priorities set out in the 2021-2027 programming period, which were adopted in 2022, remain valid.

Investments in R&I for low carbon and the circular economy, in research centres and in the digitalisation for people, companies, research organisations and public authorities continue to be necessary and investments to support the green transition are particularly relevant. The promotion of energy efficiency in public infrastructure as well as the development of renewable energy and the reduction of greenhouse gas emissions, including the development of enabling and emerging green technologies and sustainable transport remains important. The Just Transition Fund should be used effectively in particular in the south of the country where greenhouse gas emissions are the highest.

Luxembourg could also benefit from the opportunities of the Strategic Technologies for Europe Platform (STEP) to support industry transformation, notably by investing in strategic value chains like net-zero industry, decarbonization of energy-intensive industries and digital innovation.

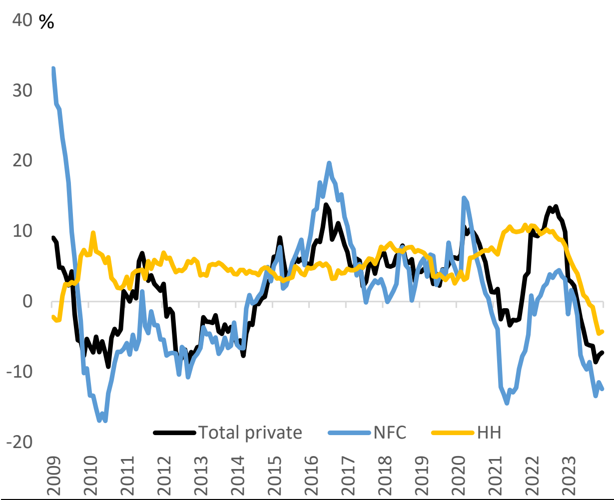
Luxembourg has maintained its position as the leading investment-fund hub in the EU. As a key international financial centre, Luxembourg's financial sector accounted for approximately 22.4% of the country's GDP and 11.3% of total employment in 2023. In particular, Luxembourg stands out as the primary European – and one of the world's largest – fund domiciles, with its investment funds overseeing assets worth EUR 6.2 trillion.

Activity in the key financial-services sector contracted significantly in 2023. Gross value added in the sector dropped by 8.8% year-on-year in Q3-2023. Despite this, exports of financial services remained robust throughout 2023. Even though these exports have not yet fully recovered from their previous peak (reaching EUR 18.8 billion in Q3-2023 compared to EUR 18.9 billion in Q4-2021) they continue to be a crucial contributor to Luxembourg's current account. Moreover, employment in the financial services and insurance sector has been growing rapidly, registering a 3.8% increase between Q2-2022 and Q3-2023.

Luxembourg's banks are well capitalised with good asset quality, reflected in the lowest non-performing loans (NPL) ratio in the EU (0.7% in 2023). There has been a significant erosion in their deposit base over the past year, with deposits declining by 9.9% since its peak in April 2022 to EUR 773 billion in December 2023. Deposits declined for most sectors, but especially so for the non-bank financial sector, which saw a decline of EUR 29 billion (9.5%) between December 2022 and December 2023. This dip in deposits is primarily attributable to the withdrawal of funds by investment entities, as alternative monetary vehicles such as money market funds became more attractive amidst the general rise in interest rates. On the assets side, and in line with the decrease in Luxembourg's GDP in 2023, loans to non-financial corporations declined by 4.3% in 2023, while loans for house purchases decreased by 1.1%, and loans to other financial intermediaries saw a reduction of 5.9%.

The profitability of the banking sector improved considerably in 2023. Activity declined and balance sheets shrank further during the year. However, lending rates rose, helping to bolster net income. Coupled with both substantial capital buffers (reflected in a capital adequacy ratio of 18.8%) and a high liquidity ratio, the sector is well-positioned to absorb any potential losses.

Graph A18.1: **Evolution of credit activity**



Source: ECB

As monetary policy tightened throughout 2023, increased financial risks emerged within Luxembourg's real estate market and for more heavily indebted households,. with lower incomes and variable-rate mortgages, who continue to face financial stress in meeting mortgage obligations in a higher-interest-rate environment. A study using 2021 data found that around 30% of Luxembourg households could be considered financially vulnerable. However, indebted households in this group only account for 11% of the number of mortgage contracts and 9% of aggregate household sector debt ([135]). So far, there has only been a slight increase in the NPL ratio of households, rising to 1.9% in June 2023 from 1.7% a year earlier. As credit risk is concentrated among low-income households, the probability of default in this sector could

([135])Giordana and Ziegelmeyer, June 2023, *Household indebtedness and their vulnerability to rising interest rates*, BCL Working Papers, BCL.lu.

Table A18.1: **Financial Soundness Indicators**

	2017	2018	2019	2020	2021	2022	2023	EU	Median
Total assets of the banking sector (% of GDP)	1784.7	1787.8	1861.8	1935.6	1913.7	1772.2	1808.7	257.0	184.6
Share (total assets) of the five largest banks (%)	26.2	26.3	27.7	31.3	29.6	31.2	-	-	69.6
Share (total assets) of domestic credit institutions (%)[1]	13.2	13.0	12.8	14.1	13.5	14.7	13.7	-	62.9
NFC credit growth (year-on-year % change)	3.2	4.5	4.9	-1.6	-4.7	3.1	-12.4	-	2.4
HH credit growth (year-on-year % change)	7.8	7.3	2.6	7.7	10.0	7.9	-4.3	-	1.4
Financial soundness indicators:[1]									
- non-performing loans (% of total loans)	0.7	0.8	0.6	0.7	0.6	1.2	0.7	1.8	1.8
- capital adequacy ratio (%)	22.5	21.4	19.7	21.7	20.5	18.8	18.7	19.6	20.1
- return on equity (%)[2]	5.7	5.5	5.2	4.4	5.5	5.2	9.3	9.9	13.2
Cost-to-income ratio (%)[1]	56.0	59.3	62.2	61.6	61.2	56.4	48.2	52.8	44.9
Loan-to-deposit ratio (%)[1]	76.6	75.6	76.5	62.4	55.6	56.3	59.2	93.3	80.2
Central bank liquidity as % of liabilities	0.9	0.8	0.6	1.1	1.7	1.0	0.7	-	0.7
Private sector debt (% of GDP)	289.4	289.2	298.4	327.8	343.9	325.5	-	133.0	118.4
Long-term interest rate spread versus Bund (basis points)	22.7	16.8	13.2	9.7	1.7	58.5	53.2	107.7	104.2
Market funding ratio (%)	65.8	65.7	63.0	64.7	66.8	65.7	-	50.8	39.8
Green bonds outstanding to all bonds (%)[3]	-	-	-	0.8	1.8	2.6	2.8	4.0	2.7

1-3	4-10	11-17	18-24	24-27	Colours indicate performance ranking among 27 EU Member States.

1Last data: Q3 2023.
2Data are annualised.
3Data available for EA countries only, EU average refers to EA area.
Source: ECB, Eurostat.

increase if interest rates remain high and the unemployment rate increases further.

The investment-fund sector in Luxembourg has shown resilience amidst the financial market disruptions caused by Russia's war of aggression in Ukraine and rising interest rates. Both the decline in market valuations of financial assets and the general economic slowdown have led to a decrease in the value of investment funds' assets. Throughout 2023, market valuations have rebounded, although net asset emissions for Luxembourg undertakings for collective investment (UCITs) continued falling, and remained below their peak volume at the end of 2021 (a peak volume of EUR 5.9 trillion at the end of 2021 versus EUR 5.3 trillion in December 2023).

In parallel to the growth in UCITS, alternative investment funds have continued to expand. The segment expanded nearly seven-fold in the 5 years to November 2023, accounting for assets of EUR 594 billion. Luxembourg has also experienced a surge in the growth of private-debt funds' assets in recent years. Luxembourg's private-debt funds act as non-bank lenders across the EU. Their current attractiveness may be attributable to the recent rise in bank lending rates which prompted more borrowers to explore alternative – and potentially cheaper – funding sources. As a result, private lending has become one of the primary strategies for alternative investment funds, enabling companies to bypass traditional banks when seeking loan facilities. The recently agreed-upon review of the Alternative Investment Fund Managers Directive by the EU introduces a pan-European loan-origination regime for alternative investment funds. This reform provides greater legal certainty, enabling the private-debt-funds sector in Luxembourg to continue growing in the coming years.

Luxembourg is an important base for the European life-insurance industry, although the amount of gross premiums written by this industry has decreased in the past 2 years. Luxembourg is the eighth largest domicile for life-insurance businesses in the EU, with gross premiums written of EUR 15.6 billion by Q3 2023. It also continues to play a crucial role in the cross-border distribution of life-insurance products. Despite insurers bolstering their financial solvency from 190% in 2022 to a comfortable 201% in Q3 2023, this level of financial solvency remains below the EU average (262%).

In the context of climate change, Luxembourg demonstrates a relatively high level of insurance coverage against natural hazards. As evidenced by the EIOPA's 2023 Dashboard on the insurance protection gap for natural catastrophes, approximately 58% of the total losses caused by extreme weather and climate-related events in Luxembourg are covered, surpassing the EU average of 22%. However, it will remain an ongoing challenge to increase resilience and insurance coverage against extreme events, particularly floods.

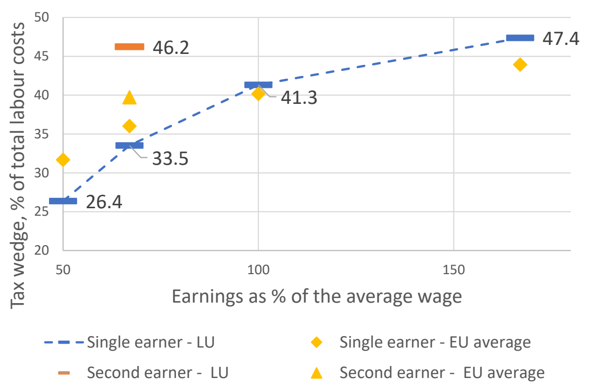
This annex provides an indicator-based overview of Luxembourg's tax system. It includes information on the tax structure (the types of tax that Luxembourg derives most of its revenue from), the tax burden on workers, and the progressivity and the redistributive effect of the tax system. It also provides information on tax collection and compliance, and on the risks of aggressive tax planning.

Luxembourg's tax revenues in relation to its GDP are slightly below the EU average. Table A19.1 shows that Luxembourg's tax revenues as a percentage of GDP (38.4%) were slightly below the EU aggregate in 2022 (40.2%) but increased to 41.1% in 2023. Luxembourg's revenues from labour taxation as a share of GDP are below the EU average, Revenues from consumption and environmental taxes as a share of GDP are among the lowest in the EU. The temporary decrease of VAT rates by 1% in 2023, no longer applies in 2024. Environmental taxation is limited and mostly consists of transport fuel taxes. This suggests scope to better incentivise environmentally friendly behaviour, including by developing pollution and resources taxes which only represent 0.8% of the environmental tax revenues and do not cover NOx emissions, waste landfilling and incineration, fertilisers, pesticides, and plastic products. Revenues from capital taxes as a share of GDP are the highest in the EU, and revenues from property taxes in general are relatively high, but revenues from recurrent property taxes are among the lowest in the EU. Following the government's announcement of tax cuts, since 1 January 2024 an inflation adjustment of personal income brackets and an adjustment of the income tax scale to include four index-linked brackets is in force.

In December 2023, the Parliament adopted a law on tax credits of up to 18 percent favouring double transition by enterprises, that is in force since 1 January 2024. The measure is intended to benefit companies investing in the digital transformation and ecological and energy transition. On 31st January 2024, the government announced a package of measures intended to revive the construction sector and facilitate access to housing which include an increase of the existing mortgage interest deductibility from 2.4% to 3.5% and of the income limit ([136]).

Luxembourg's income tax burden is relatively low across the income distribution. Graph A19.1 shows that Luxembourg's tax wedge in 2023 was lower than the EU average at lower income levels (i.e. for single earners at 50% and 67% of the average wage), while being higher than the EU average at 100% and 167% of the average wage. Furthermore, the tax wedge for second earners at 67% of the average wage was clearly higher than the EU average. In addition, the difference between the tax wedge for second earners and the tax wedge for single persons at 67% of the average wage was the highest among all EU Member States. While the difference between the tax wedge at 50% and at 167% of the average wage was higher than for the EU average, the tax-benefit system as a whole has a relatively small impact in reducing income inequality as measured by the difference in the Gini coefficient before and after taxes and social transfers.

Graph A19.1: **Tax wedge for single and second earners as a % of total labour costs, 2023**



The second earner tax wedge assumes a first earner at 100% of the average wage and no children. For the methodology of the tax wedge for second earners, see OECD, 2016, *Taxing Wages 2014-2015*.
Source: European Commission

([136]) Mesures adoptées - logement et fiscalité (gouvernement.lu)

Table A19.1: **Taxation indicators**

		Luxembourg					EU-27				
		2010	2020	2021	2022	2023	2010	2020	2021	2022	2023
Tax structure	Total taxes (including compulsory actual social contributions) (% of GDP)	35.7	38.3	38.3	38.4	41.1	37.9	40.0	40.4	40.2	
	Labour taxes (as % of GDP)	15.8	18.9	18.1	18.6		20.0	21.3	20.7	20.3	
	Consumption taxes (as % of GDP)	9.9	8.4	8.6	8.8		10.8	10.7	11.2	11.0	
	Capital taxes (as % of GDP)	10.0	11.1	11.6	11.1		7.1	8.0	8.6	8.9	
	Of which, on income of corporations (as % of GDP)	5.4	4.8	4.5	4.4		2.4	2.5	3.0	3.4	
	Total property taxes (as % of GDP)	1.0	2.5	2.6	2.6		1.9	2.3	2.2	2.1	
	Recurrent taxes on immovable property (as % of GDP)	0.1	0.1	0.1	0.1		1.1	1.2	1.1	1.0	
	Environmental taxes as % of GDP	2.3	1.4	1.5	1.2		2.4	2.2	2.3	2.0	
Progressivity & fairness	Tax wedge at 50% of average wage (Single person) (*)	25.3	25.8	26.1	26.0	26.4	33.9	31.7	32.1	31.8	31.7
	Tax wedge at 100% of average wage (Single person) (*)	35.3	39.5	39.8	39.9	41.3	41.0	40.1	39.9	40.0	40.2
	Corporate income tax - effective average tax rates (1) (*)		23.5	23.5	23.2			19.5	19.0	19.0	
	Difference in Gini coefficient before and after taxes and cash social transfers (pensions excluded from social transfers) (2) (*)	9.7	6.9	5.3	4.9		8.6	8.1	8.2	7.9	
Tax administration & compliance	Outstanding tax arrears: total year-end tax debt (including debt considered not collectable) / total revenue (in %) (*)		12.9	9.9				40.9	35.5		
	VAT Gap (% of VAT total tax liability, VTTL)(**)	10.0	5.1	1.6				9.7	5.4		

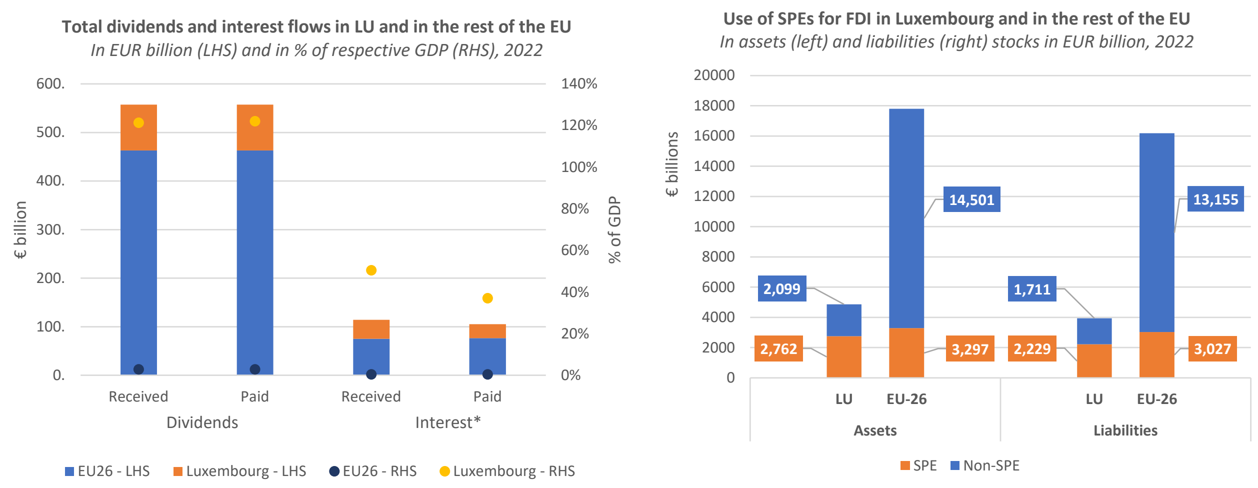
(1) Forward-looking effective tax rate (OECD).
(2) A higher value indicates a stronger redistributive impact of taxation.
(*) EU-27 simple average.
(**) forecast value for 2022, if available. For more details on the VAT gap, see European Commission, Directorate-General for Taxation and Customs Union, 2023, VAT gap in the EU, https://data.europa.eu/doi/10.2778/911698.
For more data on tax revenues as well as the methodology applied, see the Data on Taxation webpage, https://ec.europa.eu/taxation_customs/taxation-1/economic-analysis-taxation/data-taxation_en
Source: European Commission and OECD

Luxembourg scores well on indicators of the effectiveness of its tax administration. Outstanding tax arrears decreased by 2 pps between 2020 and 2021 to 9.9% of total net revenue, which is significantly below the EU-27 average of 35.5%. The VAT gap further decreased to 1.6% in 2021, which indicates a high level of VAT compliance (compared with the EU aggregate of 5.4%). The ICT costs are only 2.3% of total operating expenditure, which suggests some scope for increasing efficiency.

There continues to be a high risk of aggressive tax planning in Luxembourg. Luxembourg's level of inward FDI stock of EUR2 825 bn and outward FDI stock of EUR 3 746 bn in 2022 was only surpassed by the Netherlands and was the highest in the EU in terms of percentage of GDP (see Graph A19.2 ([137])). Around 60% of Luxembourg's inward and outward stock is held through special purpose entities (SPEs). Luxembourg is also a major conduit for dividend and interest flows (see Graph A19.2). It receives 21% of all dividends and around 34% of all interest received by the EU and is the source of 21% of all the dividends and 27% of all interest paid by the EU. Luxembourg is a major financial hub in the EU and globally, but the scale of these figures suggests that there is a high risk of aggressive tax planning in Luxembourg, especially when compared with other Member States. As part of its RRP, Luxembourg introduced a conditional measure of non-deductibility of interest and royalty payments in 2021. However, the scope is limited to the EU-list of non-cooperative jurisdictions which are not Luxembourg's main economic partners and does not specifically target low or zero tax jurisdictions, so the expected economic impact of the measure is small. Based on data provided by Luxembourg, this measure has resulted in the refusal of EUR 2 338 million worth of deductions in 2021 (this data is still provisional). The impact of this measure has not been quantified yet, so it is not possible to assess its effectiveness. Luxembourg's other measures have been limited to implementing EU legislation and Council Conclusions. The Pillar 2 Directive has been in force in the EU since 1 January 2024, and Luxembourg has notified the Commission of its transposition into national law. However, it is expected to have a limited impact on the outbound payment issue in Luxembourg because its scope is limited to the largest multinationals (revenue threshold of EUR 750 million) and there are some sectoral

([137]) See Eurostat:

Graph A19.2: **Financial activity risk in Luxembourg: dividend and interest flows, and the use of special purpose entities (SPEs) for foreign direct investment (FDI)**



Source: European Commission

exemptions (138). Finally, as the 2023 Country Report already pointed out, Luxembourg's tax system allows transfer pricing mismatches (for example by deducting deemed interest payments) which can facilitate aggressive tax planning.

(138)Excluded entities are governmental entities, international organisations, non-profit organisations, pension funds, and any investment fund or real estate investment vehicle that is the ultimate parent entity (UPE) of an MNE group.

Table A20.1: **Key economic and financial indicators**

	2004-07	2008-12	2013-20	2021	2022	2023	forecast 2024	forecast 2025
Real GDP (y-o-y)	5.2	0.6	2.0	7.2	1.4	-1.1	1.4	2.3
Potential growth (y-o-y)	.	2.2	2.4	2.3	2.0	1.8	1.9	1.8
Private consumption (y-o-y)	1.8	2.4	1.2	11.4	2.3	4.0	2.9	2.4
Public consumption (y-o-y)	1.7	3.6	3.4	5.1	2.6	2.5	3.0	2.1
Gross fixed capital formation (y-o-y)	4.4	2.8	0.8	16.9	-7.7	-1.0	0.1	3.3
Exports of goods and services (y-o-y)	8.3	1.6	3.8	10.3	-0.6	-1.4	2.7	3.3
Imports of goods and services (y-o-y)	7.3	2.9	4.1	12.4	-1.9	-0.1	3.2	3.6
Contribution to GDP growth:								
Domestic demand (y-o-y)	1.8	1.9	1.1	7.2	-0.3	1.5	1.5	1.8
Inventories (y-o-y)	0.1	-0.1	0.1	0.0	-0.4	0.0	0.0	0.0
Net exports (y-o-y)	3.3	-1.3	0.8	-0.1	2.1	-2.6	-0.1	0.5
Contribution to potential GDP growth:								
Total Labour (hours) (y-o-y)	.	1.3	1.6	1.2	1.4	1.5	1.5	1.4
Capital accumulation (y-o-y)	.	1.3	0.9	1.0	0.7	0.7	0.6	0.7
Total factor productivity (y-o-y)	.	-0.3	-0.2	0.0	-0.2	-0.3	-0.3	-0.2
Output gap	1.5	-1.4	-1.1	0.8	0.2	-2.7	-3.1	-2.6
Unemployment rate	4.6	4.9	6.1	5.3	4.6	5.2	5.8	5.7
GDP deflator (y-o-y)	4.1	3.8	1.9	4.6	5.7	3.4	4.0	2.5
Harmonised index of consumer prices (HICP, y-o-y)	3.2	2.7	0.9	3.5	8.2	2.9	2.3	2.0
HICP excluding energy and unprocessed food (y-o-y)	2.5	2.4	1.5	1.5	4.4	4.7	2.7	2.1
Nominal compensation per employee (y-o-y)	4.0	2.2	1.9	5.1	5.8	7.3	3.6	2.9
Labour productivity (real, hours worked, y-o-y)	1.9	-1.1	0.1	0.0	-1.4	-3.5	0.1	0.3
Unit labour costs (ULC, whole economy, y-o-y)	2.2	4.3	2.8	0.9	7.9	11.0	3.5	2.5
Real unit labour costs (y-o-y)	-1.8	0.5	0.9	-3.6	2.1	7.3	-0.4	0.0
Real effective exchange rate (ULC, y-o-y)	1.0	2.1	1.2	0.8	3.9	3.9	-0.9	0.2
Real effective exchange rate (HICP, y-o-y)	1.2	0.4	0.1	0.9	-1.1	-1.8	.	.
Net savings rate of households (net saving as percentage of net disposable income)	5.2	6.1	9.2	12.4	.	.	.	.
Private credit flow, consolidated (% of GDP)	40.4	5.1	14.1	64.1	-19.5	.	.	.
Private sector debt, consolidated (% of GDP)	218.0	287.4	306.3	343.9	325.5	.	.	.
of which household debt, consolidated (% of GDP)	46.2	55.1	63.1	66.6	66.8	.	.	.
of which non-financial corporate debt, consolidated (% of GDP)	171.8	232.3	243.2	277.3	258.7	.	.	.
Gross non-performing debt (% of total debt instruments and total loans and advances) (1)	.	.	0.7	0.5	0.9	.	.	.
Corporations, net lending (+) or net borrowing (-) (% of GDP)	7.2	0.5	-1.5	-2.7	-2.2	-7.6	-7.6	-7.9
Corporations, gross operating surplus (% of GDP)	28.6	30.9	30.6	30.6	29.9	26.8	27.1	26.9
Households, net lending (+) or net borrowing (-) (% of GDP)	-0.2	0.2	1.2	2.8	2.7	4.7	4.4	4.7
Deflated house price index (y-o-y)	8.1	1.2	6.1	12.5	4.0	-12.2	.	.
Residential investment (% of GDP)	3.2	3.2	3.8	4.0	3.7	3.5	.	.
Current account balance (% of GDP), balance of payments	6.8	5.7	6.1	7.9	7.7	6.8	6.3	6.3
Trade balance (% of GDP), balance of payments	29.6	36.5	39.7	38.5	37.4	34.2	.	.
Terms of trade of goods and services (y-o-y)	0.0	1.1	0.0	0.6	-0.7	-0.7	0.3	-0.1
Capital account balance (% of GDP)	0.4	-0.4	0.1	1.0	0.2	-0.3	.	.
Net international investment position (% of GDP)	10.1	12.1	68.3	42.6	47.0	33.8	.	.
NENDI - NIIP excluding non-defaultable instruments (% of GDP) (2)	.	.	-3672.8	-4598.7	-3753.7	-3854.6	.	.
IIP liabilities excluding non-defaultable instruments (% of GDP) (2)	.	.	10289.5	11414.6	9618.0	9883.5	.	.
Export performance vs. advanced countries (% change over 5 years)	.	.	17.0	21.5	2.6	4.7	.	.
Export market share, goods and services (y-o-y)	4.5	-1.3	4.7	-1.6	-16.6	-2.4	-0.8	-0.3
Net FDI flows (% of GDP)	.	.	43.8	191.0	104.0	55.1	.	.
General government balance (% of GDP)	1.2	0.8	1.1	0.5	-0.3	-1.3	-1.7	-1.9
Structural budget balance (% of GDP)	.	.	1.6	0.2	-0.4	0.0	-0.3	-0.7
General government gross debt (% of GDP)	8.0	17.7	21.7	24.5	24.7	25.7	27.1	28.5

(1) domestic banking groups and stand-alone banks, EU and non-EU foreign-controlled subsidiaries and EU and non-EU foreign-controlled branches.
(2) NIIP excluding direct investment and portfolio equity shares.
Source: Eurostat and ECB as of 2024-5-17, where available; European Commission for forecast figures (Spring forecast 2024).

This annex assesses fiscal sustainability risks for Luxembourg over the short, medium and long term. It follows the multi-dimensional approach of the European Commission's 2023 Debt Sustainability Monitor, updated based on the Commission 2024 spring forecast.

1 – Short-term risks to fiscal sustainability are low. The Commission's early-detection indicator (S0) does not point to short-term fiscal risks (Table A21.2) ([139]). Government gross financing needs are expected to decrease around 3% of GDP on average over 2024-2025 (Table A21.1, Table 1). Financial markets' perceptions of sovereign risk remain positive, as confirmed by the government bond spreads (versus Germany) and the 'AAA' rating that the three major rating agencies assign to Luxembourgish government debt.

2 – Medium-term fiscal sustainability risks appear low. The DSA baseline shows that the government debt ratio is expected to remain broadly stable below 60% of GDP in the medium term (at around 30% of GDP in 2034) (Graph 1, Table 1) ([140]). The assumed structural primary surplus (excluding changes in cost of ageing) of 0.1% of GDP as of 2024. appears plausible compared to past fiscal performance (Table A21.2) ([141]).The debt decline also benefits from a still favourable but declining snowball effect, Finally, government gross financing needs are expected to slightly increase by the end of the projection period in 2034 around 4% of GDP, above the average over 2024-2025.

The baseline projections are stress-tested against four alternative deterministic scenarios to assess the impact of changes in key assumptions relative to the baseline (Graph 1). For Luxembourg, the debt ratio would be lower than under the baseline only under the historical structural primary balance (SPB) scenario (i.e. the SPB returns to its historical 15-year average of 1.7% of GDP). Under this scenario, the debt is about 11 pps. of GDP lower than the baseline in 2034. Otherwise, all the other stress tests scenarios would lead to worse results as compared to the baseline, with particularly adverse developments under the adverse interest-growth rate differential scenario (i.e. the interest-growth rate deteriorates by 1 pp. compared with the baseline), with the debt ratio that would be higher than under the baseline by around 2 pps. of GDP in 2034. Similar results are obtained under the lower structural primary balance scenario (i.e. the projected cumulative improvement in the SPB over 2023-2024 is halved) and under the financial stress scenario (i.e. interest rates temporarily increase by 1 pp. compared with the baseline), with debt ratio that would higher by only around 1 pp. and 0.3 pp. respectively.

The stochastic projections indicate low risk, pointing to the low sensitivity of these projections to plausible unforeseen events ([142]). These stochastic simulations indicate about 64% probability that the debt ratio will be higher in 2028 than in 2023, implying low risks given the low debt level. In addition, the uncertainty surrounding the

([139])The So is a composite indicator of short-term risk of fiscal stress. It is based on a wide range of fiscal and financial-competitiveness indicators that have proven to be a good predictor of emerging fiscal stress in the past.

([140]) The assumptions underlying the Commission's 'no-fiscal policy change' baseline include in particular: (i) a structural primary surplus, before changes in ageing costs, of 0.1% of GDP from 2024 onwards; (ii) inflation converging linearly towards the 10-year forward inflation-linked swap rate 10 years ahead (which refers to the 10-year inflation expectations 10 years ahead); (iii) the nominal short- and long-term interest rates on new and rolled over debt converging linearly from current values to market-based forward nominal rates by T+10; (iv) real GDP growth rates from the Commission 2024 spring forecast, followed by the EPC/OGWG 'T+10 methodology projections between T+3 and T+10 (average of 2.1%); (v) ageing costs in line with the 2024 Ageing Report (European Commission, Institutional Paper 279, April 2024). For information on the methodology, see the 2023 Debt Sustainability Monitor (European Commission, Institutional Paper 271, March 2024).

([141])This assessment is based on the fiscal consolidation space indicator, which measures the frequency with which a tighter fiscal position than assumed in a given scenario has been observed in the past. Technically, this consists in looking at the percentile rank of the projected SPB within the distribution of SPBs observed in the past in the country, taking into account all available data from 1980 to 2022.

([142]) The stochastic projections show the joint impact on debt of 10,000 different shocks affecting the government's budgetary position, economic growth, interest rates and exchange rates. This covers 80% of all the simulated debt paths and therefore excludes tail events.

baseline debt projections is low, as measured by the difference between the 10th and 90th debt distribution percentiles in five years' time (Graph 2).

3 – Long-term fiscal sustainability risks appear overall high. This assessment is based on the combination of two fiscal gap indicators, capturing the required fiscal effort to stabilise debt (S2 indicator) and bring to 60% of GDP (S1 indicator) over the long term ([143]). This assessment is mostly driven by the projected increase in ageing costs.

The S2 indicator points to high fiscal sustainability risks. The indicator shows that, relative to the baseline, the SPB would need to improve by 7.8 pps. of GDP in 2025 to ensure debt stabilisation over the long term. This result mostly driven by the projected increase in ageing-related costs (contribution of 7.7 pps. of GDP). Ageing cost developments are primarily driven by the projected increase in pensions (5.7 pps. of GDP) as well as long-term care and health-care spending (2.2 pps.) (Table 2).

The S1 indicator points to medium fiscal sustainability risks. The indicator shows that the country would need to improve its fiscal position by 2.7 pps. of GDP in 2025 to ensure that its debt does not exceed 60% of GDP by 2070. This result is mainly driven by the increase of the ageing-related public expenditure (contribution of 3.9 pps. of GDP), which is partly offset by the debt requirement (-0.7 pp.) and the favourable initial budgetary position (-0.4 pp.) (Table 2).

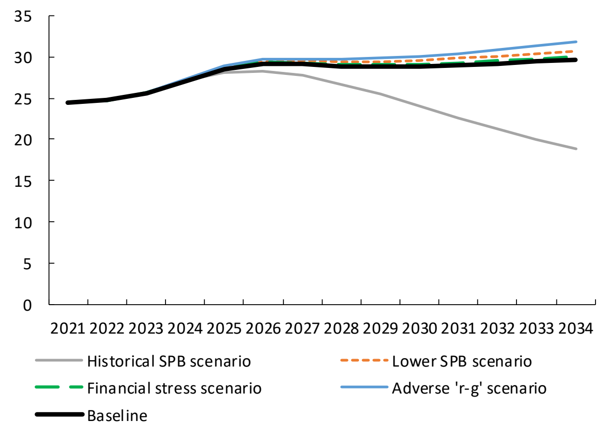
4 – Finally, several additional risk factors need to be considered in the assessment. On the one hand, risk-increasing factors are related to contingent liability risks stemming from guarantees granted to the private sector and changes in international corporate tax regulations. On the other hand, risk-mitigating factors include the lengthening of debt maturity in recent years, very small share of short-term debt, relatively stable financing sources (with a diversified and large investor base), the government debt fully denomination in euro, and historically low borrowing costs supported by the AAA-ratings. In addition, Luxembourg's positive net international investment position (stronger compared to 2020) helps mitigating vulnerabilities.

([143]) The S2 fiscal sustainability indicator measures the permanent SPB adjustment in 2025 that would be required to stabilise public debt in the long term. It is complemented by the S1 indicator, which measures the permanent SPB adjustment in 2025 to bring the debt ratio to 60% by 2070. For both the S1 and S2 indicators, the risk assessment depends on the amount of fiscal consolidation needed: 'high risk' if the required effort exceeds 6 % of GDP, 'medium risk' if it is between 2% and 6% of GDP, and 'low risk' if the effort is negative or below 2% of GDP. The overall long-term risk classification combines the risk categories derived from S1 and S2. S1 may notch up the risk category derived from S2 if it signals a higher risk than S2. See the 2023 Debt Sustainability Monitor for further details.

Table A21.1: **Debt sustainability analysis – Luxembourg**

Table 1. Baseline debt projections	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Gross debt ratio (% of GDP)	**24.5**	**24.7**	**25.7**	**27.1**	**28.5**	**29.2**	**29.1**	**28.8**	**28.8**	**28.9**	**29.0**	**29.2**	**29.4**	**29.7**
Changes in the ratio	-0.1	0.2	0.9	1.4	1.5	0.7	-0.1	-0.2	0.0	0.1	0.1	0.2	0.2	0.3
of which														
Primary deficit	-0.7	0.2	0.9	1.3	1.2	0.7	0.1	-0.1	0.0	0.2	0.4	0.6	0.8	1.0
Snowball effect	-2.5	-1.5	-0.3	-1.0	-0.7	-1.0	-1.1	-0.9	-0.7	-0.6	-0.6	-0.5	-0.5	-0.5
Stock-flow adjustments	3.1	1.5	0.2	1.0	1.1	1.0	0.9	0.8	0.7	0.5	0.3	0.2	0.0	-0.2
Gross financing needs (% of GDP)	2.7	3.5	4.6	2.9	3.0	2.7	2.3	2.2	2.4	2.7	3.0	3.2	3.5	3.6

Graph 1. Deterministic debt projections



Graph 2. Stochastic debt projections 2024-2028

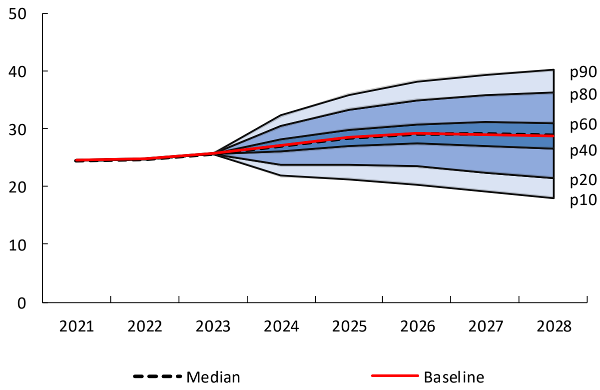


Table 2. Breakdown of the S1 and S2 sustainability gap indicators

		S1	S2
Overall index (pps. of GDP)		**2.7**	**7.8**
of which			
Initial budgetary position		-0.4	0.2
Debt requirement		-0.7	
Ageing costs		3.9	7.7
of which	*Pensions*	2.9	5.7
	Health care	0.5	0.9
	Long-term care	0.7	1.3
	Education	-0.2	-0.2

Source: Commission services.

Table A21.2: **Heat map of fiscal sustainability risks – Luxembourg**

Short term	Medium term - Debt sustainability analysis (DSA)								Long term		
			Deterministic scenarios								
Overall (S0)	Overall		Baseline	Historical SPB	Lower SPB	Adverse 'r-g'	Financial stress	Stochastic projections	S2	S1	Overall (S1 + S2)
LOW	LOW	Overall	LOW	LOW	LOW	LOW	LOW	LOW	HIGH	MEDIUM	HIGH
		Debt level (2034), % GDP	29.7	18.8	30.8	31.8	30.0				
		Debt peak year	2034	2026	2034	2034	2034				
		Fiscal consolidation space	97%	78%	100%	97%	97%				
		Probability of debt ratio exceeding in 2028 its 2023 level						64%			
		Difference between 90th and 10th percentiles (pps. GDP)						22.1			

(1) Debt level in 2034. Green: below 60% of GDP. Yellow: between 60% and 90%. Red: above 90%. (2) The debt peak year indicates whether debt is projected to increase overall over the next decade. Green: debt peaks early. Yellow: peak towards the middle of the projection period. Red: late peak. (3) Fiscal consolidation space measures the share of past fiscal positions in the country that were more stringent than the one assumed in the baseline. Green: high value, i.e. the assumed fiscal position is plausible by historical standards and leaves room for corrective measures if needed. Yellow: intermediate. Red: low. (4) Probability of debt ratio exceeding in 2028 its 2023 level. Green: low probability. Yellow: intermediate. Red: high (also reflecting the initial debt level). (5) the difference between the 90th and 10th percentiles measures uncertainty, based on the debt distribution under 10000 different shocks. Green, yellow and red cells indicate increasing uncertainty. (For further details on the Commission's multidimensional approach, see the 2023 Debt

Source: Commission services.