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2023 Country Report - Luxembourg

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Recommendation for a COUNCIL RECOMMENDATION

on the 2023 National Reform Programme of Luxembourg and delivering a Council opinion on the 2023 Stability Programme of Luxembourg

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Luxembourg

2023 Country Report



ECONOMIC AND EMPLOYMENT SNAPSHOT

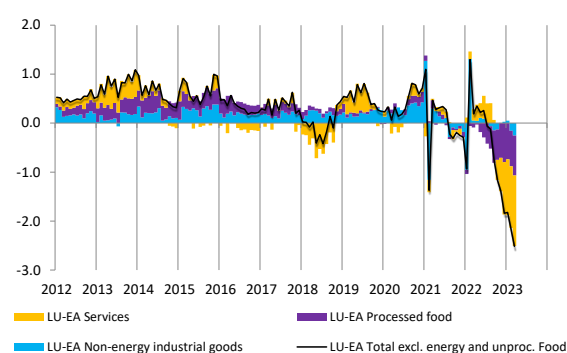
Luxembourg's economy continues to grow despite headwinds

Luxembourg's economy recovered rapidly after the COVID-19 crisis, but the momentum was slowed down by a less supportive international environment, amid inflationary pressures, shifting monetary policy and uncertainty about the economic impact of Russia's war in Ukraine. Real GDP was growing fast before the COVID-19 crisis, registering average annual growth of 2.4% in the five years to 2019. Following a mild drop of 0.8% in 2020, growth recovered to 5.1% in 2021, as the restrictive measures related to COVID-19 were lifted. However, lingering disruptions to global supply chains from the COVID-19 pandemic continued to reduce growth and push prices up, especially for energy and food.

The global economic impact of Russia's war in Ukraine worsened the international environment, to which Luxembourg's economy is highly sensitive. As in other euro area Member States, high inflation has persisted longer than expected. In the first half of 2022, Harmonised Index of Consumer Prices (HICP) inflation rose to its highest level since the 1980s, peaking above 10% in June before gradually falling, thanks to the slowdown in the rise in prices of energy and services. Inflationary pressures broadened, however, to food and non-energy industrial goods. A key factor in slower economic growth was the tightening of monetary policy in the euro area, which led to a fall in investment and larger redemptions and downward valuations in the funds industry. However, the situation was different for banks that are focused on the Luxembourg market, where the rise in interest rates increased their profitability.

In 2022 and March 2023, the government reached four agreements with stakeholders, to roll-out measures to protect households and firms from rising energy prices and to curb inflation levels. The fiscal interventions agreed with stakeholders in 2022 were set to end on 31 December 2023. However, STATEC forecasts (2023) indicated a rebound in inflation in 2024, leading stakeholders to request additional measures. An agreement was reached with the government on 7 March 2023, with new fiscal interventions continuing until 31 December 2024. While the agreements helped to limit wage indexations, HICP inflation in Luxembourg was significantly lower than the euro area aggregate, with that difference reaching historical heights for both the overall and the underlying inflation (Graph 1). Close monitoring and communication would be key to ensure these measures remain temporary and targeted to the most in need, while supporting the transition toward clean energy consumption.

Graph 1.1: **Luxembourg's underlying inflation (1) differentials against the euro area (year-on-year percent).**



(1) Total inflation excluding energy and unprocessed food.

Source: Eurostat

Boosted by fiscal interventions, economic growth will continue to be driven by private consumption, though slowed down by a less supportive environment. Government measures to mitigate the impact

- Luxembourg adopted several support measures to cushion the impact of energy price inflation on households and businesses. The Commission's 2023 spring forecast has estimated that their costs in 2023 will amount to 1.1% of GDP ⁽¹⁾. Most measures do not preserve the price signal in 2023 and a large share are untargeted. Nevertheless, in 2022 they did support households' purchasing power and ensured the competitiveness of the corporate sector by reducing how often wages are increased by automatic indexation. The measures are considered overall to be progressive and to have had a positive net impact on the purchasing power of lower-income households. The measures were extended in March 2023 and are expected to be phased out by the end of 2024.
- The most significant measures in 2023 are aimed at curbing inflation to reduce the risk of a wage-price spiral as the result of automatic wage indexation. In this light, the government put a price cap on gas (at +15% above the average price level in September 2022) and a freeze of electricity prices at their 2022 level. To support vulnerable households, targeted allowances and tax credits were brought in to compensate lower income households for higher energy prices. In addition, a support scheme for energy-intensive companies was set up, in line with the EU State aid framework. Some measures provide grants to support investment in the green transition. Measures are financed by the national budget and do not impose restrictions on the prices set by companies operating in the market.
- In March 2023, the government presented to Parliament the [draft law](#) to apply Council Regulation (EU) 2022/1854 ⁽²⁾. On the solidarity contribution, Luxembourg has reported to the Commission that it has no companies that fall within the scope of Chapter III of Council Regulation (EU) 2022/1854 on an emergency intervention to address high energy prices.
- As regards the security of energy supplies, Luxembourg has put in place measures to speed up the roll out of renewable energy and encourage energy efficiency (for example, by revising the aid scheme and introducing a '100% social top-up'). It has raised awareness of energy consumption through energy saving campaigns (for gas and electricity).

of high energy prices and a series of wage indexations are expected to support households' purchasing power and, therefore, consumer spending. By contrast, investment is expected to remain subdued due to rising interest rates, tighter financing conditions and weak economic growth, weighing on the borrowing demand from firms and households. Economic growth slowed to 1.5% in 2022 and it is expected to remain weak in 2023. According to the Commission's spring forecast, economic growth is expected to reach 1.6% in 2023 before returning to 2.4% in 2024.

Despite the costs of the successive measures adopted since the pandemic, Luxembourg's public finances remain sound. The deficit and debt levels generally remained below their respective 3% and 60% limits, except in 2020 when, due to the

pandemic-related measures, the deficit reached 3.4%. However, the costs of the support measures for high energy prices are expected to result in a deficit of 1.7% in 2023, while a deficit of 1.5% is projected for 2024. The debt-to-GDP level is, therefore, expected to increase from 24.6% in 2022 to 27.0% in 2024. The main fiscal challenge for Luxembourg remains long-term sustainability, mainly due to the big increase expected in the cost of pensions, which will weigh heavily on public finances in the coming decades.

After a decade of very low interest rates, the normalisation of monetary policy is

⁽¹⁾ For 2022, gross budgetary costs of measures amounted to 0.5% of GDP. Some of the measures outlined in this box were already in place in 2022.

⁽²⁾ [EUR-Lex - 32022R1854 - EN - EUR-Lex \(europa.eu\)](#)

affecting financing conditions for businesses and households. The normalisation of monetary policies prompted by the rise in inflation are translating into the higher rates imposed by credit institutions, which impact consumer spending and companies' readiness to invest. In addition, as an important financial centre, Luxembourg is relatively more exposed to volatility risks in the financial markets⁽³⁾, which could occur as a result of an unexpected tightening of financial conditions, and which could trigger sharp decreases in the value of assets under management of the funds industry and in real estate collateralised in mortgage loans.

The challenging macroeconomic context has contributed to the emergence of vulnerabilities that are assessed in the In-depth Review for Luxembourg. ⁽⁴⁾ The rising price of residential real estate⁽⁵⁾ continues to feed into higher levels of household debt, raising concerns about potential problems arising with the downturn of the cycle. Although household debt remains moderate as a share of GDP (65% in 2022), the aggregate debt level is high compared to income. After steadily increasing over the last two decades, the ratio of debt to gross disposable income peaked at 180% in 2022, one of the highest levels in the EU. The level of household debt is largely attributable to the strong growth in loans for residential real estate. The house price dynamics increase inequality and could make the country a less attractive place to work, which would become a competitive disadvantage. The government's strategy to tackle the housing situation in Luxembourg includes measures in several policy areas (see Section 3). These concerns are expected to slow down this year in the face of the worsening economic outlook and

the tightening of financial conditions (see Annex 22)].

While sequential indexed wage increases support households' purchasing power in 2022-2023, the government support packages also alleviate the burden on employers. Nominal⁽⁶⁾ wages grew by 5.4% in 2022, while real wages proved to be relatively well protected and declined by only 0.2%. Automatic wage indexation of 2.5% took place in April 2022 and in February and April (postponed from July 2022) 2023. One additional indexation is projected to take place in the last quarter of 2023. Nominal unit labour costs are therefore expected to increase significantly by 7.8% in 2023, after the already high 7.4% in 2022.

The labour market proved to be resilient in 2021-2022, with strong employment growth and unemployment falling to record low levels. The employment rate (20-64) reached 74.1% in 2021 and registered the strongest growth in the EU. Then it decreased in 2022 from 75.4% in Q1-2022 to 74.4% in Q3-2022, and it is slightly below the EU average in a labour market where around 47% of the workforce comes from the neighbouring countries. According to the Commission's spring forecast, the labour market is expected to remain resilient, although it is forecast to slow down slightly, in line with the lower economic activity growth in 2022 and 2023. The unemployment rate fell to 4.6% in 2022, below its pre-pandemic level, although it slightly increased in the second half of 2022. The unemployment rate, while remaining relatively low in Luxembourg, is expected to gradually increase to 4.8% in 2023 and 5.0% in 2024.

Poverty indicators in Luxembourg have to some extent deteriorated as a result of the COVID-19 crisis and the increase in house prices. The share of people at risk of poverty or social exclusion increased in 2021 to 21.1%. Non-EU citizens aged 18+ are more

⁽³⁾ The potential impact of this risk may be mitigated by financial market participants with hedging strategies against volatility in the value of financial assets in place.

⁽⁴⁾ European Commission (2023), In-Depth Review for Luxembourg, Commission staff working document (COM(2023) 638 final).

⁽⁵⁾ "External Sustainability Analysis: Thematic Note to Support In-Depth Review", European Economy Discussion Paper, No. 197, [2023](#).

⁽⁶⁾ Nominal wages are expressed in current prices, without taking inflation into account, as opposed to real wages, where adjustments are made for price level changes over time.

likely to experience poverty in Luxembourg: 38.7% were at risk of poverty or social exclusion in 2021 compared to 13.9% of people who are citizens of Luxembourg. The rate of in-work poverty also increased and is among the highest in the EU. This is highlighted by the social scoreboard underpinning the European Pillar of Social Rights (Annex 12). Moreover, persistent house price inflation is a major concern for people. According to Eurostat, social transfers (excluding pensions) reduced the share of people at risk of poverty by 34.2% in 2021, compared to 39.4% in 2020. Therefore, social transfers, including the social inclusion income scheme (REVIS), appear to have become less effective in alleviating poverty in Luxembourg. Further action on social policy would help Luxembourg reach the national target of having at least 4 000 fewer people at risk of poverty by 2030.

The ratio of vacancies over all jobs reached historically high levels in 2022.

Labour shortages increased sharply since the beginning of 2021, especially in non-financial services. Overall, 72% of companies indicated that the lack of availability of labour was a factor limiting production. In parallel, the job vacancy rate in the private sector increased from 1.8% in 2020 to 3.1% in 2022. The overall skills mismatch increased from 22.4% in 2020 to 23.8% in 2021. Luxembourg's research and innovation system relies heavily on its ability to attract foreign talents. The national research and innovation strategy recognises the need to better monitor the skills gap between needs and supply and to train more people in new, highly dynamic digital skills.

Skills development is a very high priority on the government's agenda.

There have been many initiatives in recent years to promote vocational training among job seekers, to address the challenges of digitalisation and to better anticipate the skills that are needed, particularly in the framework of the Skillsdësch. Nevertheless, effective action is still needed to improve access to lifelong learning for less educated employees, people with fewer skills and older workers. The project to create individual learning accounts appears to have stalled as negotiations

between the government and social partners have so far proven unsuccessful. Moreover, the specificity of Luxembourg's labour market, in which 47% of the workforce are cross-border workers, makes it more challenging to implement the Council Recommendation on individual learning accounts as it implies bilateral negotiations with neighbouring countries. It is also essential to implement the Council Recommendation to meet Luxembourg's national target of at least 62.5% of all adults participating in education and training each year by 2030.

Although still one of the highest in the EU, Luxembourg's labour productivity has been stagnating since the 2000s.

Luxembourg has one of the highest levels of gross domestic product per hour worked in the EU and the OECD. When analysing labour productivity per hour worked in terms of growth rates rather than levels, the situation looks less positive. Graph A12.1 in Annex 12 shows that since 2007, Luxembourg's productivity has evolved less favourably than the average in the euro area and neighbouring countries. In 2022, labour productivity decreased by 2.0%.

Low productivity gains are partly explained by low levels of business investment, including in R&D.

In 2021, business investment represented 8.3% of GDP in Luxembourg, against 13.5% in the EU. This is amongst the lowest in the EU ⁽⁷⁾ and in the OECD ⁽⁸⁾. R&D expenditure by the business sector has continued to decline and fell to 0.47% of GDP in 2021, against 1.5% in the EU ⁽⁹⁾ (see Annex 11).

Overall, Luxembourg performs relatively well on several sustainable development goals (SDGs) indicators, although challenges remain in certain areas.

For SDGs on environmental sustainability: the country performs well on Sustainable cities and communities (SDG 11) and Industry, innovation and infrastructure' (SDG 9). In some

⁽⁷⁾ EC, Eurostat, [SDG_08_11](#)

⁽⁸⁾ OECD [Economic surveys: Luxembourg 2022](#), 17/11/2022

⁽⁹⁾ EC, Eurostat, [RD_E_BERDPFR2](#)

cases, despite being below the EU average, it is improving on Affordable and clean energy (SDG 7) and Responsible consumption and production (SDG 12). 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 target in Quality education (SDG 4) and is catching up on Decent work and economic growth (SDG 8). Finally, Luxembourg performs very well on SDG indicator 16 on Macroeconomic stability.

THE RECOVERY AND RESILIENCE PLAN IS UNDERWAY

Luxembourg's recovery and resilience plan (RRP) aims to address the key challenges related to skills, climate, digitalisation, health and anti-money laundering. It consists of nine reforms and ten investments that are supported by EUR 83 million in grants, representing 0.11% of GDP (see Annex 3 for more details).

The implementation of Luxembourg's recovery and resilience plan is underway.

Luxembourg submitted its first payment request on 28 December 2022, corresponding to 26 milestones and targets in the Council implementing Decision, for the disbursement of EUR 20 million under the recovery and resilience facility. On 28 April, the Commission adopted a preliminary assessment finding that all 26 milestones and targets were satisfactorily fulfilled.

The milestones and targets positively assessed demonstrate significant steps in the implementation of Luxembourg's plan.

This includes the entry into force of the "Housing Pact 2.0" reform, aimed at increasing the supply of affordable rental housing offered by municipalities, investments for the digitalisation of the public sector and for the development of ultra-secure communication, the upskilling of the workforce with the launch of the "FutureSkills" programme, as well as a reform on the procurement of clean vehicles. Luxembourg is expected to submit a REPowerEU chapter and has already decided to transfer 128.5 million EUR from the Brexit Adjustment Reserve (BAR) to the RRF in order to finance its implementation.

The following, more detailed review of measures being implemented under the RRP in no way implies formal Commission approval or rejection of any payment requests.

Luxembourg submitted an updated RRP to the Commission on 11 November 2022

to take into account the downward revision of its maximum financial contribution from €93.4 million to €82.7 million. Luxembourg proposed to remove from its initial plan the digital skills training programme for workers on partial unemployment schemes as it did not meet the initial expectations in terms of demand, mainly due to a stronger than expected rebound of Luxembourg's economy in spring 2021. In its assessment, the Commission considered that the limited modification put forward by Luxembourg did not affect its positive assessment of the initial RRP, as regards its relevance, effectiveness, efficiency and coherence. On this basis, it proposed that the Council approve the updated RRP. The Council followed that recommendation and adopted an amended implementing decision, approving the updated RRP, on 17 January 2023.

Luxembourg submitted its first payment request, for EUR 24.9 million, on 28 December 2022 ⁽¹⁰⁾.

Luxembourg's first payment request covers milestones and targets pertaining to reforms in the areas of skills, housing, climate, health and anti-money laundering. It also includes investment, for example in the areas of skills and digitalisation. On 28 April, the European Commission has endorsed a positive preliminary assessment of Luxembourg's first payment request).

Although the digital skills investment has been removed, the updated RRP still contains digital measures, including on upskilling and reskilling,

which help to implement the European Pillar of Social Rights. In particular, the FutureSkills programme gives jobseekers soft, digital, and managerial skills, with a particular emphasis on people aged 45 and above, to help them to get back into

⁽¹⁰⁾ Gross amount (before deduction of pre-financing)

employment. The *Skillsdësch* reform (launched in January 2021) is aimed at designing vocational training programmes (Skillsbridges) to help workers and jobseekers to enhance their employability during the green and digital transitions.

Furthermore, the updated RRP also keeps a number of investments in digitalisation and innovation that contribute to the digital transition in the areas of healthcare and public services, and by developing an ultra-secure communication infrastructure. Several measures have been implemented already, including a central platform for public administrations to manage documents and cases electronically, and the adoption of ADEM's (Agence pour le développement de l'emploi) 2025 strategy to tackle the operational and digital challenges resulting from its further digitalisation. Following the amendment of the plan, 30% of the final allocation will support digital measures and 69% will support green measures, which are above the minimum levels of 20% and 37% respectively that are laid down in the Regulation setting up the Recovery and Resilience Facility.

Building on Luxembourg's commitment to the digital transition, the recovery and resilience plan includes investments and reforms supporting R&D and technological innovation. The plan allocates substantial support for the development of quantum communication infrastructure and LuxQCI Laboratory, which is expected to help Luxembourg develop key research and innovation capabilities in this field, while providing opportunities for cooperation between research labs and the private sector.

The RRP has a strong focus on environmental and climate challenges. As indicated in Annex 6, the RRP emphasises the green transition. The measures in this area include rolling out a system to generate renewable energy for a new housing area. The Housing Pact 2.0 reform included in the RRP will encourage investment in energy efficiency in buildings and will incentivise municipalities to increase their stock of affordable housing.

The RRP will also help reduce the high level of emissions from transport by implementing new measures to electrify the public transport vehicles and through a financing scheme to expand the network of charging points for electric vehicles.

Luxembourg has taken further steps in the electrification of its public transport network. As required by milestone 2A-1 of the RRP, Luxembourg has adopted a new Grand-Ducal Regulation by which each contracting authority must procure a minimum percentage of clean road vehicles in 2021-2025. At least 38.5% of vehicles lightweight (category M1 and N1) from 2021 to 2025 must correspond to the criteria for clean vehicles. The central government applies more ambitious targets as only electric cars are purchased for its own car fleet.

Luxembourg has adopted additional measures to protect nature and biodiversity. Luxembourg adopted the *Naturpakt* Law by which municipalities may sign a *Naturpakt* contract with the State in which they commit to implement initiatives until 2030 to protect nature and biodiversity. Municipalities receive a certification once they have signed the contract and are entitled to financial subsidies once they reach a sufficient level of performance. This is assessed on the basis of their implementation of a catalogue of measures adopted by each municipality, which are based on the categories of activities in a list published by the State.

Luxembourg also adopted a new law to replace the Housing Pact, which aims to increase the effectiveness of State support to municipalities to provide affordable housing. In particular, the Housing Pact 2.0 aims to increase sustainably the supply of affordable public housing. Natural gas makes up around one third of the final energy consumption in the residential sector. Luxembourg's RRP is helping reduce dependency on gas by installing photovoltaic panels on the Neischmelz housing project, one of the largest development projects in the country.

Key deliverables of the recovery and resilience plan in 2023-2024

- Installation of additional 1300 charging points for electric vehicles by the end of 2023 under the scheme to decarbonise transport
- At least 70% of municipalities to sign the new Housing Pact 2.0 by the end of 2023
- At least 30 municipalities to sign the Naturpakt contract by the beginning of 2024
- Cross-border demonstration of a quantum distribution system in late 2024 through a satellite connection under the ultra-secure connectivity measure.

The RRP addresses vulnerabilities in the health sector. The COVID-19 pandemic has highlighted shortages in health professions, against the background of increasing demand for healthcare. Measures in the RRP aim to make staff management more efficient by investing in telemedicine and an electronic register of health professionals. This digital register should improve day-to-day staff management and help anticipate shortages of doctors and nurses. Policy action aims to improve the attractiveness of health professions, in particular by redefining the skills demanded of healthcare professionals. The first reform – establishing a consultative board of stakeholders called the *Gesondheitsdösch* – is done and will provide input to further reforms and investments and to the national health plan.

Luxembourg has adopted several measures to fight against money laundering and combat terrorist financing. The RRP improves the understanding of and the legal measures included strengthen the framework for anti-money laundering and the financing of terrorism. Three milestones included in the first payment request consist of the publication of reports for a better risk identification, assessment and understanding of anti-money laundering and the financing of terrorism. In addition, two acts have entered into force, reinforcing the supervision and sanctioning powers of supervisory authorities and self-regulatory bodies in the field of anti-money laundering and the financing of terrorism. Another measure in the first payment request is a study on the supervisory regime applicable to professionals providing trust and company services with the aim to inform a consecutive milestone that envisages

to reinforce the anti-money laundering framework for these professionals.

FURTHER PRIORITIES AHEAD

Luxembourg faces additional challenges to those tackled in its recovery and resilience plan (RRP). These include: (i) the long-term sustainability of public finances, mainly stemming from the pension system; (ii) legal loopholes that could be used by multinationals engaging in aggressive tax planning; (iii) vulnerabilities related to high house prices and household debt; (iv) weaknesses in the education system that add to inequality; (v) issues with the transport network; and (vi) potential obstacles to the transition from fossil fuels. Addressing these challenges will also help to make further progress in achieving the SDGs where Luxembourg currently shows room for further improvement, on Affordable and clean energy (SDG 7), Responsible consumption and production (SDG 12) and Climate action (SDG 13). Despite its performance above the EU average on Quality education (SDG 4), the low achievement of 15-years-olds in reading and the number of early leavers from education and training remain an issue.

Strengthening the long-term sustainability of public finances

The general government debt is still very low at present. However, in the longer-term, the picture looks different. Public debt has been gradually increasing, although it remains at a low level. It reached 24.6% of GDP in 2022. However, in the long term Luxembourg faces the sharpest increase in pension-related spending of all EU countries. The expected impact on public finances is also among the highest in the EU and threatens Luxembourg's long-term fiscal sustainability.

Indicators on the risk to Luxembourg's long-term fiscal sustainability remain high. Luxembourg faces high long-term risks

based on the overall long-term risk classification by the 2022 report on the stability and convergence programmes (European Commission, 2022). The risks are entirely driven by the expected increase in age-related expenditure (projected to be around 10.4pps of GDP higher by 2070), mainly on pensions (around 8.7pps of GDP).

The impact of demographic trends on government spending will become more acute in the coming decades. This is because the number of pensioners per worker is expected to rise steadily due to the ageing population and the slowdown in net migration flows. In a scenario where there is no policy change, by 2070 Luxembourg will face one of the EU's sharpest increases in pension spending, as a share of GDP, which is projected to double to around 18% of GDP, among the highest in the EU. This will lead to a significant increase in government debt, putting the sustainability of government finances at risk.

The average retirement age is among the lowest in the EU. The high level of pensions compared to wages and the availability of early retirement schemes result in an early effective retirement age of 61.3 on average, one of the lowest in the EU. Similarly, the employment rate of older workers (aged 55-64), at 46,6% in 2022, remains much lower than the EU average (62.4%). No further increase in the statutory retirement age has been laid down by law. It is thus expected to remain at 65 if no reform is adopted.

The recovery and resilience plan does not address the long-term sustainability of the pension system. Specifically, the plan does not address the negative effects of early retirement schemes and financial incentives to leave the labour market early, which explains the low rate of employment (and activity) among older workers. Some studies have

estimated the long-term impacts of different reform options; however, the results are subject to a high degree of uncertainty about the impact on the different variables and are unspecific as regards the design and implementation of the policy mix. The major impact is usually found on broad demographic and economic variables, in particular the labour force, employment, economic growth and productivity⁽¹¹⁾. In this light, raising the effective retirement age would have a very beneficial macroeconomic impact, with great potential to reduce spending on pensions. Especially if this were achieved by reducing the percentage of the pension (compared to the previous wage) paid to someone who retires early, which is around 81% in Luxembourg, one of the highest in the EU. Phasing out the early retirement schemes and eventually linking the retirement age to life expectancy, in combination with measures to encourage people to keep working, would also help achieve a higher rate of older workers in employment, thereby supporting economic growth and increasing economic fairness between generations.

The government has commissioned the National Economic and Social Council (CES) to discuss possible implications of the ageing population for the financial sustainability of the pension system in the long run. The CES started working on this issue in late autumn 2022 and is expected to publish a report with concrete proposals. This measure is a first step towards a national debate on pension reform.

⁽¹¹⁾ IMF *Selected Issues*, [2019](#) reports the results of three reforms estimated by a calibrated DSGE model and concludes that a combination of the three would yield a better impact. However, estimates do not seem to take into account the implications of a labour market where half of workers are non-residents and underlying assumptions are only partially made clear. The latest report from the national working group on pensions (IGSS, [2022](#)) concluded that a reform was not needed in 2023-2032. See also European Commission, [2021](#) and OECD, [2022](#).

Tackling aggressive tax planning

It is essential to tackle aggressive tax planning to prevent distortions to competition between firms, ensure fairness for EU taxpayers and safeguard public finances. Economic data point to a potentially greater risk of aggressive tax planning than in most other Member States. Some aspects of Luxembourg's tax system, such as the absence of withholding taxes or allowing transfer pricing mismatches, for example by deducting deemed interest payments⁽¹²⁾, can facilitate such practices more than in other Member States. Furthermore, Luxembourg has taken fewer steps to address the issue than most other Member States.

Economic evidence suggests that Luxembourg's tax rules are used by companies to engage in aggressive tax planning. In 2021, Luxembourg had the EU's highest stock of incoming and outgoing foreign direct investment, expressed as a percentage of GDP. Most of the foreign direct investment stock in Luxembourg (85% of inward flows of foreign direct investments and 79% of outward flows of foreign direct investments in 2020) is held through special-purpose entities (SPEs)⁽¹³⁾. The large proportion of foreign direct investment stocks held by SPEs may be an indication of aggressive tax-planning. Luxembourg is a major conduit of capital flows, recipient of 24% of all dividends received by the EU27 and the origin of 28% of all dividends paid by the EU27 (2020). It is also the recipient of 36% of all interests received by the EU27 and the origin of 31% of all interests paid by the EU27 (2019). These flows are the highest in the EU,

⁽¹²⁾ The Commission has identified this possibility as an aggressive tax planning indicator; see https://taxation-customs.ec.europa.eu/system/files/2016-09/taxation_paper_61.pdf.

⁽¹³⁾ A special purpose entity is a legal entity that has little or no employment, operations, or physical presence in the jurisdiction where it is located. It is linked to another corporation, often by subsidiarity, typically located in a different jurisdiction.

and disproportionately high compared to the size of the economy. Luxembourg is a small open economy, with a large international financial sector, which explains a large part of these financial flows. However, they also reflect the significant presence of foreign-controlled companies in the country, which carry out intra-group treasury activities.

The lack of withholding taxes on interest and royalty payments to low- or zero-tax jurisdictions, or measures with an equivalent effect, are of particular concern. The lack of withholding taxes on outbound payments of interest, and royalties from Luxembourg-based companies to non-EU jurisdictions, could lead to little or no taxation if these payments are not taxed or taxed at a low level in the recipient jurisdiction. In 2021, Luxembourg adopted a non-deductibility measure for interest and royalties paid to jurisdictions on the EU list of non-cooperative jurisdictions for tax matters. However, the scope of this measure is too narrow to address aggressive tax planning risks linked to outbound payments by Luxembourg. Moreover, the OECD Pillar 2 rules on a global minimum corporate tax rate are yet to be implemented in the EU. They will help to address the outbound payment issue in Luxembourg but will not fully address it because their scope is limited to the largest multinationals (threshold of €750 million⁽¹⁴⁾) and because there are certain sectoral exemptions.

The steps taken by Luxembourg do not go beyond the implementation of EU legislation and Council conclusions. While being a step in the right direction, the Directive on minimum effective taxation (Pillar 2) does not fully address the issue and has not yet been implemented. Therefore, currently no measure in Luxembourg's tax system sufficiently addresses the issue of non-deductibility of outbound payments of interest and royalties.

⁽¹⁴⁾ Article 1.1 of the OECD Model Rules provides that the Pillar Two GloBE Rules apply to Constituent Entities in an MNE Group that have annual revenue of 750 million euros or more in the Consolidated Financial Statements of the UPE in at least two of the four Fiscal Years preceding the relevant Fiscal Year.

Addressing the persistent housing shortage and rising residential real estate prices

Luxembourg is facing increasing vulnerabilities related to high house price growth and high household debt. House prices in Luxembourg have historically increased faster than in the euro area, sustained by strong migration inflows, with housing supply persistently lagging demand, leading to a growing housing shortage. Between 2010 and 2021, house prices increased by 135% (42% in the euro area), with 86% of this increase taking place over the last four years. Over the same period, population increased by around 30% (5% in the euro area), more than 7000 households per year. Meanwhile, the production of new dwellings was below 4000 units per year, resulting in a high housing shortage, which is only partially mitigated by the cross-border housing market.

In recent years, concerns have risen, as household debt in terms of disposable income continued increasing and is substantially higher, compared to other Member States. At an aggregate level, household debt reached 180% of disposable income in 2022, 61% above its long-term average, which is one of the highest deviations from its historical average among the EU Member States. Household debt is largely attributable to the strong growth in residential real estate loans, as bank mortgages account for more than 80% of household debt (146% of disposable income).

A long period of supportive fiscal policies, favouring home ownership over tenancy, further contributed to sustain mortgage credit growth. As in other Member States, borrowers benefited from historically low mortgage rates and favourable financing conditions. However, high fiscal support to home ownership, including deductibility of mortgage interests, largely explain the higher household credit growth and debt stock, in recent years, compared to other Member States. Furthermore, given the persistent

housing shortage, tax relief and subsidies have been capitalised into higher house prices.

Several factors can mitigate the risks of disorderly corrections that could be potentially triggered by the downturn cycle at the current juncture.

Structural demand pressure and supply constraints have been among the main factors underlying the strong long-lasting trend of house price growth, including over the global financial crisis (2008-2009) and the subsequent sovereign crisis (2010-2012). They are expected to support the expansionary phase of the cycle, but not amplify shocks during the downturn. In particular, permanent migration inflows are expected to act as a mitigating factor at the current downturn, as they continue to support demand for housing when prices drop (ESRB, [2019](#)). The risk for banks is mitigated because a large share of debt is owed by wealthy households and appears to be well covered by liquid financial assets. Banks' buffers, appear sufficient to absorb potential shocks stemming from the residential real estate market and mortgage debt.

Despite possible price adjustments, in the short term, sustainably stabilising house prices remains among the main pressing challenges in Luxembourg going forward.

The government is adopting measures aimed to curb house price growth. While these risk to take long to be implemented, there is a need to step up efforts and improve policy coordination with municipalities and the Greater Region for an effective implementation. The "Housing Pact 2.0" (*Pacte de logement*) is a step in the right direction. The implementation of the reviewed spatial planning policy needs to be accelerated to allow for a more efficient land-use across the national territory. Swift adoption of the recurrent taxation policy proposals, such as those on vacant land and unoccupied dwellings, need to be prioritised to discourage land hoarding and foster housing development. Fiscal instruments supporting homeownership need to be phased out, including mortgage interest deductibility, which benefits more high-income households, as they are more likely to finance their house

with mortgage debt, while affordability has worsened, and home ownership rates have declined.

High energy prices are also making housing less affordable in Luxembourg.

The increased energy prices in 2022 negatively affected household budgets, in particular for low-income groups. As a result of price changes from November 2021 to October 2022 (see Annex 7), the proportion of people living in households that spend more than 10% of their budget on energy is estimated to have increased by 12.1%. The proportion of the household budget spent on electricity is estimated to have increased the most for low and lower-middle income groups, whereas residential domestic expenditure on gas increased the most in the top income groups.

Addressing inequality in the education system

Luxembourg's rate of early leavers from education and training (9.3%) is close to the EU-level target (below 9%) but it is steadily increasing.

The share of young people with work experience aged 20-34 who left education and training without completing upper secondary education increased from 6.3% in 2018 to 9.3% in 2021. Repeating a school year is the strongest predictor for dropping out of school: in 2020-21, 80% of pupils who dropped out had repeated a year at least once.

Pupils' basic skills and overall performance depend largely on their socioeconomic and linguistic background.

Educational outcomes are strongly influenced by a pupil's socio-economic background. In Luxembourg, average skills levels at age 15, as measured by the OECD Programme for International Student Assessment (PISA), are significantly lower than the EU average. The gap between advantaged students and their disadvantaged peers is bigger in Luxembourg than any other EU country. The language spoken in the national school system at

primary level is Luxembourgish, while pupils learn to read and write in German. All subjects (except for French) are taught in German. This constitutes a very high demand for language skills in a country where only one in three pupils speaks Luxembourgish as their first language. In September 2022, Luxembourg launched a pilot project in four primary schools, where pupils start learning first in French and then in German. If extended to more schools, this pilot could help improve the performance of pupils whose first language is not German. The number of European public schools – with free access to pupils – has increased to six. Pupils in these schools can choose between English, French or German as main tuition language, instead of the trilingual system. Only 4% of pupils at pre-primary and primary level in Luxembourg are currently enrolled in such public international schools and pupils with a disadvantaged socio-economic or a non-German/-French background are underrepresented there. If the option of teaching through one main language were to be extended to cover a larger part of the school population, it could substantially improve their chances to reach better learning outcomes.

Luxembourg has invested heavily in access to and the quality of early childhood education and care (ECEC). In September 2017, national quality standards were introduced in the non-formal education sector, which all providers must meet to be eligible for the government's childcare co-financing voucher scheme. This includes activities to familiarise children aged 1 to 4 with French and Luxembourgish. Widening access to early childhood education and care (ECEC) and creating incentives to improve its quality are positive steps likely to improve children's learning outcomes at a later stage.

The green transition and fossil energy dependence

Member States should implement REPowerEU to ensure security of supply and affordable energy prices. This specifically entails: (i) continuous efforts to

reduce our dependence on fossil fuels; (ii) by taking actions to diversify away from Russian fuels; (iii) keep up efforts made to reduce demand through more structural measures such as energy efficiency and deploying renewables.

Luxembourg is highly dependent on fossil fuel imports. Reducing Luxembourg's reliance on fossil fuels is an essential part of ensuring security of supply. Luxembourg imports more than 90% of its energy consumption. In 2021, oil accounted for 69% of Luxembourg's energy mix, natural gas 18% and 12% from renewable energy sources. The high share of oil reflects the central role of transportation in Luxembourg's economy. In 2021, almost 100% of the gas Luxembourg consumed was imported through pipelines from Belgium and Germany. Luxembourg does not have any fossil gas production, but it does produce biogas, which is injected into the network.

Luxembourg has a good level of security of supply thanks to its partnership with neighbouring countries. Luxembourg is highly interconnected to its neighbours for both power and gas. While Luxembourg's electricity and gas grids are sufficient for its current needs, there are plans to further develop the electricity grid and improve the interconnections with Germany by 2040 to absorb the expected higher demand for electricity. In December 2022, the government presented an updated risk plan for the electricity sector, which indicated no particular risks due to a significant reduction in demand and increased capacities with Germany.

Luxembourg has made considerable progress in recent years on renewable energies and the digitalisation of the energy transition. Its renewable energy capacity has increased substantially in recent years. The government has set ambitious targets in its climate law to meet over a third of the demand for electricity with renewables by 2030 (mostly solar photovoltaic and wind energy), reduce greenhouse gas emissions by 50% to 55% by 2030 and achieve climate neutrality by 2050. In this perspective, Luxembourg has continued its public support schemes to roll out renewable energy,

including through feed-in tariffs for small-scale installations, market premiums and calls for tender, though results have been lower than expected. The aid scheme promoting photovoltaic energy has increasingly involved private individuals. Furthermore, incentives to promote the consumption of hydrogen were announced by the government in September 2021.

Some barriers continue to hamper the further development of renewable energy. The administrative procedure to obtain authorisation for a renewable energy project is long, caused to some extent by a lack of administrative staff. L taxes on fossil fuels provide little incentive to invest in renewables and energy efficiency. In addition, fossil fuel subsidies amounted to more than EUR 41 million in 2020 and have increased by 30% since 2015 ⁽¹⁵⁾. Luxembourg has already taken some action by gradually phasing out subsidies for combustion engine vehicles, which will only apply to zero-emission cars from 2025. However, some relevant issues remain, such as excise tax refunds and exemptions for diesel used in agriculture, or on the use of natural gas, and these act as a disincentive to adopting cleaner alternatives.

The residential sector accounts for around one third of the total consumption of natural gas. Renovation of the building stock and making further energy savings remain critical to reducing dependency on oil and natural gas. Around 89% of the residential building stock uses fossil fuel heating systems. Luxembourg has a long-term renovation strategy for energy renovations in buildings, with the aim of reaching a 3% per year renovation rate in the residential sector, and of renovating all existing houses to net zero emissions by 2050. While energy prices have decreased, uncertainty remains regarding next winter, which requires continued efforts to structurally reduce gas demand.

Transport is the main cause of traffic congestion, air pollution and greenhouse

gas emissions in Luxembourg. Personal transport creates traffic congestion and still causes air pollution hotspots despite the overall good quality of air in the country. The implementation of the 2035 national mobility plan is expected to gradually overcome those shortcomings through direct investments in infrastructure and public transport services. Incentives to foster multimodal transport and reduce the use of individual vehicles remain rather unspecific. Better coordination with neighbouring Member States would be needed to improve public transport services in the greater region. A commitment to make progress on the CO₂ tax by 2030 would allow firms to plan the necessary adjustments, thereby fostering the transition.

Energy poverty has increased in Luxembourg in recent years. The share of the total population unable to keep their homes adequately warm increased from 0.9% in 2015 to 2.5% and energy poverty affected 5.1% of the population at risk of poverty in 2021. The increase of energy prices in 2022 negatively affected low-income households. The proportion of people living in households spending more than 10% of their budget on energy is estimated to have increased by 21.7 percentage points among the population that is at risk of poverty.

Luxembourg took significant emergency action to mitigate the impact of energy price hikes and to support households. On 11 November 2022, the Government Council approved a package of measures called the '*Solidarit tspak 2.0*', which is principally intended to help reduce households' dependence on fossil fuels and promote their conversion to renewable energies. It also included measures to cap and stabilise energy prices on households and consumers' bills for electricity and natural gas. The Government Council also approved a draft law for a temporary change in the '*Klimabonus Wunnen*' financial aid. The measure will be valid for applications made between 1 November 2022 and 31 December 2023. The government should ensure that these measures are temporary and targeted, and that they preserve the energy price signal. The government should also ensure that the

⁽¹⁵⁾ These barriers also drive Luxembourg's high level of vulnerability in the areas 'climate change mitigation and adaptation' and the 'sustainable use of resources' of the resilience dashboards (Annex 5).

measures do not hinder the green transition, promote greater energy consumption or increase inflation.

In the context of the green transition, in recent years Luxembourg has experienced increased labour shortages in key sectors. These are also linked to a lack of relevant skills, and are creating obstacles in the transition to a net-zero economy. In 2022, labour shortages were reported in seven occupations in Luxembourg that require specific skills or knowledge for the green transition, including policy and planning managers ⁽¹⁶⁾. The job vacancy rate increased across key sectors, such as construction (from 0.6% in 2015 to 1.2% in 2021) and manufacturing (from 0.7% in 2015 to 1.3% in 2021), with both sectors below the EU average of 3.6% and 1.9%, respectively, in 2021 ⁽¹⁷⁾. In 2022, 27% of firms reported labour shortages as a factor that constrained production ⁽¹⁸⁾. Upskilling and reskilling for the green transition, including for the people most affected, and promoting inclusive labour markets are essential policies to speed up the transition to net-zero and ensure its fairness (see Annex 8).

Productivity and business investment

Although still one of the highest in the EU, Luxembourg's labour productivity has stagnated since the 2000s. Hourly labour

productivity hardly changed between 2000 and 2019, registering +0.7% increase over the whole period. Productivity has evolved less favourably than in the euro area average and neighbouring countries, especially since the global financial crisis (Annex 12). In 2021 and 2022, annual labour productivity per hour worked fell by 2.3% and 2.0%, respectively.

Structural change in Luxembourg has provided marginal support to labour productivity growth since 2000 and negative after 2008. As the main contributor to GDP growth, the financial sector is also the main driver of productivity per hour worked, where three distinct periods were observed in these years. In 2000-2007 productivity gains within this sector reached record heights, close to 3% per year, which contributed significantly to the aggregate productivity growth. However, from the global financial crisis to 2019 productivity in financial services fell markedly, while the sector maintained a high contribution to GDP growth, thanks to increases in relative prices compared with other sectors' output. In contrast, more productive sectors, such as manufacturing and transportation were relatively downsized, with labour reallocating to less productive sectors, which also contributed to decrease the aggregate productivity. Since the pandemic, financial services achieved internal productivity gains, although this improvement was more than offset by a decrease in relative prices and negative reallocation effects. Losses within information and communication, professional and technical services and construction further brought down the aggregate productivity in 2021 and 2022.

Low productivity gains are partly explained by low levels of business investment, including in R&D, with public support for business innovation remaining at very low levels. In 2021, business investment in Luxembourg (at 8.3% of GDP) was amongst the lowest in the EU. Business expenditure on R&D has continued to decline and fell to 0.47% in 2021, against 1.5% in the EU. Although Luxembourg has taken steps to foster business innovation, public support for business innovation is still marginal (Annex 11). Luxembourg does not

⁽¹⁶⁾ Data on shortages is based on the European Labour Authority 2023 EURES Report on labour shortages and surpluses. National authorities report through a questionnaire, based on administrative data and other sources as submitted by the EURES National Coordination Offices (definitions of shortages differ, thus data is not comparable across countries and covers a wide variety of sectors). Skills and knowledge requirements are based on the ESCO (European Skills Competences and Occupations) taxonomy on skills for the green transition (for occupations at ISCO 4-digit level of which there are 436 in total). Examples are identified based on their ESCO 'greenness' score and relevant sectors.

⁽¹⁷⁾ Eurostat (JVS_A_RATE_R2).

⁽¹⁸⁾ European Business and Consumer Survey.

provide indirect support to R&D in the form of tax credits, unlike most OECD and EU countries. Only 6% of business R&D is funded by government ⁽¹⁹⁾.

The lack of skilled staff is the most cited long-term barrier to investment by Luxembourg's firms ⁽²⁰⁾. Despite the high proportion of cross-border workers (around 46% of the country's workforce), labour shortages are significant, particularly in ICT, construction and industry (Annex 14). The share of businesses reporting difficulties filling vacancies for jobs requiring ICT specialist skills is well above the EU average (Annex 10). The shortage of skilled labour, particularly people with digital skills, harms SMEs to become greener and more digital.

⁽¹⁹⁾ [OECD Economic Surveys: Luxembourg 2022 | READ online \(oecd-ilibrary.org\)](#).

⁽²⁰⁾ [EIB Investment Survey 2022](#), 11/2022, based on interviews carried out between April and July 2022.

KEY FINDINGS

Luxembourg's RRP includes measures to address a series of structural challenges through:

- a reform that will help increase the supply of affordable housing;
- vocational training programmes aimed at addressing the skills mismatch in the job market and at promoting inclusive growth;
- measures to help decarbonise transport, 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 citizens and businesses, as well as the digitalisation of the health sector.
- Luxembourg should proceed with the steady implementation of its revised recovery and resilience plan and swiftly finalise the REPowerEU chapter with a view to rapidly starting its implementation.

Beyond the reforms and investment in the RRP, Luxembourg would benefit from:

- improving the long-term sustainability of the pension system to maintain sound public finances and fairness, in particular by increasing the participation rate of older workers;
- strengthening action to effectively tackle aggressive tax-planning, which would prevent distortions of competition between firms, treat EU taxpayers fairly and safeguard public finances;
- addressing the persistent shortage of housing, which will help reduce inequality and improve the attractiveness of the

country for workers, which is an obstacle to investment and growth in the medium term, and may become a competitive disadvantage for the economy;

- tackling growing traffic congestion, a major challenge in Luxembourg with economic, social and environmental consequences;
- 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 and transport;
- boosting productivity by supporting business investment, in particular in research and innovation;
- reducing the impact of inequalities on pupils' performance and promoting equal opportunities for all students in the educational system.

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CROSS-CUTTING INDICATORS

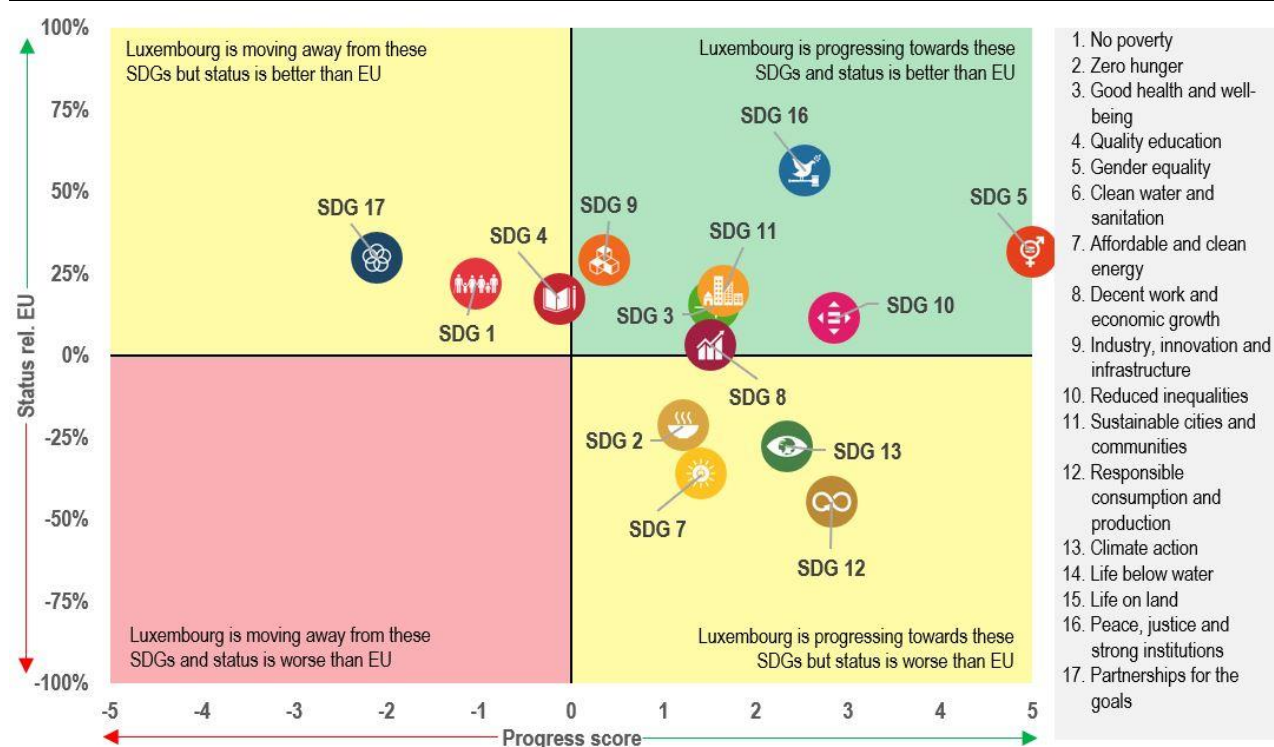
ANNEX 1: SUSTAINABLE DEVELOPMENT GOALS

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), it performs well only on SDGs 11 (Sustainable cities and communities) and SDG 9 (Industry, innovation and infrastructure). Luxembourg

has made progress in particular on the area under organic farming as a percentage of utilised agricultural land, which edged up from 3.5% in 2016 to 5.2% in 2021, but remains below the EU average of 9.1% (SDG 2). On SDG 7 (Affordable and clean energy), the share of renewable energy in gross final energy consumption more than doubled (from 5.4% in 2016 to 11.7% in 2021, EU average 21.8%), whereas energy import dependency as a percentage of imports in gross available energy decreased (from 96.3% in 2016 to 92.5% in 2021) but remains above the EU average of 55.5%. Average CO2 emissions per km from new passenger cars (SDG 12) improved, dropping from 126.1 g CO2 per km in 2016 to 123.8 g in 2021 (still above the EU average of 116.3 g). Luxembourg also recorded an improvement in net greenhouse gas emissions (SDG 13), decreasing from 19.2 tonnes per capita in 2016 to 16.9 tonnes in 2021, but it is still above the EU average (7.4 tonnes). The country further improved its performance on the recycling of

Graph A1.1: Progress towards the SDGs in Luxembourg in the last 5 years



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 \(europa.eu\)](#). The status of each SDG in a country is the aggregation of all indicators for the specific goal compared to the EU average. 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 early April 2023, except for the EU Labour Force Survey (LFS) indicators released on 27 April 2023. Data mainly refer to 2016-2021 or 2017-2022.

municipal waste as a percentage of total waste generated (SDG 11) from 49.2% in 2016 to 55.3% in 2021, well above the EU average (49.6%). Luxembourg's recovery and resilience plan (RRP) has the highest percentage of green measures (68.8%) of the 22 RRP approved in 2021, which will help decarbonise transport in particular.

While Luxembourg performs well on some SDG indicators related to *fairness* (SDGs 3, 4, 5, 10), it is improving on others (SDGs 7, 8).

The percentage of people with good or very good self-perceived health aged 16 or over increased from 69.2% in 2016 to 76.5% in 2021 (EU average 69.0%). On SDG 4 (Quality education), tertiary educational attainment as a percentage of the population aged 25-64 jumped from 51.3% in 2017 to 61.0% in 2022, well above the EU average of 42.0%, and the percentage of the adult population in learning in the past 4 weeks improved from 17.2% in 2017 to 18.1% in 2022 (EU average 11.9%). On the other hand, the percentage of young people not in education, employment or training has slightly increased from 6.6% of the population aged 15-29 to 6.8%, but remains below the EU average (11.7%). On SDG 5 (Gender equality), Luxembourg improved both in its gender employment gap (from 7.9% of those aged 20-64 in 2017 to 6.5% in 2022, EU average 10.7%) and in seats held by women in national parliaments and government, which increased from 28.3% in 2017 to 35.0% in 2022, and is now above the EU average of 32.5%. The RRP includes measures to strengthen the resilience of the health system, including by digitalising the sector.

Regarding *productivity*, Luxembourg is moving away from SDG 4, improving on SDG 9 and needs to catch up on SDG 8.

Gross domestic expenditure on R&D (SDG 9) dropped from 1.27% of GDP in 2016 to 1.02% in 2021, while the EU average increased to 2.26%. The number of early leavers from education and training (SDG 4) as a percentage of the population aged 18-24 increased from 7.3% in 2017 to 8.2% in 2022, edging closer to the EU average (9.6%). On SDG 8, despite real GDP per capita remaining the highest in the EU with a small drop from EUR 84 020 per capita in 2017 to EUR 83 940 in 2021 (EU average EUR 28 820), the in work at-risk-of-poverty rate as a percentage of the population went up from 10.9% in 2016 to 13.5% in 2021, above the EU average of 8.9%. 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, 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*, improving on SDG 8, but is moving away from SDG 17.

General government gross debt (SDG 17) increased from 21.8% of GDP in 2017 to 24.6% in 2022, but remains very low compared to the EU average of 84.0%. On SDG 8, the employment rate of the population aged 20-64 went from 71.5% in 2017 to 74.8% in 2022 (EU average 74.6%), and the long-term unemployment rate as a percentage of the active population dropped from 2.1% in 2017 to 1.3% in 2022 (EU average 2.4%). On the other hand, the investment share of GDP decreased from 17.3% in 2016 to 16.6% in 2021, well below the EU average at 23.2%. The perceived independence of the justice system (very good and fairly good) increased from 72% of the population in 2017 to 77% in 2022, 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 would deter criminals from using these entities to launder illicit money.

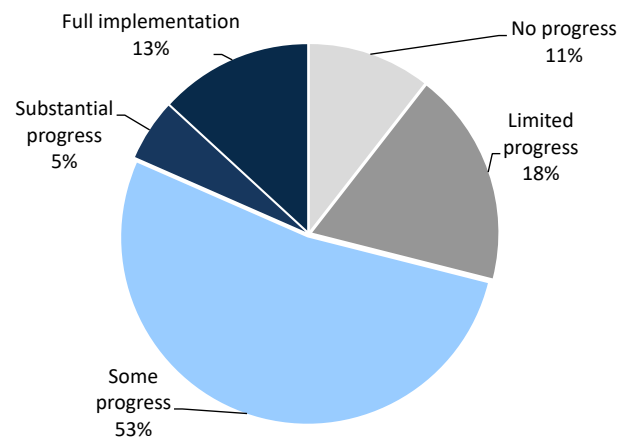
As the SDGs form an overarching framework, any links to relevant SDGs are either explained or depicted with icons in the other Annexes.



ANNEX 2: PROGRESS IN THE IMPLEMENTATION OF COUNTRY-SPECIFIC RECOMMENDATIONS

The Commission has assessed the 2019-2022 country-specific recommendations (CSRs)⁽²¹⁾ addressed to Luxembourg as part of the European Semester. These recommendations concern a wide range of policy areas that are related to 9 of the 17 Sustainable Development Goals (see Annexes 1 and 3). The assessment considers the policy action taken by Luxembourg to date⁽²²⁾ and the commitments in its recovery and resilience plan (RRP)⁽²³⁾. At this stage of RRP implementation, 71% of the CSRs focusing on structural issues from 2019-2022 have recorded at least 'some progress', while 18% recorded 'limited progress' (see Graph A2.1). As the RRP is implemented further, considerable progress in addressing structural CSRs is expected in the years to come.

Graph A2.1: Luxembourg's progress on the 2019-2022 CSRs (2023 European Semester)



Source: European Commission

⁽²¹⁾ 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 \(europa.eu\)](#)

⁽²²⁾ Including policy action reported in the national reform programme and in Recovery and Resilience Facility (RRF) reporting (twice a year reporting on progress in implementing milestones and targets and resulting from the payment requests assessment).

⁽²³⁾ Member States were asked to effectively address all or a significant subset of the relevant country-specific recommendations issued by the Council in 2019 and 2020 in their RRP. 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 are not yet 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 2019-2022 CSRs

Luxembourg	Assessment in May 2023*	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	Some progress		
In 2022, pursue a supportive fiscal stance, including the impulse provided by the Recovery and Resilience Facility, and preserve nationally financed investment.	Full Implementation	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.	Full Implementation	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.	Substantial Progress	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.	Limited Progress	Not applicable	SDG 8, 16
2022 CSR 1	Limited 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,	Some 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

Note:

* See footnote (22).

** RRP measures included in this table contribute to the implementation of CSRs. Nevertheless, additional measures outside the RRP are 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.



The Recovery and Resilience Facility (RRF) is the centrepiece of the EU's efforts to help it recover from the COVID-19 pandemic, speed up the twin transition and strengthen resilience against future shocks. The RRF also contributes to implementation of the SDGs and helps to address the Country Specific Recommendations (see Annex 2).

Luxembourg submitted its initial recovery and resilience plan (RRP) on 30 April 2021. The Commission's positive assessment on 18 June 2021 and Council's approval on 13 July 2021 paved the way for disbursing EUR 93.4 billion in grants under the RRF over the 2021-2026 period.

Table A3.1: **Key elements of Luxembourg's RRP**

Current RRP	
Scope	Revised plan (article 18)
CID adoption date	17 January 2023
Total allocation	EUR 83 million in grants (0.11% of 2021 GDP)
Investments and reforms	12 investments and 10 reforms
Total number of milestones and targets	60

Source: RRF Scoreboard

Since the entry into force of the RRF Regulation and the assessment of the national recovery and resilience plans, geopolitical and economic developments have caused major disruptions across the EU.

In order to effectively address these disruptions, the (adjusted) RRF Regulation allows Member States to amend their recovery and resilience plan for a variety of reasons. In line with article 11(2) of the RRF, the maximum financial contribution for Luxembourg was moreover updated on 30 June 2022 to an amount of EUR 82.7 billion in grants.

In this context, **Luxembourg submitted an amended RRP to the Commission on 11 November 2022** to take account of its revised maximum financial contribution, in line with Article 18 of the RRF Regulation. Given its reduced financial contribution, Luxembourg proposed to remove from this revised plan the digital skills training program targeting workers on short-time

working schemes, explaining that it did not meet initial expectations in terms of demand. This is mainly explained by a stronger than expected rebound of the Luxembourg economy in the spring of 2021, with a large number of beneficiaries returning to full-time contracts earlier than expected. The revised RRP was approved by the Commission on 12 December 2022 and Council on 17 January 2023.

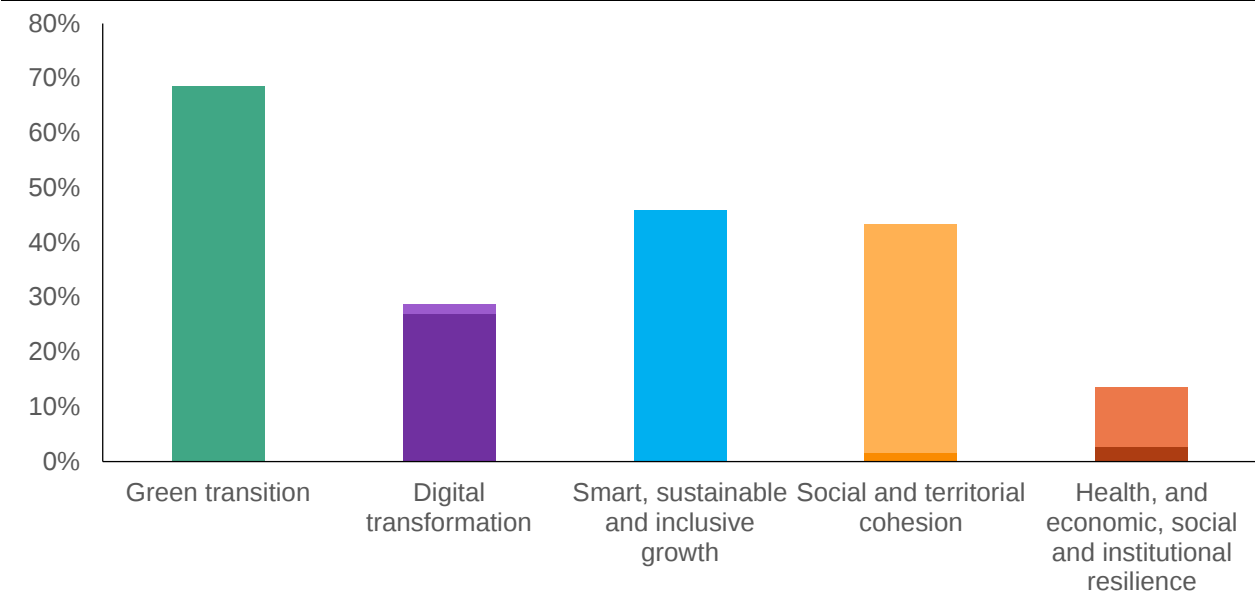
Luxembourg's progress in implementing its plan is published in the Recovery and Resilience Scoreboard ⁽²⁴⁾. The Scoreboard also gives an overview of the progress made in implementing the RRF as a whole, in a transparent manner. The graphs in this Annex show the current state of play as reflected on the Scoreboard.

EUR 12.1 million has so far been disbursed to Luxembourg under the RRF. The Commission disbursed this amount in pre-financing on 3 August 2021, equivalent to 13% of the financial allocation.

In December 2022, Luxembourg submitted its first payment request for an amount of EUR 20.2 million. The Commission published its positive preliminary assessment on 28 April 2023. The payment request is now discussed in the Council.

⁽²⁴⁾ https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/country_overview.html

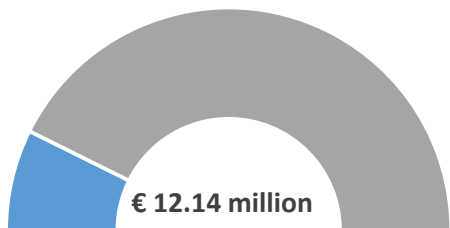
Graph A3.1: **Share of RRF funds contribution to each policy pillar**



Note: Each measure contributes towards two policy areas of the six pillars, therefore the total contribution to all pillars displayed on this chart amounts to 200% of the estimated cost of the RRP. The bottom part represents the amount of the primary pillar, the top part the amount of the secondary pillar.

Source: RRF Scoreboard

Graph A3.2: **Total grants disbursed under the RRF**



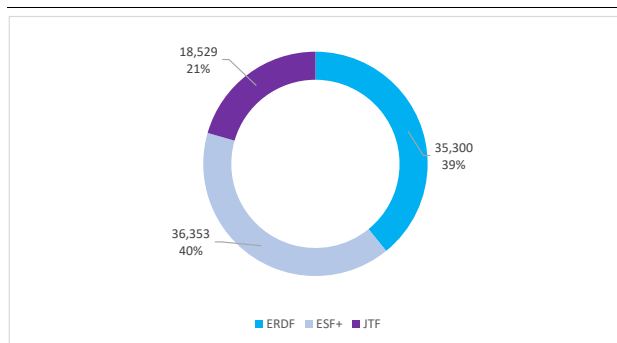
Note: This graph displays the amount of grants disbursed so far under the RRF. Grants are non-repayable financial contributions. The total amount of grants given to each Member State is determined by an allocation key and the total estimated cost of the respective RRP.

Source: RRF Scoreboard



The EU budget of over EUR 1.2 trillion for 2021-2027 is geared towards implementing the EU's main priorities. Cohesion policy investment amounts to EUR 392 billion across the EU and represents almost a third of the overall EU budget, including around EUR 48 billion invested in line with REPowerEU objectives.

Graph A4.1: **Cohesion policy funds 2021-2027 in Luxembourg: budget by fund**



(1) million EUR in current prices, % of total; (total amount including EU and national co-financing)

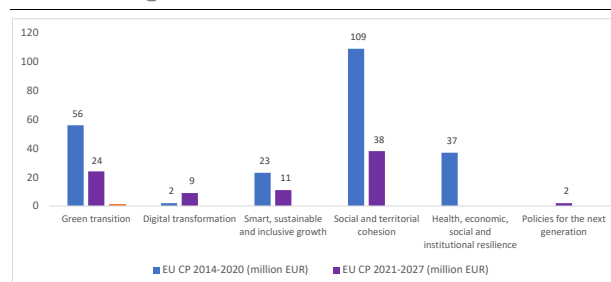
Source: European Commission, Cohesion Open Data

In 2021-2027, in Luxembourg, cohesion policy funds⁽²⁵⁾ will invest EUR 8.5 million in the green transition and EUR 0.5 million in the digital transformation as part of the country's total allocation of EUR 90 million. In particular, the European Regional Development Fund (ERDF) will boost research and innovation, digitalisation and energy efficiency. SMEs lie at the heart of ERDF support to companies, and financial instruments will be deployed widely to improve their access to finance. Over 16 000 households will improve energy performance of their dwellings and 20 000 will get high-capacity internet connection. The Just Transition Fund will facilitate the green transition and foster job creation in regions with emission-intensive industries. The European Social Fund Plus (ESF+) is key to supporting investment in people and reforms in the areas of employment, education and training, and social inclusion. Luxembourg allocated EUR 7.2 million to employment and life-long learning, of which 66% target the development of digital skills and jobs. EUR 3.8 million will support disadvantaged groups through integrated pathways to work.

⁽²⁵⁾ European Regional Development Fund (ERDF), European Social Fund+ (ESF+), Just Transition Fund (JTF) excluding Interreg programmes. Total amount includes national and EU contributions. Data source: [Cohesion Open Data](#).

Of the investments mentioned above, EUR 10 million will be invested in line with REPowerEU objectives. This is on top of the EUR 5.8 million dedicated to REPowerEU under the 2014-2020 budget. EUR 5 million (2021-2027) and EUR [4] million (2014-2020) is for improving energy efficiency; EUR [5] million (2021-2027) and EUR [1.8] million (2014-2020) is for renewable energy and low-carbon R&I.

Graph A4.2: **Synergies between cohesion policy funds and the RRF with its six pillars in Luxembourg**



(1) million EUR in current prices (total amount, including EU and national co-financing)

Source: European Commission

In 2014-2020, cohesion policy funds made EUR 182.5 million available to Luxembourg⁽²⁶⁾ with an absorption of 79%⁽²⁷⁾. Including national financing, the total investment amounts to EUR 231.4 million - around 0.1% of GDP for 2014-2020.

Luxembourg continues to benefit from cohesion policy flexibility to support recovery, step up convergence and provide vital support to regions following the COVID-19 pandemic. The Recovery Assistance for Cohesion and the Territories of Europe instrument (REACT-EU)⁽²⁸⁾ under NextGenerationEU provides EUR 144 million on top of the 2014-2020 cohesion policy allocation for Luxembourg. REACT-EU financed close to 2 million COVID-19 vaccines and other medical supplies. Close to 5 500 SMEs received loans to overcome from the lockdown period and 450 000 workers were supported

⁽²⁶⁾ Cohesion policy funds include the ERDF and ESF. ETC programmes are excluded here. According to the 'N+3 rule', the funds committed for 2014-2020 must be spent by 2023. REACT-EU is included in all figures. The total amount includes EU and national co-financing. Data source: [Cohesion Open Data](#).

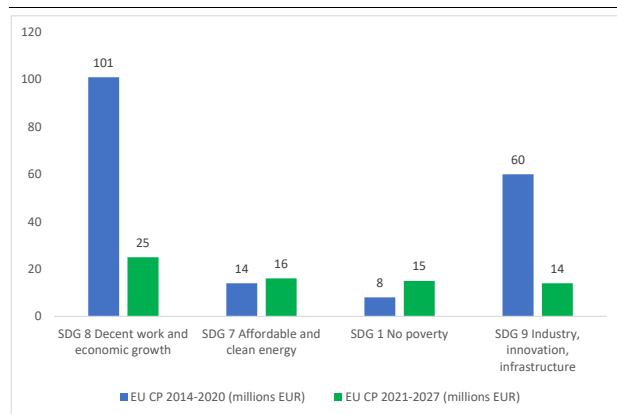
⁽²⁷⁾ 2014-2020 Cohesion policy EU payments by MS is updated daily on [Cohesion Open Data](#).

⁽²⁸⁾ REACT-EU allocation on [Cohesion Open Data](#).

through short-time work and similar schemes. With SAFE (Supporting Affordable Energy), the 2014-2020 cohesion policy funds may also be mobilised by Luxembourg to support vulnerable households, jobs and companies particularly affected by high energy prices.

In both 2014-2020 and 2021-2027, cohesion policy funds have contributed substantially to the Sustainable Development Goals (SDGs). These funds support 11 of the 17 SDGs, notably SDG 8 'decent work and economic growth' and SDG 7 'affordable and clean energy' ⁽²⁹⁾.

Graph A4.3: **Cohesion policy funds contribution to the SDGs in 2014-2020 and 2021-2027 in Luxembourg**



(1) 5 largest contributions to SDGs in million (EUR) current prices

Source: European Commission

Other EU funds make significant resources available for Luxembourg. The common agricultural policy (CAP) made available EUR 0.4 billion in 2014-2022, and will continue to support Luxembourg with EUR 0.2 billion in 2023-2027. The two CAP Funds (European Agricultural Guarantee Fund and European Agricultural Fund for Rural Development), contribute to the European Green Deal while ensuring long-term food security. They promote social, environmental and economic sustainability and innovation in agriculture and rural areas, in coordination with other EU funds.

Luxembourg also benefits from other EU programmes, notably the Connecting Europe Facility, which under CEF 2 (2021-2027) has so far allocated EU funding of EUR 4.23 million to

three specific projects on strategic transport networks. Similarly, Horizon Europe has so far allocated nearly EUR 46 million to R&I actors, while in the previous programming period, Horizon 2020 earmarked EUR 201 million. The Public Sector Loan Facility established under the Just Transition Mechanism makes EUR 0.7 million of grant support from the Commission available for projects located in Luxembourg for 2021-2027, which will be combined with loans from the EIB to support investments by public sector entities in just transition regions.

The Technical Support Instrument (TSI) supports Luxembourg in designing and implementing growth-enhancing reforms. Luxembourg has received significant support since 2018. Examples include: (i) developing a strategy to improve the relevance and take-up of vocational education and training (VET); (ii) modernising the production and dissemination of official statistics by supporting open standards for data exchange; (iii) assisting with the adoption of an accrual accounting system based on international standards; and (iv) implementing the European Child Guarantee ⁽³⁰⁾.

⁽²⁹⁾ Other EU funds contribute to the implementation of the SDGs. In 2014-2022, this includes both the European Agricultural Fund for Rural Development (EARDF) and the European Maritime and Fisheries Fund (EMFF).

⁽³⁰⁾ Country factsheets on reform support are available [here](#).



This Annex illustrates Luxembourg's relative resilience capacities and vulnerabilities using the Commission's resilience dashboards (RDB) ⁽³¹⁾. Comprising a set of 124 quantitative indicators, the RDB provide broad indications of Member States' ability to make progress across four interrelated dimensions: social and economic, green, digital, and geopolitical. The indicators show vulnerabilities ⁽³²⁾ and capacities ⁽³³⁾ that can become increasingly relevant, both to navigate ongoing transitions and to cope with potential future shocks. To this end, the RDB help to identify areas that need further efforts to build stronger and more resilient economies and societies. They are summarised in Table A5.1 as synthetic resilience indices, which illustrate the overall relative situation for each of the four dimensions and their underlying areas for Luxembourg and the EU-27 ⁽³⁴⁾.

According to the set of resilience indicators under the RDB, Luxembourg generally displays a similar level of vulnerabilities compared to the EU average. Luxembourg shows medium-low vulnerabilities in the social and economic and the digital dimensions of the RDB but faces medium-high and high vulnerabilities in the geopolitical and green dimensions. It has higher vulnerabilities than the EU average in all areas of the green dimension as well as in 'cybersecurity', 'raw material and energy supply' and 'security and demography'. Luxembourg has relatively low vulnerabilities in relation to 'health, education and work', 'economic and financial stability and sustainability', and 'digitalisation of the public and personal space'.

Compared to the EU average, Luxembourg shows an overall similar but somewhat higher level of capacities across all RDB

indicators. It has medium-high resilience capacities in the social and economic and digital dimensions, and high capacities in the green and geopolitical dimensions. Luxembourg shows stronger capacities than the EU average in all areas of the green dimension, but also in 'cybersecurity', 'raw material and energy supply', 'value chains and trade' and 'financial globalisation'. There is room for improving capacities compared to the EU in 'economic and financial stability and sustainability' and 'digitalisation for industry'.

Table A5.1: Resilience indices summarising the situation across RDB dimensions and areas

Dimension/Area	Vulnerabilities		Capacities	
	LU	EU-27	LU	EU-27
Social and economic				
Inequalities and social impact of the transitions				
Health, education and work				
Economic & financial stability and sustainability				
Green				
Climate change mitigation & adaptation				
Sustainable use of resources				
Ecosystems, biodiversity, sustainable agriculture				
Digital				
Digital for personal space				
Digital for industry				
Digital for public space				
Cybersecurity				
Geopolitical				
Raw material and energy supply				
Value chains and trade				
Financial globalisation				
Security and demography				

Vulnerabilities Index

- High
- Medium-high
- Medium
- Medium-low
- Low
- Not available

Capacities Index

- High
- Medium-high
- Medium
- Medium-low
- Low
- Not available

Data are for 2021, and EU-27 refers to the value for the EU as a whole. Data underlying EU-27 vulnerabilities in the area 'value chains and trade' are not available as they comprise partner concentration measures that are not comparable with Member States' level values.

Source: JRC Resilience Dashboards - European Commission

⁽³¹⁾ For details see https://ec.europa.eu/info/strategy/strategic-planning/strategic-foresight/2020-strategic-foresight-report/resilience-dashboards_en; see also 2020 Strategic Foresight Report (COM(2020) 493).

⁽³²⁾ 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.

⁽³³⁾ Capacities refer to enablers or abilities to cope with crises and structural changes and to manage the transitions.

⁽³⁴⁾ 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.

Luxembourg's green transition requires continued action on several aspects including sustainable transport, energy efficiency and renewable energy. Implementation of the European Green Deal is underway in Luxembourg; this Annex provides a snapshot of the key areas involved ⁽³⁵⁾.

Luxembourg is projected to reach its 2030 climate policy target for the effort sharing sectors, if it implements additional measures tabled ⁽³⁶⁾. Data for 2021 on Luxembourg's greenhouse gas emissions in these sectors are expected to show the country generated less than its annual emission allocations ⁽³⁷⁾. Current policies in Luxembourg are projected to reduce these emissions by 14% relative to 2005 levels in 2030, which would miss the effort sharing target by far, let alone the new target set in line with the EU's 55% objective. However, adopting the additional measures tabled would bring the emission reductions to 53%, exceeding the new target of 50 % ⁽³⁸⁾. In its recovery and resilience plan (RRP), Luxembourg has allocated 69 % of its Recovery and Resilience Facility grants to key reforms and

investments to attain climate objectives ⁽³⁹⁾. Luxembourg's climate law of 2020 obliges the country to reduce greenhouse gas emissions in the effort sharing sectors by 55% compared to 2005 levels by 2030 and sets the objective to achieve climate neutrality by 2050 ⁽⁴⁰⁾.

⁽³⁵⁾ The overview in this Annex is complemented by Annex 7 on energy security and affordability, Annex 8 on the fair transition to climate neutrality and environmental sustainability, Annex 9 on resource productivity, efficiency and circularity, Annex 11 on innovation, and Annex 19 on taxation.

⁽³⁶⁾ Member States' greenhouse gas emission targets for 2030 ('effort sharing targets') were increased by Regulation (EU) 2023/857 (the Effort Sharing Regulation) amending Regulation (EU) 2018/842, aligning the action in the concerned sectors with the objective to reach EU-level, economy-wide greenhouse gas emission reductions of at least 55% relative to 1990 levels. The Regulation sets national targets for sectors outside the current EU Emissions Trading System, notably: buildings (heating and cooling), road transport, agriculture, waste, and small industry. Emissions covered by the EU ETS and the Effort Sharing Regulation are complemented by net removals in the land use sector, regulated by Regulation (EU) 2018/841 (the Land Use, Land Use Change and Forestry (LULUCF) Regulation) amended by Regulation (EU) 2023/839.

⁽³⁷⁾ Luxembourg's annual emission allocations for 2021 were some 8.4 Mt CO₂eq, and its approximated 2021 emissions were 8.1 Mt (see European Commission, *Accelerating the transition to climate neutrality for Europe's security and prosperity: EU Climate Action Progress Report 2022*, SWD(2022)343).

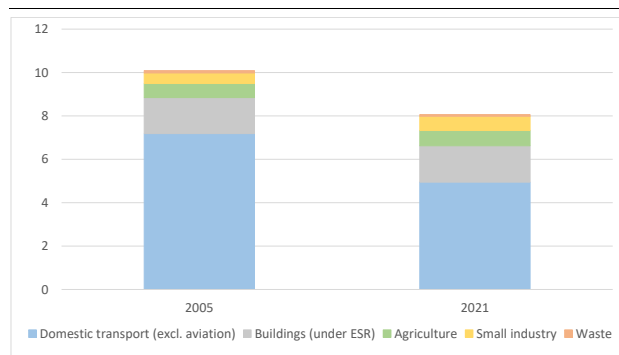
⁽³⁸⁾ See the information on the distance to the 2030 climate policy target in Table A6.1. Existing and additional measures as of 15 March 2021.

⁽³⁹⁾ For example, a support scheme to extend the network of charging points for electric vehicles across the country and a new housing district built on a former industrial site with heat and electricity produced from renewables. The RRP also includes a reform to electrify the fleet of contracting authorities. Luxembourg adopted a Grand-Duchy Regulation in November 2022 setting a minimum percentage of clean vehicles of the vehicles purchased through public contracts for all contracting authorities and entities to achieve over the period 2021-2025.

⁽⁴⁰⁾ The law also establishes the legal framework for the implementation of Luxembourg's national energy and climate plan (NECP). The plan was adopted on 20 May 2020. An update, mandated by Regulation (EU) 2018/1999 (the Governance Regulation), is underway.



Graph A6.1: **Thematic – greenhouse gas emissions from the effort sharing sectors in Mt CO₂eq, 2005-2021**

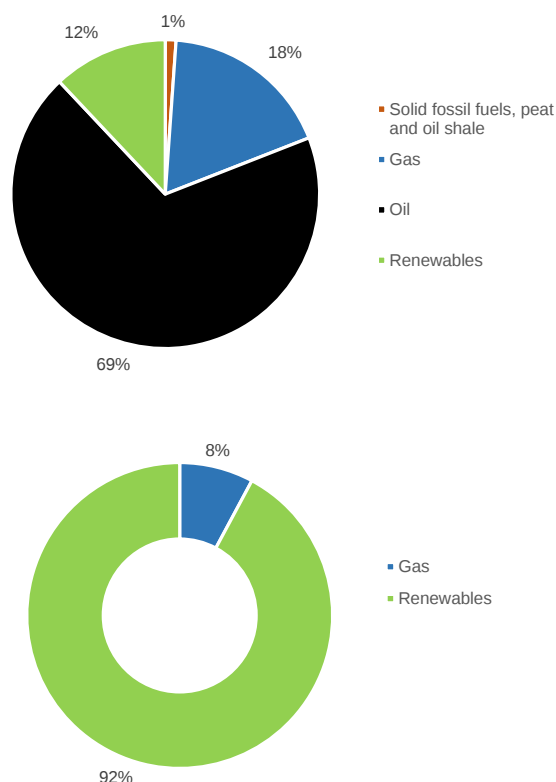


Source: European Environmental Agency.

Luxembourg is on track to meet its 2030 net carbon removals value for its land use sector. Luxembourg delivers net carbon removals through land use thanks to forest management. Carbon removals by re-forestation and afforestation are negligible, as are the emissions generated by deforestation. Net removals were 605 kt CO₂eq in 2021. For 2030, Luxembourg's target for the land use, land use change and forestry sector (LULUCF) implies to achieve net removals of 403 ktCO₂eq (see Table A6.1) ⁽⁴¹⁾.

Fossil fuels still play a strong role in Luxembourg's energy mix. In 2021, oil provided 69% of Luxembourg's energy mix, and natural gas 18%, while 12% came from renewable energy sources. Luxembourg's target of 25% of share of energy from renewable sources in gross final energy consumption by 2030 included in the NECP was considered sufficiently ambitious. Luxembourg will need to increase its renewable energy target in the updated NECP to reflect the more ambitious EU climate and energy targets in the Fit for 55 Package and in the REPowerEU Plan .

Graph A6.2: **Thematic - energy mix (top) and electricity mix (bottom), 2021**



The energy mix is based on gross inland consumption, and excludes heat and electricity. The share of renewables includes biofuels and non-renewable waste.

Source: Eurostat.

Luxembourg has continued to support renewable energy nationally, but also through cooperation agreements with other Member States. It continued its public support schemes to roll out renewable energy, including through feed-in tariffs for small-scale installations, market premiums and calls for tender. Luxembourg also continues to roll out its public tendering scheme, which is expected to bring in 55-65 MW of new capacity per year. However, the 2021 tender resulted in an increase of only 14 MW (of the 55 MW tendered). Luxembourg also chose to use cooperation mechanisms on renewables, by signing a binding commitment to participate as a contributing country in the first cross-border tender under the European renewable energy financing mechanism and concluding a cooperation agreement with Denmark to invest in new projects, such as the financing of energy islands in the North Sea.

⁽⁴¹⁾ This value is indicative and will be updated in 2025 (as mandated by Regulation (EU) 2023/839).

Natural gas makes up around half of the final energy consumption in the residential sector, showing the need to renovate the building stock and prioritise energy savings.

Luxembourg's NECP target for final energy consumption (FEC) was considered sufficient in the 2020 Commission assessment. Based on the energy consumption trajectory for 2018-2021, Luxembourg is expected to be on track to meet its 2030 target for primary energy consumption and is expected to be on track to meet its 2030 target for FEC, as these were notified in its NECP⁽⁴²⁾. Luxembourg plans to reduce energy consumption by modernisation measures and energy efficiency improvements to the public-sector and private-sector building stock, energy efficiency support measures and demonstration projects in SMEs, in large companies and electric transport. Planned investments in energy efficiency also aim to tackle and reduce energy poverty. Luxembourg has a long-term renovation strategy for energy renovations in buildings, with the aim of reaching a 3% renovation rate in the residential sector, which is approximatively 4500 dwellings per year. The aim is to renovate all existing houses to net zero emissions by 2050. The recovery and resilience plan (RRP) includes measures on renewable energy in buildings (for instance installing solar energy on the roof of the rehabilitated structure of the Neischmelz project) and renovating public buildings. For residential buildings, around 89% of the residential building stock uses fossil fuel heating systems (heating oil and natural gas).

Transport generates the highest share of greenhouse gas emissions in the effort sharing sectors in Luxembourg. The country has some measures to promote sustainable transport, and others tabled in the recovery and resilience plan. It has the highest share of electrified railway kilometres in the EU. The market maturity for zero-emission passenger vehicles is close to the EU average, and the number of electric cars is growing fast. However, individual transport has increased congestion. Emissions of key air pollutants (PM_{2.5}, NO_x) have fallen significantly lately⁽⁴³⁾. Overall, air quality is good,

but road traffic causes air pollution hotspots. Though it promotes sustainable public transport⁽⁴⁴⁾, Luxembourg does not sufficiently tackle the issue of pollution from individual cars and congestion. Luxembourg has the potential to rely more on environmental taxes to further internalise the costs of air pollution⁽⁴⁵⁾. It has one of the lowest shares of environmental taxes among the EU Members, notably on pollution (see Annex 19), and the share has decreased between 2016 and 2021 (from 4,7% to 3,8% of total taxation).

Luxembourg would benefit from investing more in environmental protection, in tackling pollution and in promoting the circular economy. Between 2014 and 2020, the environmental investment needs⁽⁴⁶⁾ were estimated to be at least EUR 627.7 million, while investment was about EUR 362.5 million, leaving a gap of at least EUR 265.1 million per year (see Graph A6.4)⁽⁴⁷⁾. A large investment gap remains and slows down performances in circular economy (see Annex 9). Despite good water infrastructure, there is still an investment gap in the sector (see Graph A6.3). Luxembourg invests significant resources in biodiversity and in protecting its ecosystems. It has the largest share of land protected areas (Natura 2000 and other nationally designated zones) in the EU, covering 51.5% of its land⁽⁴⁸⁾. Restoring habitats and reducing pressure on ecosystems from pollution, agriculture and urban sprawl remain priorities to counter biodiversity losses. All surface waters and a major share of Luxembourg's groundwater bodies fail to

zones in the city of Luxembourg. Since then, the authorities have taken measures that have achieved some progress.

⁽⁴⁴⁾ Public transport is free in Luxembourg (since 1 March 2020).

⁽⁴⁵⁾ European Commission, 2021, Green taxation and other economic instruments – Internalising environmental costs to make the polluter pay, [Ensuring that polluters pay](#).

⁽⁴⁶⁾ Environmental objectives include pollution prevention and control, water management and industries, circular economy and waste, biodiversity and ecosystems (European Commission, 2022, Environmental Implementation Review, [country report Luxembourg](#)).

⁽⁴⁷⁾ When also accounting for needs estimated at EU-level only (e.g., water protection, higher circularity, biodiversity strategy).

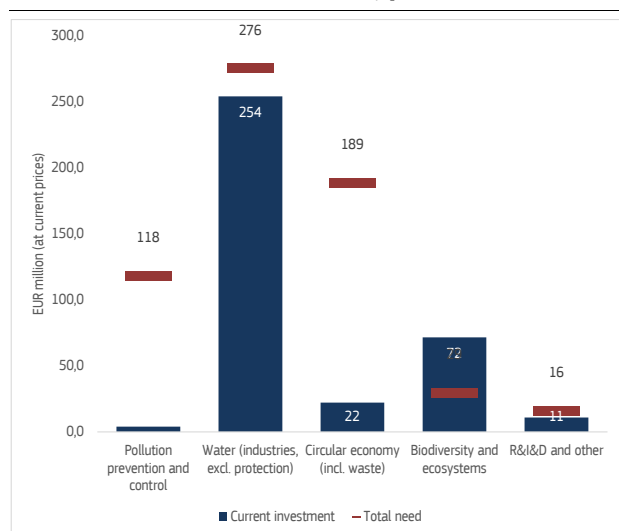
⁽⁴⁸⁾ In 2021, Luxembourg had 55.8% terrestrial protected areas (Natura 2000 and nationally designated areas), against the EU average of 26.4% (European Environment Agency, 2023, [Natura 2000 Barometer](#)).

⁽⁴²⁾ After the conclusion of the negotiations for a recast EED, the ambition of both the EU and national targets as well as of the national measures for energy efficiency to meet these targets is expected to increase.

⁽⁴³⁾ In 2017, the Commission sent a letter of formal notice to Luxembourg for NO₂ exceedances in several air-quality

achieve good chemical status ⁽⁴⁹⁾. High agricultural pressure in some areas causes eutrophication, and the country needs to act on nitrate pollution. The recovery and resilience plan contains municipal investment on nature and biodiversity under the 'Naturpakt'.

Graph A6.3: **Thematic – environmental investment needs and current investment, p.a. 2014-2020**



Source: European Commission.

Climate change is affecting many sectors, ⁽⁵⁰⁾ and vulnerability to climate disasters is expected to rise ⁽⁵¹⁾. The sectors affected include housing, water management, agriculture, and forestry. Extreme weather events (tornadoes, torrential rainfall, flooding, extended drought) have been frequent in recent years ⁽⁵²⁾. Droughts, heatwaves, and the spread of bark beetle, exacerbated by climate change, has caused the damage or destruction of over 60% of forests in Luxembourg ⁽⁵³⁾. Municipalities will get support for climate adaptation under the recovery and resilience plan. Luxembourg has adopted a strategy and an action plan for climate adaptation,

⁽⁴⁹⁾ Environmental Implementation Review 2022 – [country report Luxembourg](#).

⁽⁵⁰⁾ Government of Luxembourg (2018), Strategy and action plan for adaptation to the effects of climate change in Luxembourg 2018-2023.

⁽⁵¹⁾ The European Commission Disaster Risk Management Knowledge Centre (DRMKC) [Risk Data Hub \(europa.eu\)](#).

⁽⁵²⁾ In addition to the historical vulnerability to winter floods, the 2016 and 2021 extreme flooding events in spring and summer show that the traditional weather patterns in the country have changed.

⁽⁵³⁾ Government of Luxembourg (2022), [The results of the 2022 phytosanitary inventory of forests – Nature and Forest Administration](#)

but it has not yet created an adaptation portal to provide easier access to information.

Luxembourg provides sector-specific fossil fuel and other environmentally harmful subsidies that could be considered for reform, while ensuring food and energy security and mitigating social effects.

Environmentally harmful subsidies have been identified, via an initial assessment, in the agriculture, forestry and fishing, electricity, gas, steam and air conditioning, transportation and storage and services sectors. Luxembourg's fossil fuel subsidies were more than EUR 41 million in 2020, putting low carbon alternatives to a disadvantage. Examples of such subsidies include the flat rate taxation of privately used company cars, the excise tax refund for diesel fuel used in agriculture, the excise tax exemption on the use of natural gas, the excise duty exemption for natural gas used as motor fuel or the reduced CO2 tax rate on diesel used in agriculture ⁽⁵⁴⁾. A mapping of all environmentally harmful subsidies by Luxembourg would help prioritise candidates for reform.

⁽⁵⁴⁾ Fossil fuel figures in EUR of 2021 from the 2022 State of the Energy Union report. Initial assessment of environmentally harmful subsidies done by the Commission in [the 2022 toolbox for reforming environmentally harmful subsidies in Europe](#), using OECD definitions, and based on the following datasets: OECD Agriculture Policy Monitoring and Evaluations; OECD Policy Instruments for the Environment (PINE) Database; OECD Statistical Database for Fossil Fuels Support; IMF country-level energy subsidy estimates. [Annex 4](#) of the toolbox contains detailed examples of subsidies on the candidates for reform.

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

									'Fit for 55'		
									2030 target/value	Distance	
			2005	2017	2018	2019	2020	2021		WEM	WAM
Progress to policy targets	Greenhouse gas emission reductions in effort sharing sectors ⁽¹⁾	Mt CO ₂ eq; %; pp	10,1	-14%	-11%	-9%	-24%	-	-50,0%	-36	3
	Net carbon removals from LULUCF ⁽²⁾	kt CO ₂ eq	-566	-379	-241	-364	-448	-605	-403	n/a	n/a
									National contribution to 2030 EU target		
	Share of energy from renewable sources in gross final consumption of energy ⁽³⁾	%	1%	6%	9%	7%	12%	12%	25%		
	Energy efficiency: primary energy consumption ⁽³⁾	Mtoe	4,8	4,3	4,5	4,5	3,9	4,2	n/a		
	Energy efficiency: final energy consumption ⁽³⁾	Mtoe	4,5	4,2	4,3	4,4	3,8	4,1	3,1		
			Luxembourg						EU		
			2016	2017	2018	2019	2020	2021	2019	2020	2021
Fiscal and financial indicators	Environmental taxes (% of GDP)	% of GDP	1,7	1,6	1,7	1,8	1,4	1,5	2,4	2,2	2,2
	Environmental taxes (% of total taxation) ⁽⁴⁾	% of taxation	4,7	4,5	4,3	4,4	3,6	3,8	5,9	5,6	5,5
	Government expenditure on environmental protection	% of total exp.	1,8	2,0	2,1	2,1	2,2	2,2	1,7	1,6	1,6
	Investment in environmental protection ⁽⁵⁾	% of GDP	0,3	0,3	0,4	0,4	-	-	0,4	0,4	0,4
	Fossil fuel subsidies ⁽⁶⁾	EUR2021bn	0,0	0,0	0,0	0,0	0,0	-	53,0	50,0	-
Climate	Climate protection gap ⁽⁷⁾	score 1-4							1,5		
	Net greenhouse gas emissions	1990 = 100	78,0	91,0	95,0	96,0	83,0	86,0	76,0	69,0	72,0
	Greenhouse gas emission intensity of the economy	kg/EUR10	0,20	0,20	0,20	0,20	0,19	-	0,31	0,30	0,26
	Energy intensity of the economy	kgoe/EUR10	0,08	0,09	0,09	0,09	0,08	-	0,11	0,11	-
	Final energy consumption (FEC)	2015=100	101,2	104,7	109,0	110,0	95,5	101,8	102,9	94,6	-
Energy	FEC in residential building sector	2015=100	103,2	105,2	98,3	91,0	97,9	94,3	101,3	101,3	106,8
	FEC in services building sector	2015=100	100,8	113,2	116,1	130,9	125,0	140,6	100,1	94,4	100,7
Pollution	Smog-precursor emission intensity (to GDP) ⁽⁸⁾	tonne/EUR10	0,60	0,59	0,58	0,63	0,57	-	0,93	0,86	-
	Years of life lost due to air pollution by PM _{2.5}	per 100,000 inh.	370,9	303,1	290,2	176,6	129,5	-	581,6	544,5	-
	Years of life lost due to air pollution by NO ₂	per 100,000 inh.	163,3	151,9	155,5	125,3	89,3	-	309,6	218,8	-
	Nitrates in ground water	mg NO ₃ /litre	-	-	-	-	-	-	21,0	20,8	-
	Land protected areas	% of total	40,4	51,4	-	51,4	51,4	55,8	26,2	26,4	26,4
Biodiversity	Marine protected areas	% of total	-	-	-	-	-	-	10,7	-	12,1
	Organic farming	% of total utilised agricultural area	3,5	4,2	4,4	4,4	4,6	5,2	8,5	9,1	-
			2017	2018	2019	2020	2021	2022	2020	2021	2022
Mobility	Share of zero-emission vehicles ⁽⁹⁾	% in new registrations	0,7	0,9	1,8	5,6	10,4	15,0	5,4	8,9	10,7
	Number of AC/DC recharging points (AFIR categorisation)		-	-	-	1079	1046	1990	188626	330028	432518
	Share of electrified railways	%	95,3	95,3	91,0	91,0	91,0	91,0	56,6	n/a	56,6
	Hours of congestion per commuting driver per year		36,9	36,6	36,1	35,6	n/a	n/a	28,7	n/a	n/a

Sources: (1) Historical and projected emissions, as well as Member States' climate policy targets and 2005 base year emissions under the Effort Sharing Decision (for 2020) are measured in global warming potential (GWP) values from the 4th Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC). Member States' climate policy targets and 2005 base year emissions under the Effort Sharing Regulation (for 2030) are in GWP values from the 5th Assessment Report (AR5). The table above shows the base year emissions 2005 under the Effort Sharing Decision, using AR4 GWP values. Emissions for 2017-2021 are expressed in percentage change from 2005 base year emissions, with AR4 GWP values. 2021 data are preliminary. The table shows the 2030 target under Regulation (EU) 2023/857 that aligns it with the EU's 55% objective, in percentage change from 2005 base year emissions (AR5 GWP). Distance to target is the gap between Member States' 2030 target (with AR5 GWP values) and projected emissions with existing measures (WEM) and with additional measures (WAM) (with AR4 GWP values), in percentage change from the 2005 base year emissions. Due to the difference in global warming potential values, the distance to target is only illustrative. The measures included reflect the state of play as of 15 March 2021.

(2) Net removals are expressed in negative figures, net emissions in positive figures. Reported data are from the 2023 greenhouse gas inventory submission. 2030 value of net greenhouse gas removals as in Regulation (EU) 2023/839 amending Regulation (EU) 2018/841 (LULUCF Regulation) – Annex IIa, kilotons of CO₂ equivalent, based on 2020 submissions. (3) Renewable energy and energy efficiency targets and national contributions are in line with the methodology established under Regulation (EU) 2018/1999 (Governance Regulation).

(4) Percentage of total revenue from taxes and social contributions (excluding imputed social contributions). Revenue from the EU Emissions Trading System is included in environmental tax revenue.

(5) Expenditure on gross fixed capital formation for the production of environmental protection services (abatement and prevention of pollution) covering government, industry, and specialised providers.

(6) European Commission, Study on energy subsidies and other government interventions in the European Union, 2022 edition.

(7) The climate protection gap refers to the share of non-insured economic losses caused by climate-related disasters. This indicator is based on modelling of the current risk from floods, wildfires and windstorms as well as earthquakes, and an estimation of the current insurance penetration rate. The indicator does not provide information on the split between the private/public costs of climate-related disasters. A score of 0 means no protection gap, while a score of 4 corresponds to a very high gap (EIOPA, 2022).

(8) Sulphur oxides (SO₂ equivalent), ammonia, particulates < 10 µm, nitrogen oxides in total economy (divided by GDP).

(9) Battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV).

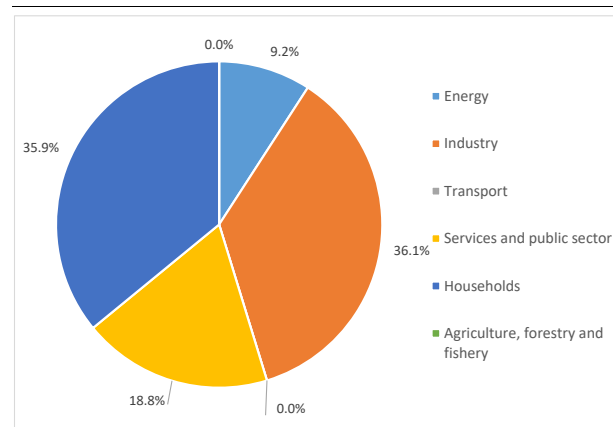
Luxembourg has limited exposure to Russian gas and oil. However, it is quite dependent on imported fossil fuels and electricity in general. This makes its economy particularly sensitive to global price developments, requiring it to step up efforts on the energy transition. This Annex⁽⁵⁵⁾ sets out actions carried out by Luxembourg to achieve the REPowerEU objectives, including through the implementation of its recovery and resilience plan, in order to improve energy security and affordability while accelerating the clean energy transition, and contributing to enhancing the EU's competitiveness in the clean energy sector⁽⁵⁶⁾.

Gas represents almost one fifth of Luxembourg's energy mix, but the country does not rely heavily on Russian gas. Most of the gas it consumes comes by pipeline from Norway and the Netherlands and transits through Belgium. It also consumes gas delivered in liquified form – liquefied natural gas – at the Belgian port of Zeebrugge. In 2021, nearly 100% of the gas Luxembourg consumed was imported by pipelines from Belgium and Germany. Luxembourg does not have any gas production, but it does produce biogas, injected into the network (around 0.01 billion cubic metres (bcm) in 2021).

Luxembourg has a good level of security of supply. In December 2022, the updated risk preparedness plan for the electricity sector was adopted and published. A new tool to monitor the national level of electricity supply, the 'StroumMonitor', has also been set up to indicate peak consumption times and alert the population in the event of a power shortage in an efficient and comprehensible way. As of 27 January 2023, no particular risks are expected due to significant demand reduction and increased capacities in Germany. Luxembourg has adopted a number of measures to reduce gas demand. These include an

information campaign by means of an official website on energy savings and building renovation. Implementation of such measures led to a gas demand reduction of 26% over the period August 2022– March 2023 when compared to the previous 5-years average⁽⁵⁷⁾

Graph A7.1: **Share of gas consumption per sector, 2021**



Source: Eurostat

Luxembourg is highly interconnected in terms of both power and gas and is highly dependent on its neighbours to meet its energy needs. Luxembourg's electricity and gas grids are sufficient for its current 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.

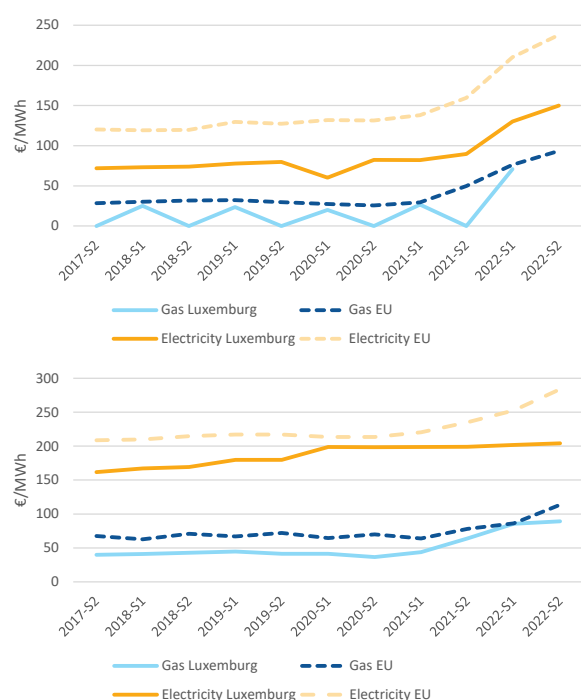
Luxembourg continues to have a low level of energy poverty, with 2.6% of people unable to keep their homes warm in 2021, compared to the EU average of 6.9%. To reduce the impact of high energy prices, Luxembourg has put a number of measures in place, such as subsidies for natural gas and fuel oil for residential customers, subsidies for electricity prices for households with an annual electricity consumption of 25 000 kWh, a VAT reduction, limiting the gas price increase to 15%, and adapting the minimum social wage. It has also put in place an extensive information campaign on energy savings.

⁽⁵⁵⁾ It is complemented by Annex 6 as the European Green Deal focuses on the clean energy transition, by Annex 8 on the actions taken to mitigate energy poverty and protect the most vulnerable ones, and by Annex 9 as the transition to a circular economy will unlock significant energy and resource savings, further strengthening energy security and affordability, and by Annex 12 on industry and single market complementing ongoing efforts under the European Green Deal and REPowerEU.

⁽⁵⁶⁾ In line with the Green Deal Industrial Plan COM(2023) 62 final, and the proposed Net-Zero Industry Act COM(2023) 161 final

⁽⁵⁷⁾ EU countries agreed to reduce their gas demand by 15% compared to their average consumption in the past 5 years, between 1 August 2022 and 31 March 2023, with measures of their own choice.

Graph A7.2: Luxembourg's retail energy prices for industry (top) and households (bottom)



(1) On electricity, the band consumption is DC for households and ID for industry

(2) On gas, the band consumption is D2 for households and I4 for industry

Source: Eurostat

Luxembourg has made considerable progress in recent years on renewable energies and the digitisation of the energy transition.

Renewable energy capacity reached 572 MW in 2022 ⁽⁵⁸⁾. The government programme makes the energy transition a key priority, with ambitious energy sector targets, including a 50-55% reduction in greenhouse gas emissions and covering over a third of 2030 electricity demand with renewables (mostly solar PV and wind energy) by 2030. Luxembourg's renewable energy share for 2021 is expected to be above its 2020 baseline. Luxembourg has provided the EU renewable energy financing mechanism with financing to reach its renewable energy targets. Luxembourg has kept in place its public support schemes for deploying renewables, including through feed-in tariffs for small-scale installations, market premiums and calls for tenders. Its low energy taxes provide little incentive to invest in renewables and energy efficiency. It is also continuing to roll out its public tendering scheme, expected to bring in 55-65 MW of renewables per year. However, the 2021 tender

resulted in only 14 MW (of the 55 MW tendered). The aid scheme promoting solar photovoltaic energy has, since 2019, increasingly involved private individuals. Luxembourg has announced a hydrogen strategy to make steel more sustainable through renewable hydrogen use.

Luxembourg has made good progress in building renovation.

As part of its recovery and resilience plan, it will develop a national strategy with targeted investments to renovate public housing in order to improve their sustainability (the Housing Pact 2.0). It will also produce solar energy on the roof of the rehabilitated structure of the Neischmelz project. As regards residential buildings, around 89% of residential building stock uses heating systems based on fossil fuels (heating oil and natural gas). Luxembourg is not carrying out checks on products covered by ecodesign and energy labelling. This generates serious concerns with respect to the level playing field among economic operators and uncertainty as to the compliance levels of the concerned products, and therefore possible missed energy and CO2 savings. ⁽⁵⁹⁾

In publication terms, Luxembourg was in 2018 the top global performer with 32% of scientific publications on clean energy technology, among the top 10% most cited. Venture capital investments in climate tech start-ups and scale-ups were EUR 60 Mln in 2019.

⁽⁵⁸⁾ IRENA, Renewable capacity statistics 2023.

⁽⁵⁹⁾ The internet-supported information and communication system for the pan-European market surveillance

Table A7.1: Key energy indicators

		Luxembourg				EU			
		2018	2019	2020	2021	2018	2019	2020	2021
ENERGY DEPENDENCE	Import Dependency [%]	95%	95%	92%	92%	58%	60%	57%	56%
	of Solid fossil fuels	101%	93%	112%	98%	44%	43%	36%	37%
	of Oil and petroleum products	100%	100%	100%	100%	95%	97%	97%	92%
	of Natural Gas	100%	100%	100%	100%	83%	90%	84%	83%
	Dependency from Russian Fossil Fuels [%]								
	of Hard Coal	8%	7%	7%	6%	40%	44%	49%	47%
	of Crude Oil	n.a	n.a	n.a	n.a	30%	27%	26%	25%
	of Natural Gas	27%	27%	27%	11%	40%	40%	41%	41%
		2015	2016	2017	2018	2019	2020	2021	2022
ELECTRICITY	Gross Electricity Production (GWh)	2,766	2,198	2,235	2,200	1,908	2,234	2,211	-
	Combustible Fuels	1,030	468	470	490	547	628	632	-
	Nuclear	0	0	0	0	0	0	0	-
	Hydro	1,531	1,528	1,422	1,337	949	1,094	1,085	-
	Wind	102	101	235	255	281	351	314	-
	Solar	104	100	108	119	130	161	180	-
	Geothermal	0	0	0	0	0	0	0	-
	Other Sources	0	0	0	0	0	0	0	-
	Net Imports of Electricity (GWh)	5,599	6,299	6,178	6,161	5,879	5,465	5,721	-
	As a % of electricity available for final consumption	90%	99%	97%	95%	92%	89%	89%	-
Electricity Interconnection (%)	-	-	-	58.44%	58.2%	55.2%	168.4%	163.5%	
		2015	2016	2017	2018	2019	2020	2021	2022
DIVERSIFICATION OF GAS SUPPLIES	Gas Consumption (in bcm)	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.6
	Gas Imports - by type (in bcm)	0.9	0.8	0.8	0.8	0.8	0.7	0.8	-
	Gas imports - pipeline	0.9	0.8	0.8	0.8	0.8	0.7	0.8	-
	Gas imports - LNG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Gas Imports - by main source supplier (in bcm)* (1)								
	Netherlands	0.0	0.0	0.0	0.0	0.0	0.0	0.3	-
	Norway	0.6	0.5	0.3	0.3	0.3	0.3	0.2	-
	Russia	0.2	0.2	0.2	0.2	0.2	0.1	0.1	-
	Belgium	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-
	Others	0.1	0.1	0.3	0.3	0.3	0.2	0.1	-
		2019	2020	2021	2022				
	LNG Terminals								
Number of LNG Terminals (2)									
LNG Storage capacity (m3 LNG)									
Underground Storage									
Number of storage facilities	0	0	0	0					
Operational Storage Capacity (bcm)	0	0	0	0					
		2019	2020	2021	2022				
CLEAN ENERGY	VC investments in climate tech start-ups and scale-ups (EUR Mln) (3)	60.0	0.0	0.0	n.a.				
	as a % of total VC investments in Luxembourg	50.6%	0.0%	0.0%	n.a.				
	Research & Innovation spending in Energy Union R&I priorities (2)								
	Public R&I (EUR mln)	n.a.	n.a.	n.a.	n.a.				
	Public R&I (% GDP)	n.a.	n.a.	n.a.	n.a.				
	Private R&I (EUR mln)	105.1	n.a.	n.a.	n.a.				
	Private R&I (% GDP)	0.17%	n.a.	n.a.	n.a.				

(1) The ranking of the main suppliers is based on the latest available figures (for 2021)

(2) FSRU included

(3) Venture Capital investments include Venture Capital deals (all stages) and Private Equity Growth/Expansion deals (for companies that have previously been part of the portfolio of a VC investment firm).

Source: Eurostat, Gas Infrastructure Europe (Storage and LNG Transparency Platform), JRC SETIS (2022), JRC elaboration based on PitchBook data (06/2022)

ANNEX 8: FAIR TRANSITION TO CLIMATE NEUTRALITY

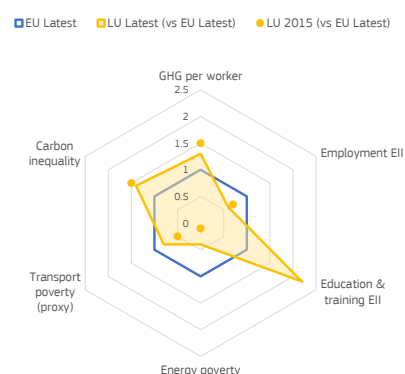
This Annex monitors Luxembourg's progress in ensuring a fair transition towards climate neutrality and environmental sustainability, notably for workers and households in vulnerable situations. To ensure a fair green transition in line with the Council Recommendation ⁽⁶⁰⁾, Luxembourg has increased its efforts to upskill and reskill workers in declining and transforming sectors. Yet labour shortages persist, notably posing a potential bottleneck in the green transition and for the implementation of REPowerEU. The reforms and investments under the recovery and resilience plan (RRP) contribute to a fair green transition ⁽⁶¹⁾, complementing the territorial just transition plans and actions supported by the European Social Fund Plus (ESF+).

Whilst Luxembourg's green economy is expanding, workers in declining activities need active support. The greenhouse gas (GHG) emissions intensity of Luxembourg's workforce fell from 21.1 to 17.6 tonnes per worker between 2015 and 2021, while remaining above the EU average of 13.7 tonnes in 2021 (see Graph A8.1 and Table A8.1). Employment in the Luxembourgish energy-intensive industries (EII) represented a stable share of 1.8% of total employment in 2021 (in 2020: 1.8% vs 3.0% in the EU). Against the long-term decline of coal and lignite mining in Luxembourg, employment in mining and quarrying increased by 3.7% since 2015 (less than 300 workers). Total jobs in the environmental goods and services sector grew by 84.1% in 2015-2019 (EU: 3.1% in 2019), reaching 4.6% of total employment, above the EU average of 2.2% (see Annex 9 for circular jobs specifically). The job vacancy rate in the construction sector is relatively low (1.4% in 2021 vs 4.0% in the EU) ⁽⁶²⁾.

Upskilling and reskilling in declining and transforming sectors increased slightly but risks of skills mismatches persist, whilst labour shortages are growing. In energy-intensive industries, workers' participation in

education and training was 22.6% in 2018 (above the EU average of 9.3%). In Luxembourg, 24% of citizens believe they do not have the necessary skills to contribute to the green transition (EU: 38%) ⁽⁶³⁾. Under the RRP, an action plan to promote continuing vocational training aims to help workers and jobseekers to improve their employability during the green and digital transition. Specific investments under the Just Transition Fund (JTF) provide training to help reskill workers in regions affected by the transition. The JTF supports measures to provide the craft workforce with 'new skills for sectors instrumental in the green transition notably in the field of electro-mobility and in construction and sustainable renovation, in particular the health and energy efficiency aspects of renovation. Of ESF+ funding, 16.5% will contribute to green skills and jobs with training measures for jobseekers and workers, but will also fund projects aimed at helping pupils and students discover green jobs and acquire relevant new skills.

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



Source: Eurostat, EMPL-JRC GD-AMEDI/AMEDI+ projects and World Inequality Database (see Table A8.1).

Energy poverty indicators have slightly worsened in recent years, even before the spike in energy prices that can be expected to aggravate the situation. The share of the total population unable to keep their homes adequately warm increased from 0.9% in 2015 to 2.5% in 2021, still well below the EU average of 6.9% ⁽⁶⁴⁾. In particular, 5.1% of the population at risk of poverty (AROP) (EU: 16.4% in 2021) and

⁽⁶⁰⁾ 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.

⁽⁶¹⁾ See 2022 Country Report (Annex 6) and Annex 3 for an overview.

⁽⁶²⁾ Eurostat (JVS_A_RATE_R2)

⁽⁶³⁾ Special Eurobarometer 527. Fairness perceptions of the green transition (May – June 2022).

⁽⁶⁴⁾ 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](#).



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

Indicator	Description	LU 2015	LU Latest	EU Latest
GHG per worker	Greenhouse gas emissions per worker - CO2 equivalent tonnes	21.1	17.6 (2021)	13.7 (2021)
Employment EII	Employment share in energy-intensive industries, including mining and quarrying (NACE B), chemicals (C20), minerals (C23), metals (C24), automotive (C29) - %	2	1.8 (2020)	3 (2020)
Education & training EII	Adult participation in education and training (last 4 weeks) in energy-intensive industries - %		22.6 (2018)	10.4 (2022)
Energy poverty	Share of the total population living in a household unable to keep its home adequately warm - %	0.9	2.5 (2021)	6.9 (2021)
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	Average emissions per capita of top 10% of emitters vs bottom 50% of emitters	7.5	7.1 (2020)	5 (2020)

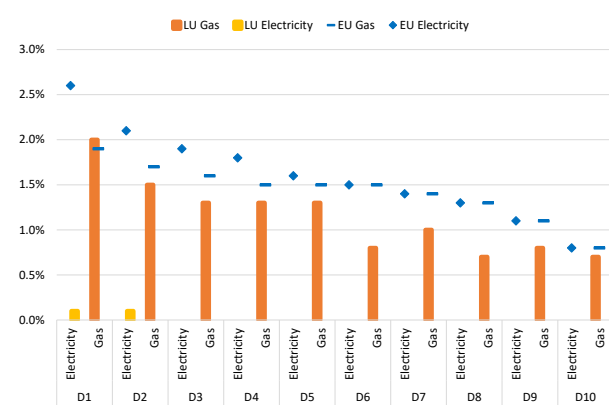
Source: Eurostat (env_ac_ainah_r2, nama_10_a64_e, ilc_mdcs01), EU Labour Force Survey (break in time series in 2021), EMPL-JRC GD-AMEDI/AMEDI+ projects and World Inequality Database (WID).

1.6% of lower middle-income households (in deciles 4-5) were affected in 2021 (EU: 8.2%). Before the energy price hikes, an estimated 10.2% of the total population and 29.5% of the (expenditure-based) at-risk-of-poverty (AROP) population had residential expenditure budget shares on electricity, gas and other fuels⁽⁶⁵⁾ above 10% of their household budget (compared with the estimated EU average of 26.9% and 48.2%, respectively). According to recent national forecasts, 3.2% of households could have fallen into or close to energy poverty in 2022 (without considering recent measures such as the limitation of energy prices)⁽⁶⁶⁾.

The increased energy prices in 2021-2023 negatively affected households' budgets, in particular for low-income groups. As a result of energy price changes during the August 2021 to January 2023 period relative to the 18 months prior (cf. Annex 7), in the absence of policy support and behavioural responses, the fraction of individuals living in households spending more than 10% of their budget on energy would have increased by 12.8 percentage points (pps) for the whole population and by 24.8 pps among the (expenditure-based) AROP population (EU: 16.4 pps and 19.1 pps, respectively)⁽⁶⁷⁾. For gas, the expenditure shares of low and lower-middle income groups would have increased the most (in line with EU-wide effects), whereas residential expenditure for electricity changed only minimally across groups, as shown in Graph A8.2. Among the (expenditure-based) AROP population, the share of individuals living in households with budget shares for private transport fuels⁽⁶⁸⁾ above 6% would

have increased more than the EU average (11.6 pps vs 5.3 pps), reaching 29.8% in January 2023 (EU: 37.1%) due to the increase in transport fuel prices.

Graph A8.2: Distributional impacts of energy prices due to rising energy expenditure (2021-2023)



Mean change of energy expenditure as a percentage (%) of total expenditure per income decile (D) due to observed price changes (August 2021 – January 2023 relative to the 18 months prior), excl. policy support and behavioural responses.

Source: EMPL-JRC GD-AMEDI/AMEDI+ projects, based on Household Budget Survey 2015 and Eurostat inflation data for CP0451 and CP0452.

Access to public transport displays a limited urban-rural divide, while carbon inequality is the highest in the EU. Citizens in Luxembourg perceive public transport to be relatively available (76% vs 55% in the EU), very affordable (92% vs 54% in the EU) and of good quality (82% vs 60% in the EU). As regards these perceptions, rural areas in Luxembourg perform slightly worse than urban areas, yet perceptions are still significantly better compared to rural areas in the EU overall⁽⁶⁹⁾. The average carbon footprint of the top 10% of emitters among the population in Luxembourg is about 7.1 times higher than that of the bottom 50% (see Graph A8.1), i.e. more pronounced than the EU average (5.0 times).

⁽⁶⁵⁾ Products defined according to the European Classification of Individual Consumption according to Purpose (ECONCOP): CP045.

⁽⁶⁶⁾ Statec, Rapport Travail et Cohésion Sociale 2022, p.142 <https://statistiques.public.lu/fr/publications/series/analyses/2022/analyses-05-22.html>

⁽⁶⁷⁾ EMPL-JRC GD-AMEDI/AMEDI+ ; see details in the related technical brief.

⁽⁶⁸⁾ CP0722; cf. footnote (21).

⁽⁶⁹⁾ EU (rural): 46%, 48%, 56% respectively. Special Eurobarometer 527.

The circular economy transition is key to delivering on the EU's climate and environmental goals and provides large socio-economic benefits. It spurs job growth, innovation and competitiveness and fosters resilience and resource security. The circularity transition of industry, the built environment and agri-food can generate significant environmental improvements (see Annex 6), as they rank among the most resource-intensive systems.

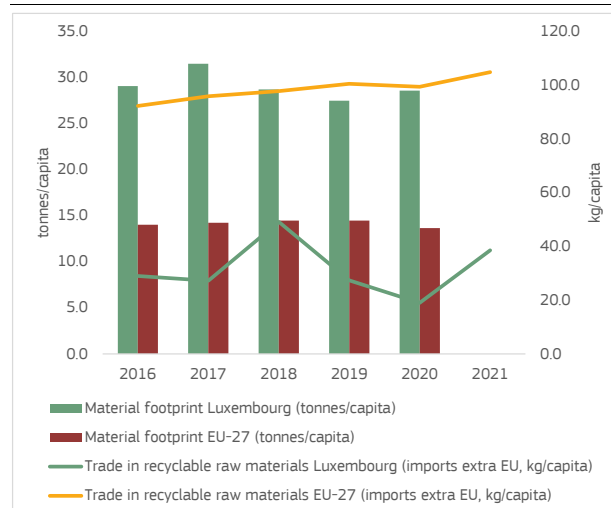
Luxembourg's circular economy transition is insufficient and needs accelerating to meet the EU's circular economy goals. The EU's 2020 circular economy action plan (CEAP) aims at doubling the circular material use rate between 2020 and 2030 while significantly decreasing the EU's material footprint. Luxembourg's circular use of material dropped significantly in 2021 to 3.8% (far below the EU average of 11.7%) and its material footprint in 2020 was among the highest, well above the EU-27 average (28.6 against 13.7 tonnes per head). This indicator has slightly decreased since 2016, but Luxembourg still relies on raw materials extraction to support its economic growth and satisfy material needs.

Luxembourg recently adopted new policies to address circular economy challenges, but more measures are needed. In February 2021, it adopted the 'Circular Economy Strategy Luxembourg', targeting products' entire life cycle and including specific actions on construction. The plan proposes three frameworks to encourage the circular economy: (1) a regulatory framework providing mandatory actions and guidance; (2) a financial framework using positive and negative incentives; and (3) a knowledge framework setting actions for research and innovation, education, and awareness-raising. Moreover, in 2018, Luxembourg adopted a new national waste and resource management plan.

Luxembourg performs well in waste management but generates too much waste. The country over-produces municipal waste (793 kg vs 530 kg per person as the EU-27 average in 2021). However, it met the EU 2020 target of 50% of municipal waste recycled and is on track to meet the EU 2025 targets for the recycling of municipal and packaging waste. Only 4% of municipal waste was landfilled in 2021 (below the EU average of 22.8%). However, there

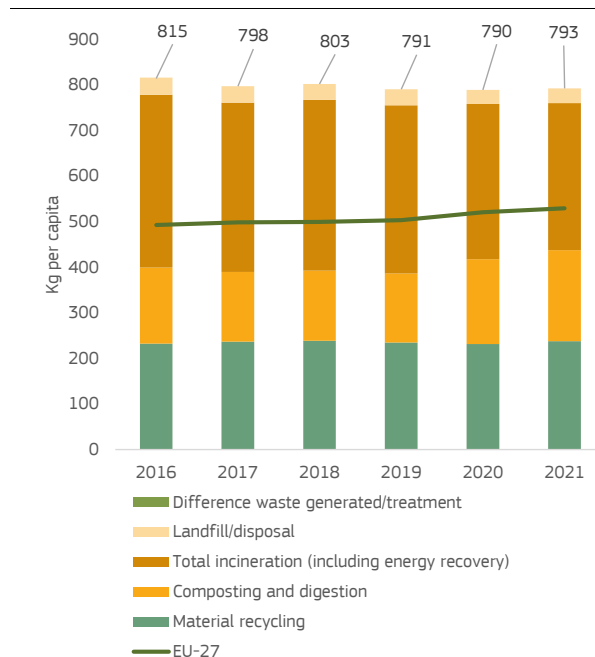
is room to shift more municipal reusable and recyclable waste away from incineration (40.7% incinerated in 2021).

Graph A9.1: Trend in material use



Source: Eurostat

Graph A9.2: Treatment of municipal waste



Source: Eurostat

The industrial system is increasingly circular.

However, the country has no sectoral strategies on plastics and textiles in place. Luxembourg's economy, particularly industry, is efficient at using materials to produce added-value (with a resource productivity of 3.5 purchasing power standard per kilogramme vs the EU average of 2.3 in 2021), which increases the country's resilience (see Annex 5). However, Luxembourg's economy relies heavily on material extraction and importation (91.4% of material import dependency in 2021).

The built environment system provides an opportunity to increase resource efficiency.

The recovery rate of construction and demolition waste is above the EU average (99% vs 89% in 2020) and has remained stable since 2016. However, soil sealing progressed between 2015 and 2018 at a faster rate than the EU average. There is scope for renovating existing buildings and improving their use rather than building new ones. The 'Neischmelz' project, supported by the Recovery and Resilience Facility, provides a promising example of the transformation of old industrial sites into sustainable housing, limiting the land take rate.

The agri-food system still generates significant food waste in Luxembourg. On the one hand, the composting and anaerobic digestion per head has increased since 2016 and remains far above the EU average in 2021 (200 kg per

head vs 100 kg). On the other hand, Luxembourg's food waste generation in 2020 was above the EU average (147 kg per head vs 131 kg per head). Despite some measures already taken to decrease general food waste production, it is a priority to tackle the issue. Luxembourg has room to increase anaerobic digestion by improving separate biowaste collection and implementing a composting quality management system. Even though Luxembourg's CAP strategic plan finances some measures to limit diffuse nitrate pollution, it is essential to reduce it further where agricultural pressure is significant.

There remains a financing gap in the circular economy, including waste management. Additional investments will be required to address growing needs.

The financing gap was estimated at EUR 167 million per year between 2014 and 2020. Over this period, investment needs were estimated to be at least EUR 189 million per year, while investment baselines were EUR 22 million per year (see Annex 6). Investing in the circular economy is key to achieving the transition, notably in eco-design, repair, reuse and remanufacturing, and uptake of new business model areas. Investments are also necessary in improving separate waste collection and treatment infrastructure for recycling, with particular focus on biowaste.

Table A9.1: Overall and systemic indicators on circularity

AREA	2016	2017	2018	2019	2020	2021	EU-27	Latest year EU-27
Overall state of the circular economy								
Material footprint (tonnes/capita)	29.1	31.5	28.7	27.5	28.6	-	13.7	2020
YoY growth in persons employed in the circular economy (%) ¹	-	-	-	-	-	-	2.9	2019
Water exploitation index plus (WEI+) (%)	0.4	0.6	0.5	0.5	-	-	3.6	2019
Industry								
Resource productivity (purchasing power standard (PPS) per kilogram)	3.3	3.2	3.4	3.4	3.6	3.5	2.3	2021
Circular material use rate (%) ²	7.1	10.6	10.8	10.5	9.9	3.8	11.7	2021
Recycling rate (% of municipal waste)	49.2	48.9	49.0	48.9	52.8	55.3	49.6	2021
Built environment								
Recovery rate from construction and demolition waste (%) ³	100.0	-	98.0	-	99.0	-	89.0	2020
Soil sealing index (base year = 2006) ⁴	105.6	-	111.3	-	-	-	108.3	2018
Agri-food								
Food waste (kg per capita) ⁵	-	-	-	-	147.0	-	131.0	2020
Composting and digestion (kg per capita)	167.0	153.0	154.0	152.0	186.0	200.0	100.0	2021

(1) Persons employed in the circular economy only tracks direct jobs in selected sub-sectors of NACE codes E, C, G and S; (2) the circular material use rate measures the share of material recovered and fed back into the economy in overall material use; (3) the recovery rate of construction and demolition waste includes waste which is prepared for reuse, recycled or subject to material recovery, including through backfilling operations; (4) soil sealing: 2016 column refers to 2015 data; (5) food waste includes primary production, processing and manufacturing, retail and distribution, restaurants and food services, and households.

Source: Eurostat, European Environment Agency

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 30% of its total RRP budget to digital (EUR 24.5 million) ⁽⁷⁰⁾.

The Digital Decade Policy Programme sets out a pathway for Europe's successful digital transformation by 2030. The Programme provides a framework for assessing the EU's and Member States' digital transformation, notably via the Digital Economy and Society Index (DESI). It also provides a way for the EU and its Member States to work together, including via multi-country projects, to accelerate progress towards the Digital Decade digital targets and general objectives ⁽⁷¹⁾. More generally, several aspects of digital transformation are particularly relevant in the current context. In 2023, the European Year of Skills, building the appropriate skillset to make full use of the opportunities that digital transformation offers is a priority. A digitally skilled population increases the development and adoption of digital technologies and leads to productivity gains ⁽⁷²⁾. Digital technologies, infrastructure and tools all play a role in the fundamental transformation needed to adapt the energy system to the current structural challenges ⁽⁷³⁾.

Luxembourg performs relatively well in digital skills, but lacks ICT specialists. The country scores well above the EU average for both

at least basic digital skills and ICT specialists. Nevertheless, the lack of ICT specialists remains an issue: While the country has a high share of ICT specialists with 6.7% of the workforce, 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%).

Luxembourg is among the EU leaders in digital infrastructure/connectivity. It scores considerably above the EU average and almost reaches full availability for very high capacity network (VHCN) coverage. By mid-2022, 5G coverage figures stood at 51% in the 3.4 to 3.8 GHz band and 93% for overall 5G coverage, both well above the EU average.

Digital technologies are well integrated in business activities. Luxembourg performs slightly below the EU average on basic digital intensity of small and medium-sized enterprises. As for the integration of advanced technologies, it scores well on artificial intelligence and big data, but is below the EU average in the use of cloud services.

Luxembourg scores well on digital public services. The country performs considerably above the EU average in digital public services – both for 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, notified under the eIDAS Regulation. A national electronic wallet is under development allowing users to manage and present digital certificates of official documents on their smartphones. The country has also started to implement some measures in the RRP to modernise and digitalise public services and to provide e-health services.

⁽⁷⁰⁾ The share of financial allocations that contribute to digital objectives has been calculated using Annex VII of the RRF Regulation and is based on the amended RRP, adopted by the Council on 10/02/2023.

⁽⁷¹⁾ The Digital Decade targets as measured by DESI indicators and complementary data sources are integrated to the extent currently available and/or considered particularly relevant in the MS-specific context.

⁽⁷²⁾ See for example OECD (2019): OECD Economic Outlook, Digitalisation and productivity: A story of complementarities, [OECD Economic Outlook, Volume 2019 Issue 1 | OECD iLibrary \(oecd-ilibrary.org\)](https://www.oecd-ilibrary.org/publications/oeecd-economic-outlook-volume-2019-issue-1_1).

⁽⁷³⁾ The need and possible actions for a digitalisation of the energy system are laid out in the Communication 'Digitalisation the energy system – EU action plan' (COM(2022)552).

Table A10.1: **Key Digital Decade targets monitored by DESI indicators**

	Luxembourg			EU	Digital Decade target by 2030 (EU)
	DESI 2021	DESI 2022	DESI 2023	DESI 2023	
Digital skills					
At least basic digital skills	NA	64%	64%	54%	80%
% individuals		2021	2021	2021	2030
ICT specialists ⁽¹⁾	6.3%	6.7%	6.7%	4.5%	20 million
% individuals in employment aged 15-74	2020	2021	2021	2021	2030
Digital infrastructure/connectivity					
Fixed Very High Capacity Network (VHCN) coverage	92%	93%	93%	73%	100%
% households	2020	2021	2022	2022	2030
Fibre to the Premises (FTTP) coverage ⁽²⁾	72%	75%	76%	56%	-
% households	2020	2021	2022	2022	2030
Overall 5G coverage	0%	13%	93%	81%	100%
% populated areas	2020	2021	2022	2022	2030
5G coverage on the 3.4-3.8 GHz spectrum band	NA	NA	51%	41%	-
% populated areas			2022	2022	2030
Digitalisation of businesses					
SMEs with at least a basic level of digital intensity	NA	NA	66%	69%	90%
% SMEs			2022	2022	2030
Big data ⁽³⁾	19%	19%	19%	14%	75%
% enterprises	2020	2020	2020	2020	2030
Cloud ⁽³⁾	NA	29%	29%	34%	75%
% enterprises		2021	2021	2021	2030
Artificial Intelligence ⁽³⁾	NA	13%	13%	8%	75%
% enterprises		2021	2021	2021	2030
Digitalisation of public services					
Digital public services for citizens	NA	93	95	77	100
Score (0 to 100)		2021	2022	2022	2030
Digital public services for businesses	NA	97	97	84	100
Score (0 to 100)		2021	2022	2022	2030
Access to e-health records	NA	NA	67	71	100
Score (0 to 100)			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 evaluation will also be monitored separately and taken into consideration when interpreting VHCN coverage data in the Digital Decade.

(3) At least 75 % of Union 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

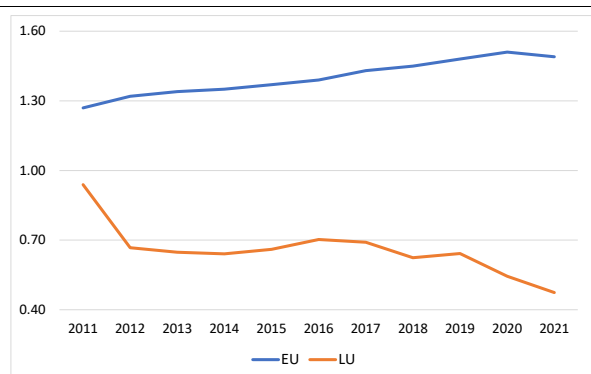
This Annex provides a general overview of the performance of Luxembourg's research and innovation system, which is essential for delivering the twin green and digital transition.

Luxembourg is a 'strong innovator' but its leadership in the EU is decreasing.

Luxembourg's innovation performance is above the EU average. However, it is increasing (by 1.4 percentage points) more slowly than the EU average (9.9 pps) ⁽⁷⁴⁾. Luxembourg's relative strengths, highlighted in the European Innovation Scoreboard, notably include the share of international scientific co-publications, which reflects the quality and attractiveness of Luxembourg's public research system, which has become of a pole of attraction for excellent researchers.

Luxembourg has been unable to raise its R&D intensity ⁽⁷⁵⁾, which has been on a declining trend over the past two decades. Low and declining R&D intensity (1.02% in 2021 compared to 1.42% in 2011) remains a challenge, holding back the much-needed diversification of the economy. In particular, while public expenditure on R&D (relative to GDP) has remained stagnant (at around 0.55%) in recent years, business R&D intensity has continued to decline, falling to 0.47% in 2021.

Graph A11.1: **Business expenditure on R&D as % of GDP, 2011-2021**



Source: Eurostat

Public support for business innovation remains very low.

Over the last few years, Luxembourg has taken concrete steps to develop a policy mix aimed at fostering business innovation, for example through the 'Fit 4' performance programmes targeting start-ups and small and medium-sized enterprises. However, public support for business innovation is still marginal (0.037% of GDP in 2020, compared to an EU average of 0.196%). 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 ⁽⁷⁶⁾. While the government recently announced an increase in research funding of nearly EUR 300 million to a total of EUR 1.7 billion for 2022–2025 ⁽⁷⁷⁾, 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).

Despite the high quality of Luxembourg's public research system, linkages with the business sector remain underexploited.

Science-business linkages remain weak, as evidenced by the low share of public expenditure on R&D financed by businesses (0.014% in 2019, compared to an EU average of 0.054%). The Luxembourg recovery and resilience plan 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 the economy needs persists, in particular due to the difficulties the national education system has in training the

⁽⁷⁴⁾ European Innovation Scoreboard 2022: ec.rtd.eis-country-profile-lu.pdf (europa.eu). 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).

⁽⁷⁵⁾ R&D intensity is R&D expenditure as a percentage of GDP.

⁽⁷⁶⁾ [OECD Economic Surveys: Luxembourg 2022 | READ online](https://oecd-ilibrary.org) (oecd-ilibrary.org)

⁽⁷⁷⁾ [Luxembourg to invest EUR 1.7 bn euro in research and higher education - researchluxembourg](https://researchluxembourg)

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

Luxembourg	2010	2015	2019	2020	2021	EU average (1)
Key indicators						
R&D intensity (GERD as % of GDP)	1.42	1.25	1.18	1.06	1.02	2.26
Public expenditure on R&D as % of GDP	0.48	0.59	0.54	0.52	0.55	0.76
Business enterprise expenditure on R&D (BERD) as % of GDP	0.94	0.66	0.64	0.54	0.47	1.5
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	12.7	14	:	:	9.8
PCT patent applications per billion GDP (in PPS)	1.6	1.7	1.7	:	:	3.3
Academia-business cooperation						
Public-private scientific co-publications as % of total publications	9.4	8.9	10.8	10.6	13.1	7.1
Public expenditure on R&D financed by business enterprise (national) as % of GDP	0.008	0.007	0.014	:	:	0.054
Human capital and skills availability						
New graduates in science & engineering per thousand pop. aged 25-34	:	1.9	2.6	2.5	:	16.3
Public support for business enterprise expenditure on R&D (BERD)						
Total public sector support for BERD as % of GDP	:	0.052	0.037	:	:	0.196
Business enterprise expenditure on R&D (BERD) financed by the public sector (national and abroad) as % of GDP	:	0.052	0.037	:	:	0.104
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	12	:	:	13.3
Finance for innovation and economic renewal						
Venture capital (market statistics) as % of GDP	0.035	0.011	0.026	0.036	0.042	0.074
Employment in fast-growing enterprises in 50% most innovative sectors	3.1	4.6	6.2	:	:	5.5

(1) EU average for the latest available year or the year with the highest number of country data.

Source: Eurostat, OECD, DG JRC, Science-Metrix (Scopus database and EPO's Patent Statistical database), Invest EU

talents that companies need and the latter's strong dependence on highly qualified people from outside.⁽⁷⁸⁾ The number of the new graduates in science and engineering per thousand population aged 25-34 is lower in Luxembourg than anywhere else in EU (2.5 in 2020 compared to an EU average of 16) and the number of graduates in computing per thousand population aged 25-34 (1.2 in 2020, compared to an EU average of 3) is the second lowest in EU.

Thus, Luxembourg's R&I system relies heavily on its continuing ability to attract foreign talents. The national research and innovation strategy recognises the need to better monitor the skills gap between needs and supply and train more people in new, highly dynamic digital skills.⁽⁷⁹⁾

⁽⁷⁸⁾

https://www.cc.lu/fileadmin/user_upload/tx_ccnews/Publications_2021_Eco_News_Flash_N_6_Ecosysteme_d_innovation.pdf

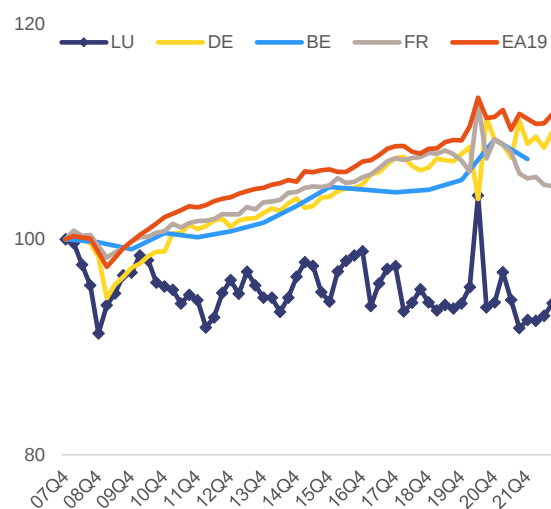
⁽⁷⁹⁾ [https://gouvernement.lu/dam-](https://gouvernement.lu/dam-assets/documents/actualites/2020/02-fevrier/25-mesr-strategie-recherche-innovation/mesr-strategy-research-innovation.pdf)

[assets/documents/actualites/2020/02-fevrier/25-mesr-strategie-recherche-innovation/mesr-strategy-research-innovation.pdf](https://gouvernement.lu/dam-assets/documents/actualites/2020/02-fevrier/25-mesr-strategie-recherche-innovation/mesr-strategy-research-innovation.pdf)

Luxembourg has a competitive economy that is well integrated into the Single Market for services. Luxembourg is the 13th most competitive economy in the world⁽⁸⁰⁾. It is a top performer in attracting talent and has a strong position in international investment and trade. Its Single Market integration is the highest in the EU, with the addition of exports and imports of goods and services representing 111% of its GDP (EU average: 46%). This is mainly due to Luxembourg's leadership in services, notably in financial services: exports and imports in services represent 83% of its GDP, far ahead of the Member States' average (14%), while exports and imports in goods represent just 28% of its GDP, below the Member States' average (31%).

Although still one of the highest in the EU, Luxembourg's labour productivity has been stagnating since the 2000's. Luxembourg has one of the highest labour productivity levels in the EU and the OECD⁽⁸¹⁾. However, when analysing labour productivity in terms of growth rates rather than levels, the situation looks less positive. Since 2007, Luxembourg's productivity has evolved less favourably than the productivity of euro area countries and of neighbouring countries (see graph A12.1). In 2023, labour productivity, expressed in terms of real GDP per occupied person, is forecast to decrease by 0.8% (vs. an increase by 0.4% in the EU)⁽⁸²⁾. Differences across sectors are significant, both in terms of levels and growth. Labour productivity in the information and communication sector has strongly declined since 2017, while increasing in financial activities and in manufacturing since 2019 and 2018 respectively⁽⁸³⁾. The growth of labour productivity per person in industry (-0.3%) was, however, still below the EU average (+1.4%) in 2022.

Graph A12.1: Evolution of labour productivity, whole economy (index, 100=07Q4)



Source: Eurostat

Low productivity gains are partly explained by low business investment, including in R&D.

In 2021, business investment represented 8.3% of GDP in Luxembourg, against 13.4% in the EU⁽⁸⁴⁾. This is amongst the lowest in the EU and in the OECD⁽⁸⁵⁾. Business expenditure in R&D has continued to decline and fell to 0.47% in 2021, against 1.5% in the EU⁽⁸⁶⁾ (see Annex 11). Investment in equipment shrank from 2014 until 2018 (with an average yearly percentage change of -4.5%, against +4.9% in the EU), but it has grown faster than the EU average since 2019⁽⁸⁷⁾.

Long-term barriers to investment persist. As in the rest of the EU, the availability of skilled staff is the most cited long-term barrier to investment by Luxembourg firms (86% vs 85% in the EU), followed by energy costs (81% vs 82%) and uncertainty about the future (79% vs 78%)⁽⁸⁸⁾. Some barriers are mentioned more frequently in Luxembourg than in the rest of the EU: demand for products and services (62% vs 53%), transport infrastructure (55% vs 48%) and access to digital infrastructure (54% vs 44%). Although business regulations are mentioned less often than in the rest of the EU (56% vs 61%), they can still be a barrier to investment. In

⁽⁸⁰⁾ Institute for Management Development, [World competitiveness ranking 2022](#), 15/6/2022

⁽⁸¹⁾ OECD, [labour productivity across countries](#), 2019

⁽⁸²⁾ EC, [2023 Spring forecast, statistical annex](#), 15/05/2023

⁽⁸³⁾ Conseil national de la productivité, [rapport annuel 2021-2022](#), 12/2022, p.18

⁽⁸⁴⁾ EC, Eurostat, [SDG 08_11](#)

⁽⁸⁵⁾ OECD [Economic surveys: Luxembourg 2022](#), 17/11/2022

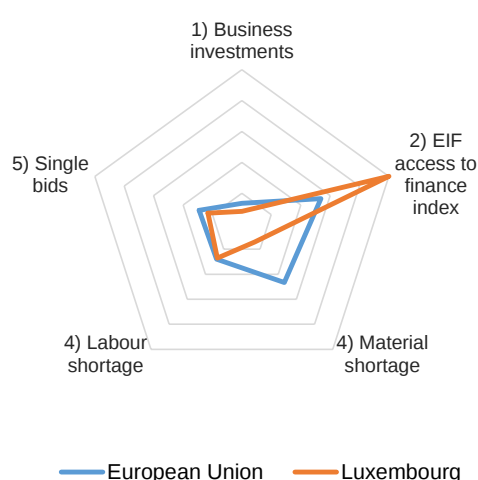
⁽⁸⁶⁾ EC, Eurostat, [RD_E_BERDPFR2](#)

⁽⁸⁷⁾ EC, [2023 Spring forecast, statistical annex](#), 15/05/2023

⁽⁸⁸⁾ [EIB Investment Survey 2022](#), 11/2022, based on interviews carried out between April and July 2022.

particular, the administrative procedure for obtaining authorisation to deploy renewable energy projects is long. One of the reasons for this is the lack of administrative staff. Lastly, availability of finance is cited by 44% of Luxembourg firms as a barrier to investment, in line with the EU average (43%). Indeed, access to finance is good both for loans and equity⁽⁸⁹⁾. Regarding late payments, the share of SMEs who experienced late payments reached 53% in 2022, above the EU average (43%).

Graph A12.2: **Business environment and competitiveness drivers**



Source: 1) % of GDP, 2021 Eurostat;
 2) composite indicator, 2021 European Investment Fund access to finance index;
 3) average payment delay in number of days, 2022 Intrum;
 4) % of firms in manufacturing facing constraints, 2022 European Commission business consumer survey;
 5) proportion of contracts awarded with a single bidder, 2022 Single Market Scoreboard.

Since the beginning of 2022, Luxembourg firms have been faced with an unfavourable economic context. High prices for energy and raw materials, persisting skills shortages, high labour costs, inflation, increasing interest rates, disruptions to supply chains and lower internal and external demand are harming Luxembourg businesses' activity, profitability and investment, particularly in the retail and industrial sectors⁽⁹⁰⁾. Investment in equipment is expected to shrink by 1% in 2022 and by 1.9% in 2023⁽⁹¹⁾. To slow

down inflation, help households and businesses faced with increasing energy prices and promote the energy and digital transitions, the government and the social partners signed tripartite agreements in March 2022, September 2022 and March 2023.

SMEs face a skills shortage, which harms their green and digital transitions. The lack of skills, particularly digital skills⁽⁹²⁾, harms SMEs' capacity to become greener and more digital. Only 9% of SMEs were selling online in 2021, against 18% in the EU⁽⁹³⁾. To help SMEs' green and digital transitions and help them retain their customers, Luxembourg adopted three packages for SMEs⁽⁹⁴⁾ on 29 November 2022.

Entrepreneurship could be further encouraged. Luxembourg ranks only 37 out of 47 countries for total early-stage entrepreneurial activity⁽⁹⁵⁾. Starting a business, while possible to do online, remains a cumbersome procedure⁽⁹⁶⁾. Entrepreneurs' fear of failure is among the highest in the EU. To modernise the right of establishment and stimulate entrepreneurship, Luxembourg tabled a bill of law in April 2022⁽⁹⁷⁾. It confers the right to start a second business after bankruptcy, simplifies the requirements relating to the holder of the business license and business transfers, eases access to certain craft professions and simplifies some administrative procedures.

Tackling structural weaknesses, including restrictive regulations in services, would improve productivity. According to the national productivity board⁽⁹⁸⁾, key to improving productivity are: investment in digitalisation (Annex 10); research and innovation (Annex 11); reskilling (Annex 14) and improving managerial skills; and adapting the regulatory framework to strengthen competition. Indeed, professional licensing rules in

⁽⁹²⁾ EC, [2022 SME country fact sheet for Luxembourg](#), 19/6/2022

⁽⁹³⁾ EC, [Luxembourg in the Digital Economy and Society Index](#), 28/7/2022

⁽⁹⁴⁾ Luxembourg, [SME packages](#), 29/11/2022

⁽⁹⁵⁾ [Global entrepreneurship monitor 2021/2022](#), 10/2/2022, p142-143.

⁽⁹⁶⁾ OECD, [Economic surveys: Luxembourg 2022](#), 17/11/2022.

⁽⁹⁷⁾ Bill of Law 7989 amending the Law of 2 September 2011 regulating access to the professions of craftsman, merchant, manufacturer and certain liberal professions.

⁽⁹⁸⁾ Conseil national de la productivité, [rapport annuel 2021-2022](#), 12/2022

⁽⁸⁹⁾ [2021 EIF SME Access to Finance Index](#), 10/22

⁽⁹⁰⁾ Luxembourg Chamber of commerce, [baromètre de l'économie](#), 2nd half 2022, 27/10/2022.

⁽⁹¹⁾ EC, [2022 Autumn forecasts statistical annex](#), 11/11/2022

Luxembourg are among the most restrictive in the OECD. Making professional regulations less restrictive could increase GDP per capita by 0.6% over five years ⁽⁹⁹⁾. Compared to other EU Member States, regulatory restrictions remain particularly high for architects, civil engineers, accountants and tax advisers, lawyers and estate agents ⁽¹⁰⁰⁾. Luxembourg has reformed its retail regulatory framework, both for establishment and operations, leading to a significant improvement of its score in the retail and restrictiveness indicator ⁽¹⁰¹⁾. Territorial supply constraints continue to affect consumer choice and prices. Food prices are the highest in the EU ⁽¹⁰²⁾.

Luxembourg could accelerate the transposition of directives to promote business integration in the single market.

Indeed, Luxembourg needs 15.7 months to transpose Single Market-related directives (EU average: 8.6 months) and its transposition deficit is 1.8% (EU average: 1.6%). Regarding Single Market-related infringements, Luxembourg's performance is good. Problematic sectors are transport and direct taxation with 46% of all pending cases. ⁽¹⁰³⁾

⁽⁹⁹⁾ OECD [Economic surveys: Luxembourg 2022](#), 17/11/2022.

⁽¹⁰⁰⁾ EC, [Communication on updating the reform recommendations for regulation in professional services](#), COM (2021)385, 9/7/2021

⁽¹⁰¹⁾ EC, [Retail Restrictiveness Indicator](#) (2022 update), forthcoming

⁽¹⁰²⁾ Eurostat, [Comparative price levels for 2021](#), data 12/2022

⁽¹⁰³⁾ EC, [Single Market scoreboard, 2022](#)

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

POLICY AREA		INDICATOR NAME	2018	2019	2020	2021	2022	EU27 average (*)
HEADLINE INDICATORS	Economic Structure	Net private investment, level of private capital stock, net of depreciation, % GDP ⁽¹⁾	2.7	3.5	1.9	3.3	3.1	3.7
		Net public investment, level of public capital stock, net of depreciation, % GDP ⁽¹⁾	1.6	1.7	2.2	1.7	1.6	0.4
		Real labour productivity per person in industry (% yoy) ⁽²⁾	-1.9	10	0.9	3.1	-0.3	1.4
	Cost competitive-ness	Nominal unit labour cost in industry (% yoy) ⁽²⁾	2.6	-7.6	-1.5	3.3	4.5	2.9
RESILIENCE	Shortages	Material shortage (industry), firms facing constraints, % ⁽³⁾	10	5	5	18	14	47
		Labour shortage using survey data (industry), firms facing constraints, % ⁽³⁾	5	6	12	16	27	28
		Vacancy rate (business economy) ⁽⁴⁾	1.9	1.9	1.8	2.3	3.1	3.1
	Strategic dependencies	Concentration in selected raw materials, Import concentration index based on a basket of critical raw materials ⁽⁵⁾	0.19	0.17	0.15	0.16	0.18	0.18
		Installed renewables electricity capacity, % of total electricity produced ⁽⁶⁾	95	93.9	94	94.5	n.a.	50.9
SINGLE MARKET	Single Market integration	EU trade integration, % ⁽⁷⁾	107.0	110.7	107.6	114.8	111.3	45.8
	Restrictions	EEA Services Trade Restrictiveness Index ⁽⁸⁾	0.07	0.07	0.07	0.07	0.07	0.05
	Public procurement	Single bids, % of total contractors ⁽⁹⁾	26	17	20	18	23	29
BUSINESS ENVIRONMENT - SMEs	Investment obstacles	Impact of regulation on long-term investment, % of firms reporting business regulation as major obstacle ⁽¹⁰⁾	18.1	11.0	10.4	12.3	12.9	29.6
	Business demography	Bankruptcies, Index (2015=100) ⁽¹¹⁾	117.1	125.7	105.7	118.8	109.6	86.8
		Business registrations, Index (2015=100) ⁽¹¹⁾	112.7	116.4	107.6	134	115.6	121.2
	Late payments	Payment gap - corporates B2B, difference in days between offered and actual payment ⁽¹²⁾	n.a.	n.a.	n.a.	n.a.	n.a.	13
		Payment gap - public sector, difference in days between offered and actual payment ⁽¹²⁾	n.a.	n.a.	n.a.	n.a.	n.a.	15
		Share of SMEs experiencing late payments in past 6 months, % ⁽¹³⁾	n.a.	49.3	39.1	68.7	53.2	43
	Access to finance	EIF Access to finance index - Loan, Composite: SME external financing over last 6 months, index values between 0 and 1 ⁽¹⁴⁾	0.79	0.72	0.49	0.89	n.a.	0.46
		EIF Access to finance index - Equity, Composite: VC/GDP, IPO/GDP, SMEs using equity, index values between 0 and 1 ⁽¹⁴⁾	0.12	0.19	0.11	0.41	n.a.	0.23

(*) Last available year

Source: (1) AMECO, (2) Eurostat, (3) ECFIN BCS, (4) Eurostat, (5) COMEXT and Commission calculations, (6) Eurostat, (7) Eurostat, (8) OECD, (9) Single Market Scoreboard, (10) EIB survey, (11) Eurostat: (12) Intrum, (13) SAFE Survey, (14) EIF SME Access to Finance Index.

This Annex outlines the performance of Luxembourg's public administration, which is essential for providing services and carrying out reforms. Government effectiveness in Luxembourg remains among the highest in the EU ⁽¹⁰⁴⁾. The government programme aims to advance digital transformation and administrative simplification ⁽¹⁰⁵⁾.

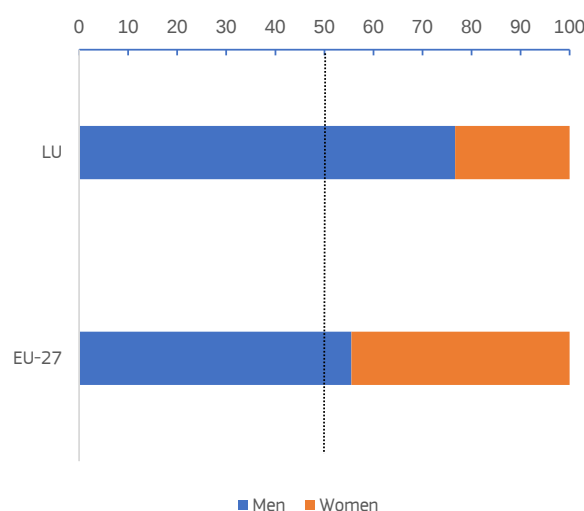
Overall, e-government in Luxembourg already scores high. The share of citizens interacting with the government via the internet in the last year has been high, showing an upward trend from previous years. In 2022, Luxembourg extended the list of services that are provided online. A new mobile app allows citizens to use eID to interact with the government. Luxembourg plans to make several investments under the recovery and resilience facility to support the digitalisation of services that issue permits to citizens and businesses. The provision of open government data is below the EU average.

Regulatory governance faces challenges in several respects. Performance on the OECD indicators on regulatory governance and policy is well below the EU average (Graph A13.2). *Ex ante* impact assessments are done for all new regulations. However, these focus only on the administrative burdens and do not analyse the effects, costs or benefits of proposals. *Ex post* evaluations are not done systematically. An online platform for conducting public consultations has been launched. However, stakeholder engagement remains limited to formal consultation with professional groups ⁽¹⁰⁶⁾.

The civil service in Luxembourg is young, compared to the EU average, but faces several challenges. The gender imbalance in senior civil service positions is one of the biggest in the EU-27 and continues to widen (Graph A13.1). The share of civil servants with higher education is below the EU average (Luxembourg: 41.8%; EU 52%), unlike the participation of public administration employees in adult learning.

The justice system performs efficiently but access could be improved. The efficiency of civil justice continues to be consistently high, although the length of proceedings is significantly longer at second and third instances (an average of 154 days at first instance, 501 days at second instance and 312 days at third instance). On the quality side, the justice system does not make many arrangements to facilitate access for people at risk of discrimination or older people. The digitalisation of justice needs to be improved. No systemic deficiencies in judicial independence have been reported. ⁽¹⁰⁷⁾

Graph A13.1: Luxembourg. Public administration. Share of women and men in senior positions. 2022 data



Source: European Institute for Gender Equality

⁽¹⁰⁴⁾ Worldwide governance indicators, 2021.

⁽¹⁰⁵⁾ Government programme (<https://gouvernement.lu/dam-assets/documents/actualites/2018/12-decembre/Accord-de-coalition-2018-2023.pdf>).

⁽¹⁰⁶⁾ OECD, Better Regulation Practices across the European Union 2022, (pp.180-181).

⁽¹⁰⁷⁾ For a more detailed analysis of the performance of the justice system in Luxembourg, see the 2023 [EU Justice Scoreboard](#) (forthcoming) and the country chapter for Luxembourg in the 2023 [Rule of Law Report](#) (forthcoming).

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

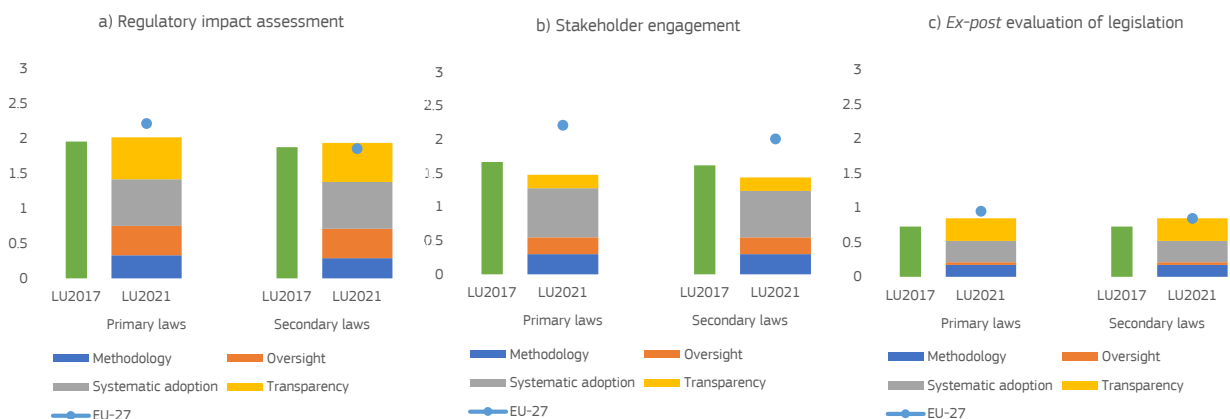
LU Indicator ⁽¹⁾	2017	2018	2019	2020	2021	2022	EU-27 ⁽²⁾
E-government and open government data							
1 Share of individuals who used the internet within the last year to interact with public authorities (%)	77.1	65.3 (b)	62.3	63.8	79.1	n/a	64.8
2 E-government benchmark overall score ⁽³⁾	n/a	n/a	n/a	84.3	87.1	88.8	72.9
3 Open data and portal maturity index	n/a	0.8	0.6	0.6	0.7	0.7	0.8
Educational attainment level, adult learning, gender parity and ageing							
4 Share of public administration employees with tertiary education (levels 5-8, %)	33.7 (u)	34.5	35.4	38.5	42.9 (b)	41.8	52.0
5 Participation rate of public administration employees in adult learning (%)	18.6	20.8	20.8	14.9	17.7 (b)	18.8 (u)	16.9
6 Gender parity in senior civil service positions ⁽⁴⁾	29.8	37.2	42.8	48.4	43.8	53.4	11.0
7 Ratio of 25-49 to 50-64 year olds in NACE sector O	2.5	2.7	2.5	2.7	2.8 (b)	3.3	1.5
Public financial management							
8 Medium term budgetary framework index	0.7	0.7	0.7	0.8	0.8	n/a	0.7
9 Strength of fiscal rules index	0.8	0.8	0.8	0.9	0.9	n/a	1.5
Evidence-based policy making							
10 Regulatory governance	1.43	n/a	n/a	n/a	1.43	n/a	1.7

⁽¹⁾ High values denote a good performance, except for indicator # 6. ⁽²⁾ 2022 value. If not available, the 2021 value 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: ICT use survey, 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).

Graph A13.2: **Luxembourg. a) Regulatory impact assessment, b) Stakeholder engagement and c) Ex post evaluation of legislation**

Source: Indicators of Regulatory Policy and Governance Surveys 2017 and 2021, (<http://oe.cd/ireg>).

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 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	Early leavers from education and training (% of population aged 18-24, 2022)	8.2
	Share of individuals who have basic or above basic overall digital skills (% of population aged 16-74, 2021)	63.79
	Youth NEET rate (% of population aged 15-29, 2022)	7.4
	Gender employment gap (percentage points, 2022)	6.5
	Income quintile ratio (S80/S20, 2021)	4.59
Dynamic labour markets and fair working conditions	Employment rate (% of population aged 20-64, 2022)	74.8
	Unemployment rate (% of active population aged 15-74, 2022)	4.6
	Long term unemployment (% of active population aged 15-74, 2022)	1.3
	GDHI per capita growth (2008=100, 2021)	111.09
Social protection and inclusion	At risk of poverty or social exclusion rate (% of total population, 2021)	21.1
	At risk of poverty or social exclusion rate for children (% of population aged 0-17, 2021)	29.4
	Impact of social transfers (other than pensions) on poverty reduction (% reduction of AROP, 2021)	34.18
	Disability employment gap (percentage points, 2021)	15.4
	Housing cost overburden (% of total population, 2021)	5.1
	Children aged less than 3 years in formal childcare (% of population under 3-years-old, 2021)	62
	Self-reported unmet need for medical care (% of population 16+, 2021)	1
Critical situation		To watch
Weak but improving		Good but to monitor
On average		Better than average
		Best performers

(1) Update of 27 April 2023. Member States are classified on the Social Scoreboard according to a statistical methodology agreed with the EMCO and SPC Committees. It looks jointly at levels and changes of the indicators in comparison with the respective EU averages and classifies Member States in seven categories. For methodological details, please consult the Joint Employment Report 2023. Due to changes in the definition of the individuals' level of digital skills in 2021, exceptionally only levels are used in the assessment of this indicator; NEET: neither in employment nor in education and training; GDHI: gross disposable household income.

Source: Eurostat

Although the labour market quickly recovered from the COVID-19 crisis, some challenges remain. The labour market has shown great resilience amid high GDP growth in 2021, with an employment rate of 74.1% in 2021 and 74.8% in 2022 (EU: 74.6%). The unemployment rate stood at 5.3% in 2021 and

reached 4.6% in 2022, well below the EU average (6.2%). However, the employment rate of low-skilled people was still modest in 2021 (59.6%) although above the EU average (54.9%). Moreover, the employment rate of older workers (aged 55-64) remains much lower than the EU average despite a steady increase in recent years (from 39.6% in 2016 to 46.6% vs. EU: 60.5% in 2021). The youth unemployment rate (16.9% in 2021, slightly above the EU average) has varied greatly over the years, largely due to the small size of the sample. Overall, there is room for further progress for Luxembourg to reach its 2030 employment target. The European Social Fund Plus (ESF+) will support measures to strengthen policies supporting an active labour market, with a focus on digital skills and jobs. It will target young people, low-skilled people, long-term unemployed people, women, and people aged over 45. Addressing these challenges would support Luxembourg's progress towards the national employment rate target of 77.6% by 2030.

Luxembourg has recorded an increase in early school leaving, and pupils' basic skills are closely linked to their socio-economic background. The share of early leavers⁽¹⁰⁸⁾ rose from 6.3% in 2018 to 9.3% in 2021 but decreased to 8.2% in 2022. In 2018, Luxembourg's average skills 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 country had the largest gap across all EU countries between advantaged students and their disadvantaged peers⁽¹⁰⁹⁾ (see Annex 15 for more information on education). The ESF+ will support measures improving education and training and career guidance, fighting early school leaving, and boosting the integration of young refugees and migrants into the school system.

Participation in adult learning is one of the highest in the EU but is still uneven among groups. The participation in adult learning over the past 4 weeks remained well above the EU average in 2021 (17.9% vs. EU: 10.8%), notably

⁽¹⁰⁸⁾ Share of the population aged 18 to 24 with, at most, lower secondary education who were not involved in any education or training during the 4 weeks preceding the survey.

⁽¹⁰⁹⁾ Luxembourg did not participate in the 2022 PISA survey.



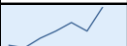
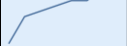
among unemployed people (34.4% vs. EU: 12.7% in 2021). Nonetheless, participation is still uneven, with only 6.8% for low-qualified people and 8.9% for older workers. Moreover, despite the high share of cross-border workers (around 46% of the country's workforce), labour shortages are significant, particularly in ICT but also in construction and industry. Despite a high digital skills level among the population, Luxembourg has a significant shortage of ICT specialists. Therefore, there is scope to improve lifelong learning to foster under-represented groups' integration into the labour market and address skills shortages. Skills figure prominently in the country's recovery and resilience plan with the ongoing skills strategy. The ESF+ will support measures promoting lifelong learning in connection with skills needs. These 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 share of people at risk of poverty or social exclusion increased in 2021 but stayed slightly below the EU average (21.1% vs. 21.7% in EU). Non-EU citizens are particularly affected (38.7% in 2021 against 13.9% for Luxembourgish citizens and 21.5% for EU citizens). In-work poverty in particular has increased in recent years (from 10.9% in 2016 to 13.5% in 2021) and is among the highest in the EU (8.9%). Young people are particularly affected: their in-work poverty rate rose from 10.2% in 2012 to 20.8% in 2021, well above the EU average of 12.8% in 2021. In-work poverty is also considerable among single-parent households with dependent children (26.9% vs. EU: 19.0%). A similar situation can be observed for people not born in the EU who tend to be much more affected by in-work poverty (26.8% in 2021) than people born in the EU (14.7%) and in Luxembourg (7.4%).

Child poverty also rose sharply in 2021 and particularly affects households with high to very high work intensity. In Luxembourg, the at-risk-of-poverty rate for workers living in a household with children is 16.5% vs. 10.2% for those living in a household without children (10.2% vs. 7.8% respectively in the EU). The strong increase in house prices has most likely contributed to this (the house price index bounced back from 151 in 2020 to 172 in 2021, one of the highest in the EU; 2015 = 100). Child poverty also has a greater impact on households with parents who have low educational attainment levels

(56.7% for ISCED levels 0-2 compared to 10.0% for ISCED 5-8) ⁽¹¹⁰⁾. The impact of social transfers (excluding pensions) on reducing poverty fell from 39.4% in 2020 to 34.2% in 2021, whereas in the EU, there was an increase from 33.2% in 2020 to 37.1% in 2021. Social transfers, including Revis ⁽¹¹¹⁾, have therefore become less effective in alleviating poverty in Luxembourg. National forecasts also expected energy poverty to rise sharply in 2022: 3.2% of households were expected to fall into energy poverty (precariousness) in 2022 (without considering recent measures such as energy price caps) ⁽¹¹²⁾ (see Annex 8 for further details). The ESF+ will support disadvantaged groups, in particular people with a migrant background, by supporting their sustainable integration into the labour market and continuing the fight against child poverty. These measures, together with further social policy action, would help Luxembourg reach the national target of having at least 4 000 fewer people at risk of poverty by 2030.

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

Indicators	Latest data	Trend (2015-2021)	National target by 2030	EU target by 2030
Employment (%)	74.1 (2021)		77.6	78
Adult learning ¹ (%)	42.6 (2016)		62.5	60
Poverty reduction ² (thousands)	+7 (2021)		-4	-15,000

Adult Education Survey, adults in learning in the past 12 months
Number of persons at risk of poverty or social exclusion (AROPE), reference year Eurostat, DG EMPL

(1) Adult Education Survey, adults in learning in the past 12 months.

(2) Number of persons at risk of poverty or social exclusion (AROPE), reference year 2019.

Source: Eurostat, DG EMPL.

⁽¹¹⁰⁾International Standard Classification of Education: levels 0-2: less than primary, primary, and lower secondary education; levels 5-8: tertiary education.

⁽¹¹¹⁾Revenu d'inclusion sociale: social minimum income.

⁽¹¹²⁾STATEC Rapport Travail et Cohésion Sociale 2022 p. 147.

This Annex outlines the main challenges for Luxembourg's education and training system in light of the EU-level targets and other contextual indicators under the European Education Area strategic framework, based on the 2022 Education and Training Monitor.

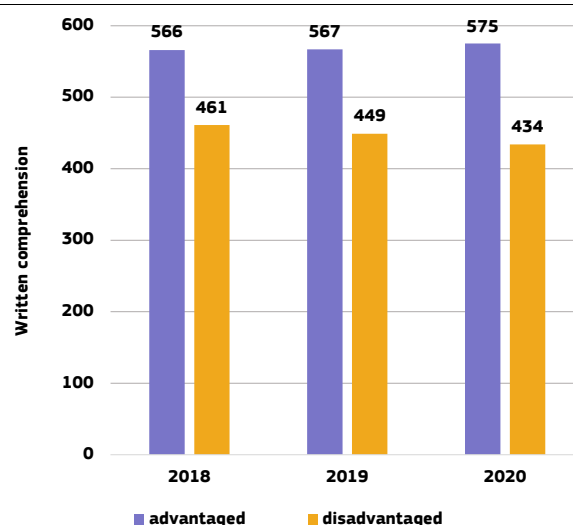
School outcomes are heavily influenced by the pupils' socioeconomic and linguistic background

The spoken language in the national school system at primary level is Luxembourgish, while pupils learn to read and write in German and all subjects (except French) are taught in German. Pupils' basic skills and overall performance therefore depend largely on their skills in these languages. At age 8, there is a marked difference between the performance of pupils in German reading comprehension depending on whether they come from a socio-economically advantaged or disadvantaged background and if they speak German / Luxembourgish or another language at home. The gap seems to be increasing over time. (Graph A15.1). At age 15, Luxembourg's average competence levels, as measured by the 2018 OECD Programme for International Student Assessment (PISA), were significantly lower than the EU average in all three areas tested, with the largest gap recorded between advantaged and disadvantaged students across all EU countries. In September 2022, Luxembourg launched a pilot project in four primary schools, 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 – with free access for pupils – has increased to six. Pupils in these schools can choose between English, French or German as main tuition language, instead of the trilingual system. At present only 4% of pupils at pre-primary and primary level in Luxembourg are enrolled in such public international schools and pupils with a disadvantaged socio-economic or a non-German/ -French background are underrepresented. If the option of teaching through one main language were extended to cover a larger part of the school population it could substantially improve their chances to reach better learning outcomes. As of 2022/23, Luxembourg offers pupils free school meals and after-school facilities.

Luxembourg invested heavily in access to and quality of early childhood education and care (ECEC). From age 3, 89.5% of children

participate in ECEC (EU average: 93.0%; EU-level target: 96%), compulsory education starting at age 4. The 2016 Youth Act established ECEC national quality standards, which all providers had to meet by September 2017 in order to be eligible for the government's childcare voucher co-financing scheme. This includes activities to familiarise children aged 1 to 4 with Luxembourgish and French. Childcare vouchers give parents reduced rates at crèches, after-school centres, mini-crèches and day-care centres.

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)

The rate of early leavers from education and training (ELET) (8.2%) is already below the EU-level target (below 9%)⁽¹¹³⁾. Using an alternative definition of early school leavers, the Ministry of education estimates that in 2020/2021, that also the share of young people aged 16-24 who left the public education system without obtaining an upper secondary qualification reached 8.2% (MENJE, 2022a). In 2020/21, 80% of pupils who dropped out had repeated a year at least once. The repetition rate remains high: by the end of primary education (age 12), 21% of pupils will have repeated at least one school year (MENJE, 2022b).

⁽¹¹³⁾The EU indicator is based on data available on population aged 18-24 whose highest level of education or training attained is at most lower secondary education and who received no education or training in the four weeks preceding the survey.

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

		2015		2022	
Indicator	Target	Luxembourg	EU27	Luxembourg	EU27
¹ Participation in early childhood education (age 3+)	96%	86.3%	91.9%	89.5% ²⁰²⁰	93.0% ²⁰²⁰
² Low achieving 15-year-olds in:	Reading	< 15%	25.6%	20.0%	29.3% ²⁰¹⁸
	Mathematics	< 15%	25.8%	22.3%	27.2% ²⁰¹⁸
	Science	< 15%	25.9%	21.1%	26.8% ²⁰¹⁸
Early leavers from education and training (age 18-24)	³ Total	< 9 %	9.3% ^b	11.0%	8.2% ²⁰¹⁸
	³ By gender	Men	10.5% ^b	12.5%	9.0% ²⁰¹⁸
		Women	8.1% ^b	9.4%	7.3% ²⁰¹⁸
	⁴ By degree of urbanisation	Cities	7.7% ^{b, u}	9.6%	8.6% ²⁰¹⁸
		Rural areas	8.9% ^b	12.2%	10.0% ²⁰¹⁸
	⁵ By country of birth	Native	6.9% ^b	10.0%	8.5% ²⁰¹⁸
		EU-born	15.7% ^b	20.7%	20.3% ²⁰¹⁸
		Non EU-born	7.7% ^{b, u}	23.4%	22.1% ²⁰¹⁸
⁶ Equity indicator (percentage points)		:	:	26.9 ²⁰¹⁸	19.3 ²⁰¹⁸
⁷ Exposure of VET graduates to work based learning	Total	≥ 60% (2025)	:	:	33.7% ²⁰¹⁸
Tertiary educational attainment (age 25-34)	⁸ Total	45%	50.3% ^b	36.5%	61.0% ²⁰¹⁸
	⁸ By gender	Men	45.0% ^b	31.2%	57.4% ²⁰¹⁸
		Women	55.5% ^b	41.8%	64.8% ²⁰¹⁸
	⁹ By degree of urbanisation	Cities	78.1% ^b	46.2%	86.3% ²⁰¹⁸
		Rural areas	41.5% ^b	26.9%	53.0% ²⁰¹⁸
	¹⁰ By country of birth	Native	44.7% ^b	37.7%	52.7% ²⁰¹⁸
		EU-born	57.5% ^b	32.7%	69.1% ²⁰¹⁸
		Non EU-born	51.4% ^b	27.0%	63.4% ²⁰¹⁸
¹¹ Share of school teachers (ISCED 1-3) who are 50 years or over		21.1%	38.3%	20.2% ²⁰²⁰	39.2% ²⁰²⁰

Source: (1,3,4,5,7,8,9,10,11) = Eurostat; 2 = OECD (PISA); 6 = European Commission (Joint Research Centre). Notes: Data is not yet available for the remaining EU-level targets under the European Education Area strategic framework, covering underachievement in digital skills and participation of adults in learning. The equity indicator shows the gap in the share of underachievement in reading, mathematics and science (combined) among 15-year-olds between the lowest and highest quarters of socio-economic status.

Luxembourg is promoting digital education.

Since 2021/22, coding has been taught in all subjects in teaching cycles 1 to 3 (ages 4 to 9). From 2022/23, digital sciences are taught once a week in all secondary schools from grade 7 (MENJE, 2021).

Tertiary educational attainment and graduate employment rates are among the highest in the EU,

with 61.0% of the population aged 25-34 holding a tertiary degree (EU: 42.0%). The rate is significantly higher among the migrant population (69.1%, compared with 53.5% of people born in Luxembourg). However, the number of new graduates in science and engineering per thousand population aged 25-34 is the lowest in the EU (2.5 in 2020 compared with an EU average of 16) and the number of graduates in computing per thousand population aged 25-34 (1.2 in 2020, compared with an EU average of 3) is the second lowest in EU (see Annex 11). The employment rate of recent tertiary graduates in 2021 improved somewhat, to reach 87% (EU average: 84.9%), but remains considerably lower than in 2019 (94.2%).

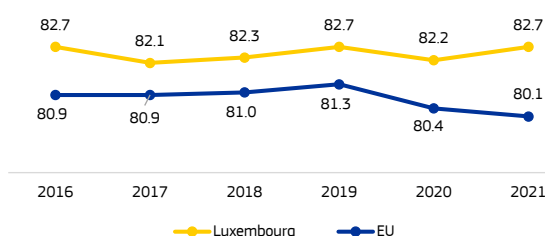
Overall participation in vocational education and training and in lifelong learning activities is high (see Annex 14).

ANNEX 16: HEALTH AND HEALTH SYSTEMS

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 it fell in 2020. There was an increase in COVID-19 mortality in 2021⁽¹¹⁴⁾. Luxembourg fares comparatively well in avoiding deaths from treatable causes. Cancers and circulatory diseases, followed by COVID-19 are the leading causes of death.

Graph A16.1: Life expectancy at birth, years



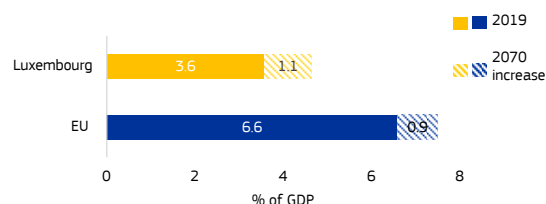
Source: Eurostat

Health spending relative to GDP in Luxembourg was below the EU average in 2020. In 2020, total healthcare spending increased slightly to 5.8% of GDP (from 5.4% in 2019), but this is partly due to data comparability issues regarding the Luxembourgish GDP⁽¹¹⁵⁾. This is in line with the upward trend in all Member States in 2020. Health spending per capita in Luxembourg is one of the highest in the EU. The share of health expenditure in total public spending increased slightly from 12% in 2019 to 12.4% in 2020. Public expenditure on health accounts for 86.4% of total health spending, a share that has increased since 2012 (82.8%) and that is above the EU average (81.2%). Public expenditure on health is projected to increase by 1.1 percentage points of GDP by 2070 (compared to 0.9 percentage points for the EU overall).

⁽¹¹⁴⁾Based on data provided directly by Member States to ECDC under the European Surveillance System (data current as of 13 April 2023)

⁽¹¹⁵⁾A significant proportion of GDP in Luxembourg consists of profits from foreign-owned companies that are repatriated. Thus, gross national income can be used as an alternative measure of the domestic economy in Luxembourg.

Graph A16.2: Projected increase in public expenditure on healthcare over 2019-2070



AWG reference scenario

Source: European Commission / EPC (2021)

In 2020, spending on prevention in Luxembourg amounted to 5.3% of total spending on healthcare, compared to 3.4% for the EU overall. This is comparatively high, with four other Member States also reporting a level above 4%. Between 2020 and 2019, spending on prevention in Luxembourg increased by 135%, compared to a 26% increase for the EU overall. Across the EU, this increase was primarily driven by spending on disease detection, surveillance, control and response programmes as part of the public health response to COVID-19. Between 2019 and 2020, a remarkable proportional increase in reported spending was noted in Luxembourg for programmes for early disease detection, epidemiological surveillance and disease control. For disease control programmes in particular, Luxembourg reported the highest increase of all Member States.

Luxembourg faces a shortage of doctors.

There were 3 practising doctors per 1 000 population in 2020 (against 4 on EU average) and the increase since 2010 is small. The age structure adds to this challenge: in 2017, 43.4% of physicians were over the age of 55, and 54.4% of practising general practitioners and 60% of specialists were over the age of 50. The low density of doctors is largely due to the absence of possibilities for medical training in the country. Moreover, historically, many Luxembourgish residents would seek healthcare in neighbouring countries. To address this challenge, the first national degree in general medicine started in 2021. Luxembourg's healthcare 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 and half of doctors practising in Luxembourg.

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

	2017	2018	2019	2020	2021	EU average (latest year)
Treatable mortality per 100 000 population (mortality avoidable through optimal quality healthcare)	73.1	67.7	63.1	60.3	NA	91.7 (2020)
Cancer mortality per 100 000 population	235.4	225.3	218.5	203.1	NA	242.2 (2020)
Current expenditure on health, % GDP	5.1	5.3	5.4	5.8	NA	10.9 (2020)
Public share of health expenditure, % of current health expenditure	84.0	84.1	85.0	86.4	NA	81.2 (2020)
Spending on prevention, % of current health expenditure	2.2	2.2	2.5	5.3	NA	3.4 (2020)
Acute care beds per 100 000 population	377	370	329	324	322	387.4 (2019)
Doctors per 1 000 population *	3.0	NA	NA	NA	NA	3.9 (2020)
Nurses per 1 000 population *	11.7	NA	NA	NA	NA	8.3 (2020)
Consumption of antibacterials for systemic use in the community, daily defined dose per 1 000 inhabitants per day (total consumption in CY and CZ) **	20.9	20.7	19.8	14.8	14.6	14.5 (2021)

Note: The EU average is weighted for all indicators, except for (*) and (**), for which the EU simple average is used. The simple average for (*) uses data for 2020 or most recent year if former not available. Doctors' density data refer to practising doctors in all countries except EL, PT (licensed to practice) and SK (professionally active). Nurses' density data refer to practising nurses in all countries except FR, PT, SK (professionally active) and EL (nurses working in hospitals only).

Source: Eurostat; except: ** ECDC

The health strategy included in the recovery and resilience plan (RRP) aims to address staff shortages. It aims to do so by decreasing reliance on foreign health professionals. Furthermore, the Gesundheitsdösch 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 of EUR 1.2 million (1.3% of the RRP's total value) helped improve telemedicine and will set up an electronic register of health professionals.

This Annex showcases the economic and social regional dynamics in Luxembourg, providing an update on economic, social and territorial cohesion in the country compared with the EU as a whole and the main regional economic recovery challenges.

Luxembourg has the highest GDP per capita (in PPS) in the EU, but its leading position has steadily eroded during the last decade. Its GDP level per capita was to 268% of the EU average in 2021 but had gradually decreased from its historical high of 283% in 2014. Real GDP per capita contracted by around 0.05% per annum on average in 2011-2020 but grew at a rate of 0.6% per year in the EU as a whole.

This is partly explained by the increase in population, which grew by around 2.1% per annum in 2011-2020 – while real GDP also grew by 2.1% per annum during the same period –, much faster than the EU population average growth of 1%. A substantial share of that growth was due to net migration.

Labour productivity has also steadily decreased. Low and declining R&D intensity (1.02% in 2021; 1.42% in 2011) remains an obstacle to achieving the much-needed diversification of the economy (see Annex 11). Labour productivity was much higher than in the rest of the EU (at 164% of the EU average in 2020) but decreased by an average of 0.6% per year during the last decade whilst the overall EU-27 growth rate was 0.2%.

Nevertheless, Luxembourg is classified as a strong innovator in the European Innovation Scoreboard. Similarly, it ranks well above the EU average in the Regional Competitiveness Index 2022 with a score of 125.1.

Luxembourg's trade openness, financial integration in the EU and labour intensity explain this trend. In particular, Luxembourg's central location in the EU and at the heart of the 'Greater Region' made up of German, Belgian and French regions enables it to attract not only commuters but also permanent residents.

Significant socio-economic disparities persist within Luxembourg between its different territories. In 2021, the unemployment rate in towns and suburbs was higher at 6.2% than in

cities (5.1%) and rural areas (4.3%). There are very significant differences in terms of educational attainment. Almost 78% of the population has a tertiary degree in cities but this share drops to 43% in towns and suburbs, and in rural areas. The share of NEETs⁽¹¹⁶⁾ is also higher in towns and suburbs, and rural areas (Table A17.1).

The incidence of poverty is higher in towns and suburbs, where 24.7% of the population was at risk of poverty or social exclusion in 2021, compared with 20.6% in cities and 16.3% in rural areas.

The COVID-19 pandemic heavily affected health conditions in Luxembourg, with significant excess mortality attributed to the disease. The impact on the economy was significant with GDP growth dropping from 2.3% in 2019 to -0.8% in 2020. The unemployment rate, which had been stable at around 5.5% in recent years, increased significantly to 6.8% in 2020. Luxembourg's economy has rapidly rebounded, however, with GDP growth increasing to 5.1% and unemployment dropping back to 5.3% in 2021.

Luxembourg has significantly reduced its greenhouse gas (GHG) emissions in recent decades. GHG emissions per capita were more than 56% lower in 2021 than in 1990. However, Luxembourg still has one of the highest levels of in the EU.

Table A17.1: **Selected indicators in Luxembourg**

	Unemployment rate (%) (2020)	Population (ages 25-64) with tertiary education % (2020)	Young people neither in employment nor in education and training % (2020)	At-risk-of-poverty or social exclusion % (2020)
Cities	5.1	77.5	8.1	20.6
Towns and suburbs	6.2	43.3	9.4	24.7
Rural areas	4.3	43.2	8.7	16.3

Source: Eurostat

⁽¹¹⁶⁾NEETs are defined as young people (aged 20-34) neither in employment nor in education and training. It is measured as a percentage of the total population aged 20-34.



Luxembourg has the largest investment-fund sector in the EU, with EUR 5.1 trillion in assets under management in 2022.

Luxembourg is an important international financial centre. The financial sector contributes about 23% to the country's GDP and accounts for about 10.5% of total employment. In particular, it has the largest investment-fund sector in the EU, thanks to its status as the main European – and one of the largest global – fund domiciles.

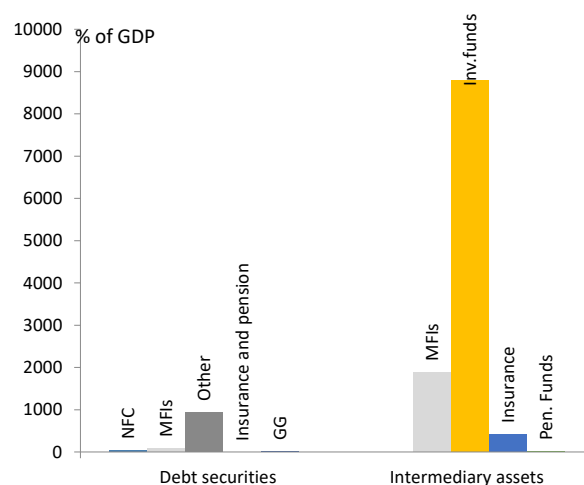
Russia's war on Ukraine put the resilience of Luxembourg's fund industry to the test.

The direct exposure of Luxembourg's investment funds to Russian and Ukrainian assets was relatively small at the beginning of the war (0.3% of total assets in February 2022). Nonetheless, fund managers exposed to Russian assets started to offload these assets from their portfolios almost immediately. This meant that the number of Russian shares and bonds held by funds domiciled in Luxembourg was already very small by mid-2022. A negligible number of funds with larger investments in companies listed in Russia had to temporarily suspend redemptions or segregate those assets that had become illiquid. But overall, the implementation of these exceptional liquidity-management tools was successful, and a wider crisis of confidence in the investment-fund sector was averted. As a result of the drawdowns, the net asset value of Luxembourg's investment funds decreased by more than 12% between end-2021 and end-2022. Still, these drawdowns did not unleash a wider 'fire sale' of funds' portfolio securities, and funds saw only manageable outflows following the Russian invasion.

Luxembourg's banks are appropriately capitalised and have outstanding asset quality, but their profitability is structurally low. Luxembourg's banks are adequately capitalised and liquid with very sound balance sheets. The non-performing-loan ratio of 0.7% in Q3-2022 is the lowest in the EU, and banks' aggregate core equity tier 1 ratio of 17.0% is well above regulatory requirements. However, with a return on equity of 5.6% (Q3 2022), the banking sector's profitability is structurally low and below the EU average of 6.1%. Banks could increase their profitability in the future by making more investments in digitalisation projects to lower their operating costs. In 2021, Luxembourg ranked above the EU average for the number of people

who had used the internet in the last 3 months for internet banking (72% vs an EU average of 65%), according to the European Commission's Digital Scoreboard. The use of e-banking services in Luxembourg has picked up in the wake of the COVID-19 pandemic. Nevertheless, banks will still need to scale up their digitalisation efforts to keep up with the rapid rate of technological progress and to better serve their clients.

Graph A18.1: **Size of the financial intermediaries and of the debt securities market in Luxembourg, end-2021**



Source: ECB, EIOPA, AMECO.

The exposure of some domestic banks to the housing market is significant and a matter of concern. The rapid pace of house-price growth could pose a threat to the country's financial stability due to the high level of household indebtedness. House prices in Luxembourg more than doubled between 2010 and 2022, a rise that is well above the EU's average growth of 39% in the same period. As a result, household indebtedness relative to GDP has also grown rapidly in Luxembourg in recent years. High household indebtedness increases the system's vulnerability to shocks, particularly if there are further increases in interest rates. This could be problematic for those Luxembourgish banks with above average housing exposure. To rein in mortgage lending by banks, the central bank introduced loan-to-value (LTV) ceilings in January 2021. This measure has had positive results, as the weighted average LTV for new loans has improved, and the share of riskier loans to lower income households has decreased somewhat. However, debt-service-to-income and debt-to-

Table A18.1: **Financial soundness indicators**

	2017	2018	2019	2020	2021	2022	EU	Median
Total assets of the banking sector (% of GDP)	1784.7	1787.8	1863.5	1928.0	1915.4	1771.1	276.8	207.9
Share (total assets) of the five largest banks (%)	26.2	26.3	27.7	31.3	29.6	-	-	68.7
Share (total assets) of domestic credit institutions (%) ¹	13.2	13.0	12.8	14.1	13.5	13.5	-	60.2
NFC credit growth (year-on-year % change)	3.2	4.5	4.9	-1.6	-4.5	0.5	-	9.1
HH credit growth (year-on-year % change)	7.8	7.3	2.6	7.7	10.1	7.9	-	5.4
Financial soundness indicators:¹								
- non-performing loans (% of total loans)	0.7	0.8	0.6	0.7	0.6	0.7	1.8	1.8
- capital adequacy ratio (%)	22.5	21.4	19.7	21.7	20.5	18.0	18.6	19.8
- return on equity (%) ²	5.7	5.5	5.2	4.4	5.5	5.6	6.1	6.6
Cost-to-income ratio (%)¹	56.0	59.3	62.2	61.6	61.2	54.0	60.6	51.8
Loan-to-deposit ratio (%)¹	76.6	75.6	76.5	62.4	55.6	57.4	88.6	78.0
Central bank liquidity as % of liabilities	0.9	0.8	0.6	1.1	1.8	1.0	-	2.9
Private sector debt (% of GDP)	281.2	280.6	310.8	320.3	340.6	-	-	120.7
Long-term interest rate spread versus Bund (basis points)	22.6	16.9	13.2	9.7	1.7	58.6	-	93.3
Market funding ratio (%)	62.4	62.1	61.7	63.3	62.3	-	50.8	40.0
Green bonds issued to all bonds (%)	0.2	0.3	0.4	1.1	1.9	2.3	3.9	2.3
	1-3	4-10	11-17	18-24	25-27	Colours indicate performance ranking among 27 EU Member States.		

(1) Last data: Q3 2022.

(2) Data is annualized.

Source: ECB, Eurostat, S&P Global Capital IQ Pro**Source:**

income ratios remain high which is of concern as borrowers' real disposable incomes are eroded by higher inflation at the same time.

Luxembourg's stock exchange has established itself as one of the leading trading venues for sovereign and sustainability-linked bonds worldwide.

Besides its leading investment-fund industry, Luxembourg has also one of the largest secondary markets for bonds in the world, and it has positioned itself as the preferred listing destination for bonds issued by international public bodies, sovereigns and public agencies. By contrast, Luxembourg's stock exchange for equities is rather small by EU standards. In addition, Luxembourg is one of the leading trading venues for listed green and social bonds. In 2016, the stock exchange created the Luxembourg Green Exchange. As at November 2022, the Luxembourg Green Exchange encompassed over 3 160 sustainable securities, with a total value of EUR 840 billion from issuers in 50 countries (¹¹⁷). Luxembourg is also one of the largest markets for sustainable fund products, in line with its positioning as the largest European fund hub, with EUR 2.2 trillion of green assets under management and over 2 000 green funds by end-2022 (¹¹⁸). Asset managers domiciled in Luxembourg managed about one third of all the

net assets of sustainable funds domiciled in Europe. But as global demand for sustainability-related investment funds grows, so too does the risk of 'greenwashing'. It is important to mitigate this risk not only to avoid legal claims against managers and reputational damage, but also to increase investor confidence in the market for sustainability-related products.

Luxembourg is one of the largest bases of the European life-insurance industry, and a major hub for the cross-border distribution of life-insurance products.

Luxembourg is the eighth largest domicile of life-insurance businesses in the EU by gross premiums written (EUR 13.3 bn by mid-year 2022). In 2021, 40% of gross insurance-premium income came from cross-border life-insurance policies, of which 45% were for French nationals. Life insurers are well capitalised, although their ratio of own funds to the solvency capital requirement of 173.2% was below the EU average of 298.4% in Q2-2022. On investment portfolios, life insurers have very little investment in property, and most of their assets are invested across the EU, with little home bias. As is the case elsewhere in the EU, the unexpectedly high levels of inflation are likely to generate significant losses in non-life insurance businesses in Luxembourg. Higher expenses from claims costs, which are directly linked to inflation, will probably outweigh the benefit from higher premium rates.

(¹¹⁷) Luxembourg Stock Exchange, November 2022.

(¹¹⁸) Sustainable Finance in Luxembourg – A quantitative and qualitative overview (2022), LSFI & PWC Luxembourg.

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 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 were slightly below the EU aggregate in 2022 (38.5% and 40.6% respectively). Luxembourg's tax revenues from personal (PIT) and corporate (CIT) income taxes account for 38.0% of all tax revenues (including social contributions) – substantially more than the average share of PIT and CIT in total tax revenues for the EU-27 (31.2%).⁽¹¹⁹⁾ Revenues from consumption and environmental taxes as a share of GDP were among the lowest in the EU. The latter indicates that the 'polluter pays' principle can be better applied (see also Annex 6). Moreover, the Luxembourg government has acted to mitigate the effects of inflation by temporarily reducing VAT-rates by one percentage point from 1 January 2023 to 31 December 2023.] Revenues from capital taxes as a share of GDP are the highest in the EU. Revenues from property taxes in general are relatively high, but revenues from recurrent property taxes, which are particularly conducive to growth, are among the lowest in the EU.

Luxembourg's income tax burden is relatively low across the income distribution. Graph A19.1 shows that for Luxembourg the tax wedge in 2022 was lower than the EU average at lower income levels, i.e. for single earners at 50% and 67% of the average wage, while equal to the EU average at 100% and higher than it at 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.⁽¹²⁰⁾ While

labour taxes are more progressive than the EU average, the tax-benefit system as a whole has a relatively small impact in reducing income inequality as measured by the Gini coefficient.

Luxembourg is doing moderately well on digitalisation of the tax administration, which can help reduce tax arrears and the VAT gap. Outstanding tax arrears marginally increased by 0.1 percentage point between 2019 and 2020 to 12.9% of total net revenue. This is significantly below the EU-27 average, which increased by 9.1 percentage points over the same period to 40.7% – although that figure is inflated by very large values in a few Member States. The VAT gap (an indicator of the effectiveness of VAT enforcement and compliance, where a low gap indicates high effectiveness) in Luxembourg decreased from 9.7% in 2019 to 6.0% in 2020. Values for both 2019 and 2020 were well below the EU aggregate and also the reduction between the 2 years was more pronounced in Luxembourg. The forward-looking effective average corporate income tax rate was well above the EU average in 2021, but aggressive tax planning may substantially reduce the tax burden.

There appears to be a high risk of aggressive tax planning in Luxembourg. In 2021, Luxembourg was ranked fourth worldwide in terms of inward foreign direct investment (FDI) stock – behind the US, China and the Netherlands but ahead of the UK – and third in terms of outward investment – behind the US and the Netherlands but ahead of China. Luxembourg's inward FDI stock of USD 3 327 bn and outward FDI stock of USD 3 392 bn are about 40 and 50 times the size of its GDP respectively⁽¹²¹⁾. Around 70% of Luxembourg's both inward it's and outward stock is held through special purpose entities (SPEs) (see Graph A19.2). By comparison, less than 20% of both the inward and outward FDI stock in the other 26 Member States is held through SPEs. Luxembourg is also a major conduit for dividend and interest flows (see Graph A19.2). It receives 21% of the total amount of dividends received by the EU-27 and is the source of 21% of the total amount of the dividends paid by the EU-27. It also receives around 40% of all interest received by the EU-27 and is the origin of around 38% of all interest paid by the EU-27 (2021). Luxembourg is

⁽¹¹⁹⁾See European Commission, Directorate-General for Taxation and Customs Union, Taxation trends in the European Union: data for the EU Member States, Iceland, Norway and United Kingdom: 2021 edition, Publications Office of the European Union, 2021, <https://data.europa.eu/doi/10.2778/843047>

⁽¹²⁰⁾For the methodology of the tax wedge for second earners see OECD (2016) "Taxing Wages 2014-2015" (https://www.oecd-ilibrary.org/sites/tax_wages-2016-4-

en/index.html?itemId=/content/component/tax_wages-2016-4-en)

⁽¹²¹⁾OECD data

Table A19.1: **Taxation indicators**

		Luxembourg					EU-27				
		2010	2019	2020	2021	2022	2010	2019	2020	2021	2022
Tax structure	Total taxes (including compulsory actual social contributions) (% of GDP)	35.7	39.6	38.2	38.5	38.4	37.9	39.9	40.0	40.6	
	Labour taxes (as % of GDP)	15.8	18.4	18.8	18.3		20.0	20.7	21.3	20.9	
	Consumption taxes (as % of GDP)	9.9	8.9	8.3	8.8		10.8	11.1	10.7	11.2	
	Capital taxes (as % of GDP)	10.0	12.4	11.0	11.5		7.1	8.1	8.0	8.5	
	Total property taxes (as % of GDP)	1.0	2.4	2.5	2.6		1.9	2.2	2.2	2.2	
	Recurrent taxes on immovable property (as % of GDP)	0.1	0.1	0.1	0.1		1.1	1.2	1.2	1.1	
	Environmental taxes as % of GDP	2.3	1.8	1.4	1.4		2.4	2.4	2.2	2.2	
Progressivity & fairness	Tax wedge at 50% of average wage (Single person) (*)	25.3	24.4	25.8	26.1	26.6	33.9	32.3	31.9	32.1	31.7
	Tax wedge at 100% of average wage (Single person) (*)	35.3	38.5	39.5	39.8	40.4	41.0	40.1	39.9	39.7	39.7
	Corporate income tax - effective average tax rates (1) (*)			23.2	23.2	23.2		19.5	19.4	19.1	
	Difference in Gini coefficient before and after taxes and cash social transfers (pensions excluded from social transfers) (2) (*)	9.7	5.2	6.9	5.3		8.6	7.7	8.1	7.8	
Tax administration & compliance	Outstanding tax arrears: total year-end tax debt (including debt considered not collectable) / total revenue (in %) (*)		12.8	12.9				31.6	40.7		
	VAT Gap (% of VAT total tax liability, VTTL)		9.7	6.0				11.0	9.1		

(1) Forward-looking effective tax rate (OECD).

(2) A higher value indicates stronger redistributive impact of taxation.

(*) EU-27 simple average

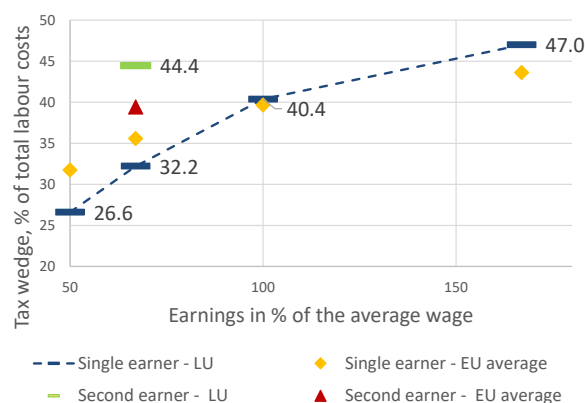
For more data on tax revenues as well as the methodology applied, see European Commission, Directorate-General for Taxation and Customs Union, *Taxation trends in the European Union: data for the EU Member States, Iceland, Norway and United Kingdom: 2021 edition*, Publications Office of the European Union, 2021, <https://data.europa.eu/doi/10.2778/843047> and the *Data on Taxation* webpage, https://ec.europa.eu/taxation_customs/taxation-1/economic-analysis-taxation/data-taxation_en.

For more details on the VAT gap, see European Commission, Directorate-General for Taxation and Customs Union, *VAT gap in the EU: report 2022*, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2778/109823>.

Source: European Commission, OECD.

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⁽¹²²⁾, 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. This should help to reduce the risk of aggressive tax planning, but its scope is limited to the EU list of non-cooperative jurisdictions which are not among Luxembourg's main economic partners and does not specifically target low or zero tax jurisdictions. Luxembourg's other measures have been limited to implementing EU legislation and Council conclusions. Moreover, the OECD Pillar 2 rules on a global minimum corporate tax-rate are yet to be implemented in the EU. It will help address the outbound payment issue in Luxembourg but will not fully address it because its scope is limited to the largest multinationals

(threshold of €750 million) and certain sectoral exemptions exist.

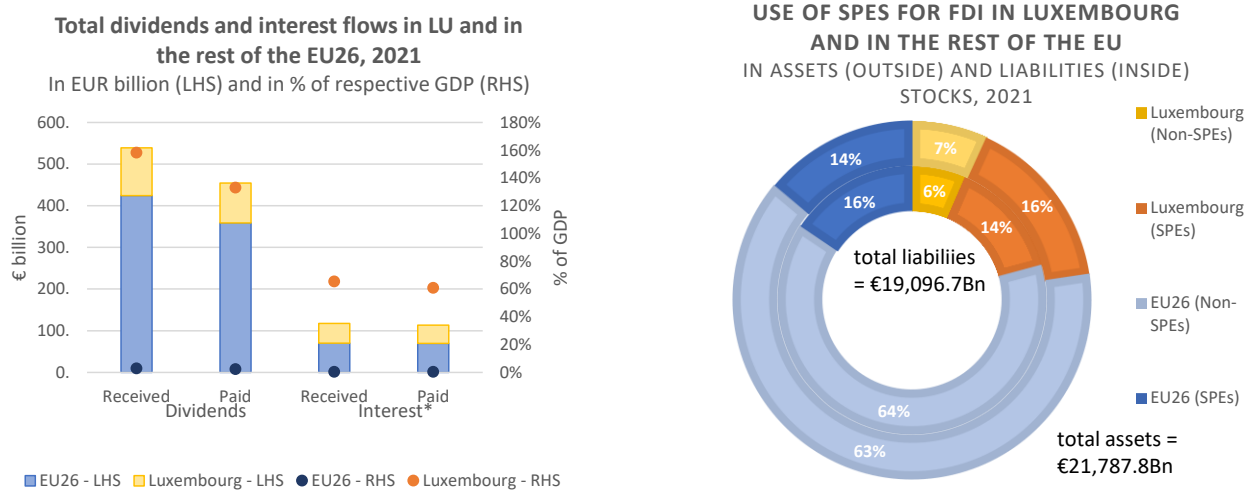
Graph A19.1: **Tax wedge for single and second earners as a % of total labour costs, 2022**

Second earner tax wedge assumes first earner at 100% of the average wage and no children.

Source: European Commission

⁽¹²²⁾ Aggressive tax planning (ATP) is by nature an opaque phenomenon, and the figures provided cannot constitute a proof in themselves. However, substantial discrepancies in macroeconomic data are indicators that ATP may be taking place. The sharing of more accurate data by Luxembourg's authorities (particularly on the source and destination jurisdictions of certain flows) would make it easier to distinguish data linked to legitimate financial activities from data linked to ATP.

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

ANNEX 20: TABLE WITH ECONOMIC AND FINANCIAL INDICATORS



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

	2004-07	2008-12	2013-19	2020	2021	2022	forecast	
							2023	2024
Real GDP (y-o-y)	5.2	0.6	2.6	-0.8	5.1	1.5	1.6	2.4
Potential growth (y-o-y)	3.8	2.2	2.2	1.9	1.9	2.2	2.3	2.3
Private consumption (y-o-y)	1.8	2.4	2.6	-7.3	9.5	2.8	2.4	2.7
Public consumption (y-o-y)	1.7	3.6	2.9	7.8	5.4	3.8	3.7	2.3
Gross fixed capital formation (y-o-y)	4.4	2.8	1.4	-3.6	6.7	-0.5	-2.9	1.6
Exports of goods and services (y-o-y)	8.3	1.6	4.4	0.2	9.7	-0.6	2.6	3.6
Imports of goods and services (y-o-y)	7.3	2.9	4.8	-0.4	11.8	-0.9	2.7	3.8
Contribution to GDP growth:								
Domestic demand (y-o-y)	1.8	1.9	1.6	-1.7	5.0	1.4	0.9	1.5
Inventories (y-o-y)	0.1	-0.1	0.2	-0.3	0.4	-0.1	0.0	0.0
Net exports (y-o-y)	3.3	-1.3	0.8	1.2	-0.3	0.2	0.7	0.9
Contribution to potential GDP growth:								
Total Labour (hours) (y-o-y)	1.9	1.3	1.6	1.4	1.4	1.9	2.2	2.1
Capital accumulation (y-o-y)	1.3	1.3	1.0	0.7	0.8	0.7	0.6	0.6
Total factor productivity (y-o-y)	0.6	-0.3	-0.4	-0.2	-0.3	-0.5	-0.5	-0.4
Output gap	1.3	-1.5	-0.7	-3.2	-0.1	-0.8	-1.5	-1.4
Unemployment rate	4.6	4.9	5.9	6.8	5.3	4.6	4.8	5.0
GDP deflator (y-o-y)	4.1	3.8	1.7	4.7	6.2	6.4	5.5	3.4
Harmonised index of consumer prices (HICP, y-o-y)	3.2	2.7	1.2	0.0	3.5	8.2	3.2	2.6
HICP excluding energy and unprocessed food (y-o-y)	2.5	2.4	1.6	1.4	1.5	4.4	5.1	3.2
Nominal compensation per employee (y-o-y)	4.0	2.2	2.2	1.2	6.0	5.4	6.9	3.4
Labour productivity (real, hours worked, y-o-y)	1.9	-1.1	-0.2	3.4	-2.0	-2.3	-1.8	-0.9
Unit labour costs (ULC, whole economy, y-o-y)	2.2	4.3	2.6	3.8	3.9	7.4	7.8	3.3
Real unit labour costs (y-o-y)	-1.8	0.5	0.9	-0.8	-2.2	0.9	2.2	-0.1
Real effective exchange rate (ULC, y-o-y)	1.0	2.1	1.4	-0.4	3.5	3.6	1.9	-0.2
Real effective exchange rate (HICP, y-o-y)	1.2	0.4	0.3	0.1	0.8	-1.1	.	.
Net savings rate of households (net saving as percentage of net disposable income)	5.2	6.1	7.9	19.1	12.4	.	.	.
Private credit flow, consolidated (% of GDP)	40.4	5.1	15.0	42.9	53.9	.	.	.
Private sector debt, consolidated (% of GDP)	218.0	287.4	300.6	320.3	340.6	.	.	.
of which household debt, consolidated (% of GDP)	46.2	55.1	61.5	68.5	66.0	.	.	.
of which non-financial corporate debt, consolidated (% of GDP)	171.8	232.3	239.1	251.7	274.6	.	.	.
Gross non-performing debt (% of total debt instruments and total loans and advances) (1)	.	.	0.7	0.6	0.5	.	.	.
Corporations, net lending (+) or net borrowing (-) (% of GDP)	7.2	0.5	-1.0	-0.4	0.7	1.8	4.6	5.6
Corporations, gross operating surplus (% of GDP)	28.6	30.9	30.7	29.3	30.0	30.6	31.6	31.7
Households, net lending (+) or net borrowing (-) (% of GDP)	-0.2	0.2	0.6	6.1	2.8	2.8	3.8	2.7
Deflated house price index (y-o-y)	8.1	1.2	4.8	13.1	12.4	3.8	.	.
Residential investment (% of GDP)	3.2	3.2	3.8	3.8	3.3	3.2	.	.
Current account balance (% of GDP), balance of payments	6.8	5.7	4.5	3.2	4.6	5.0	6.1	5.9
Trade balance (% of GDP), balance of payments	29.6	36.5	39.5	32.7	34.7	28.4	.	.
Terms of trade of goods and services (y-o-y)	0.0	1.1	-0.1	1.7	1.2	-0.3	0.6	0.3
Capital account balance (% of GDP)	0.4	-0.4	0.0	-0.1	1.2	0.5	.	.
Net international investment position (% of GDP)	10.1	12.1	65.3	63.9	40.4	28.2	.	.
NENDI - NIIP excluding non-defaultable instruments (% of GDP) (2)	.	.	-3543.9	-4148.8	-4638.1	-3767.0	.	.
IIP liabilities excluding non-defaultable instruments (% of GDP) (2)	.	.	10012.5	10869.0	11424.0	9551.8	.	.
Export performance vs. advanced countries (% change over 5 years)	26.6	16.5	16.0	18.4	19.0	.	.	.
Export market share, goods and services (y-o-y)	4.5	-1.3	3.4	15.4	-0.9	-4.3	-0.1	-0.2
Net FDI flows (% of GDP)	.	.	56.4	-32.2	173.6	47.6	.	.
General government balance (% of GDP)	1.2	0.8	1.7	-3.4	0.7	0.2	-1.7	-1.5
Structural budget balance (% of GDP)	.	.	2.0	-2.0	0.8	0.5	-1.1	-0.8
General government gross debt (% of GDP)	8.0	17.7	21.5	24.5	24.5	24.6	25.9	27.0

(1) Domestic banking groups and stand-alone banks, EU and non-EU foreign-controlled subsidiaries and EU and non-EU foreign-controlled branches.

(2) Net international investment position (NIIP) excluding direct investment and portfolio equity shares.

Source: Eurostat and ECB as of 2 May 2023, where available; European Commission for forecast figures (Spring forecast 2023).

This Annex assesses fiscal sustainability risks for Luxembourg over the short, medium and long term. It follows the same multi-dimensional approach as the European Commission's 2022 Debt Sustainability Monitor, updated based on the Commission's 2023 spring forecast.

1 - Short-term risks to fiscal sustainability are low overall. The Commission's early-detection indicator (S0) does not signal major short-term fiscal risks (Table A21.2).⁽¹²³⁾ Gross financing needs are expected to remain limited at around 6% of GDP in the short-term (i.e. over 2023-2024) and declining since 2020 (Table A21.1, Table 1). Financial markets' perceive sovereign risk to be low, as confirmed by the 'AAA' rating that the three major rating agencies assigned to Luxembourg's government debt.

2 - Medium-term risks to fiscal sustainability are low overall.

The DSA for Luxembourg shows that, under the baseline, the government debt-to-GDP ratio is expected to remain well below 60% of GDP (at 33.4% of the GDP in 2033), although increasing over the medium term (Graph 1).⁽¹²⁴⁾,⁽¹²⁵⁾ The assumed structural primary balance (a deficit of 0.5% of GDP) seems low compared to past fiscal performance, indicating ample room for correction action. At the

same time, the baseline projections up to 2033 benefit from a favourable (although diminishing) snowball effect, with real GDP growth at around 2.1% of GDP over 2025-2033. Government gross financing needs are expected to remain limited over the projection period, reaching 5% of GDP in 2033, close to the level forecast for 2024.

The baseline projection is stress-tested against four alternative scenarios to assess the impact of changes in key assumptions (Graph Ax.1). For Luxembourg, reverting to historical trajectories under the 'historical structural primary balance (SPB)' scenario would support debt reduction. If the SPB gradually converged to a surplus of 1.9 % of GDP (its historical 15-year average), the projected debt-to-GDP would be lower (by around 15 pps.) than in the baseline in 2033. Reducing the SPB level permanently by half of the cumulative forecast change under the 'lower structural primary balance' scenario would lead to a higher government debt-to-GDP ratio by 2033 (about 4 pps.) as compared with the baseline. A permanent worsening of the macro-financial conditions, as reflected under the 'adverse interest- growth rate differential' scenario (i.e. 1 pp. higher than the baseline) would also lead to higher government debt-to-GDP ratio (around 2 pps.) by 2033, as compared with the baseline. A temporary worsening of financial conditions, as reflected in the 'financial stress' scenario (i.e. temporarily increase of interest rates by 1 pp.), would provide a broadly similar, though slightly higher, public debt-to-GDP ratio by 2033 compared with the baseline.

Additionally, stochastic projections show a low risk related to these projections against plausible unforeseen events (Graph 2).⁽¹²⁶⁾ These stochastic simulations point to a 60% probability of the debt ratio in 2027 being greater than in 2022, entailing low risk given the initial low debt level. In addition, such shocks point to limited uncertainty (i.e. the difference between the 10th and 90th debt distribution percentiles) surrounding the government debt baseline projections.

⁽¹²³⁾The S0 is a composite indicator of short-term risk of fiscal stress. It is based on a wide range of macro-financial and fiscal variables that have proven to perform well in the past in detecting situations of upcoming fiscal stress.

⁽¹²⁴⁾The assumptions underlying the Commission's 'no-fiscal policy change' baseline notably comprise: (i) a structural primary deficit, before ageing costs, of 0.5% of GDP as of 2024; (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 from now); (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 2023 spring forecast until 2024, followed by EPC/OGWG 'T+10 methodology projections between T+3 and T+10, i.e. for 2025-2033 (on average 2.1%); (v) ageing costs in line with the 2021 Ageing Report (European Commission, Institutional Paper 142, November 2020). For information on the methodology, see the 2022 Debt Sustainability Monitor.

⁽¹²⁵⁾Table 1 shows the baseline debt projections and its breakdown into the primary balance, the snowball effect (the combined impact of interest payments and nominal GDP growth on the debt dynamics) and the stock-flow adjustment.

⁽¹²⁶⁾The stochastic projections show the joint impact on debt of 2000 different shocks affecting the government's budgetary position, economic growth, interest rates and exchange rates. The cone covers 80% of all the simulated debt paths, therefore excluding tail events.

3 - Long-term risks to fiscal sustainability are high overall. ⁽¹²⁷⁾

The S2 indicator (at 8.4 pps. of GDP) points to high fiscal sustainability risks. The indicator shows that, relative to the baseline, the SPB would need to significantly improve to ensure debt stabilisation over the long term. This result is underpinned by the projected increase in ageing-related costs over the projection period (contribution of 7.7 pps. of GDP). Public pension expenditure (contribution of 6.0 pps. of GDP) are projected to substantially increase, as well as – to a lower extent – health and long-term care spending (joint contribution of 2.1 pps. of GDP) (Table 2).

Combined with some long-term debt vulnerabilities, as highlighted by the S1 indicator, overall long-term risks are assessed as high. Indeed, the S1 sustainability gap indicator signals that a moderate consolidation effort of 4.3 pps. of GDP would be needed to bring debt to 60% of GDP by 2070. This result is mainly driven by the projected increase of ageing-related public expenditure (contribution of 4.5 pps. of GDP), in particular due to pension spending (contribution of 3.7 pps. of GDP) and to a lesser extent health care and long-term care spending (joint contribution of 1.3 pps. of GDP), while being only partly offset by the debt requirement (-0.7 pp. of GDP) (Table 2).

Finally, several additional risk factors need to be considered in the assessment. On one hand, risk-increasing factors are related to the recent increase in interest rates and the contingent liability risks stemming from State guarantees provided to the private sector. The possible materialisation of calls under the State guarantees

granted on bank loans to firms and self-employed during the COVID-19 and energy crises remain currently limited. Overall, contingent liabilities appear significant, including those stemming from the banking sector. Moreover, because pension fund surpluses are added to the pension reserve fund and therefore result in positive stock-flow adjustments that limit debt reduction is. On the other-hand, risk-mitigating factors include the lengthening of debt maturity in recent years, relatively stable financing sources (with a diversified and large investor base), the currency denomination of debt and the AAA-rating. Luxembourg's positive net international investment position also mitigates vulnerabilities, as well as the positive net financial asset position of the government. In addition, the structural reforms under the NGEU/RRF, if fully implemented, could have a further positive impact on GDP growth in the coming years, and therefore help to mitigate debt sustainability risks.

⁽¹²⁷⁾The S2 fiscal sustainability gap indicator measures the permanent fiscal effort (SPB adjustment) in 2024 that would be required to stabilise public debt over the long term. It is complemented by the S1 fiscal sustainability gap indicator, which measures the permanent fiscal effort required in 2024 to bring the debt-to-GDP ratio to 60% in the long term (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 pps. of GDP, 'medium risk' if it lies between 2 pps. and 6 pps. of GDP, and 'low risk' if the effort is negative or below 2 pps. of GDP. The overall long-term risk classification brings together the risk categories derived from S1 and S2. S1 may notch up the risk category derived from S2 when it signals a higher risk than S2. See the 2022 Debt Sustainability Monitor for further details.

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

Table 1. Baseline debt projections	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Gross debt ratio (% of GDP)	24.5	24.5	24.6	25.9	27.0	26.9	26.8	26.7	27.1	27.9	28.9	30.2	31.8	33.4
Changes in the ratio of which	2.1	0.0	0.1	1.3	1.1	-0.1	-0.1	-0.1	0.4	0.8	1.0	1.3	1.5	1.7
Primary deficit	3.2	-0.9	-0.3	1.5	1.1	1.0	1.0	1.0	1.2	1.4	1.6	1.8	1.9	2.1
Snowball effect	-0.6	-2.4	-1.7	-1.4	-1.1	-1.1	-1.1	-1.0	-0.7	-0.6	-0.5	-0.5	-0.4	-0.5
Stock-flow adjustments	-0.5	3.3	2.1	1.2	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gross financing needs (% of GDP)	7.4	2.7	3.6	5.9	5.5	4.4	4.3	4.2	4.3	4.4	4.6	4.7	4.9	5.3

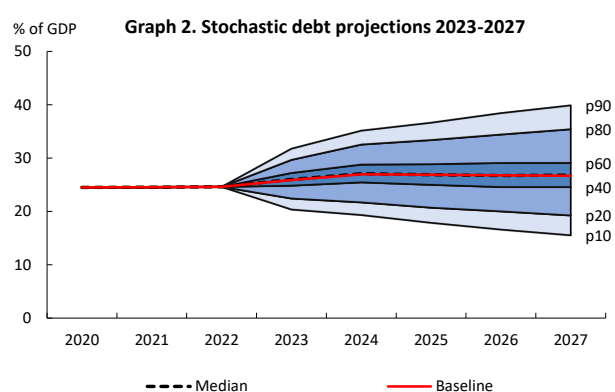
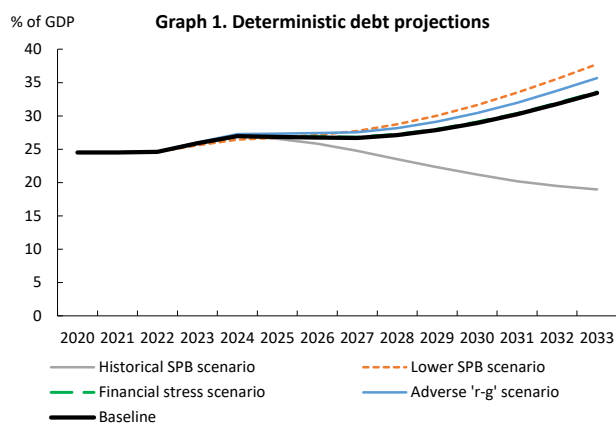


Table 2. Breakdown of the S1 and S2 sustainability gap indicators

	S1	S2
Overall index (pps. of GDP)	4.3	8.4
of which		
Initial budgetary position	0.4	0.8
Debt requirement	-0.7	
Ageing costs	4.5	7.7
of which		
Pensions	3.7	6.0
Health care	0.6	0.9
Long-term care	0.7	1.2
Others	-0.4	-0.4

Source: Commission services.

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

Short term	Medium term - Debt sustainability analysis (DSA)							Long term		
Overall (S0)	Overall	Deterministic scenarios					Stochastic projections	S2	S1	Overall (S1 + S2)
		Baseline	Historical SPB	Lower SPB	Adverse 'r-g'	Financial stress				
LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	HIGH	MEDIUM	HIGH
		33.4	19.0	37.7	35.7	33.6				
		2033	2024	2033	2033	2033				
		100%	82%	100%	100%	100%				
							60%			
							24.3			

(1) *Debt level* in 2033. 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 2027 its 2022 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 2000 different shocks. Green, yellow and red cells indicate increasing uncertainty.

Source: Commission services (for further details on the Commission's multidimensional approach, see the 2022 Debt Sustainability Monitor)

The Macroeconomic Imbalance Procedure matrix presents the main elements of the in-depth review undertaken for Luxembourg. ⁽¹²⁸⁾ Luxembourg was selected for an in-depth review in the 2023 Alert Mechanism Report. This in-depth review on the prevention and correction of macroeconomic imbalances presents the main findings on the gravity and evolution of the challenges identified, as well as policy responses and potential policy needs. Findings cover all areas of vulnerability assessed in the in-depth review.

Luxembourg is facing increasing vulnerabilities related to high house prices and high household debt. House prices in Luxembourg have historically increased faster than in the euro area, sustained by strong migration inflows, with housing supply persistently lagging demand. Between 2012 and 2022, house prices increased by 118% (44% in the euro area), with half of this increase taking place over the last four years. Over the same period, population increased by around 30% (5% in the euro area), more than 7000 households per year. Meanwhile, the production of new dwellings was below 4000 units per year, resulting in a high housing shortage, which is partly mitigated by the cross-border housing market. In 2022, a slowdown in house price growth was observed following the tightening of financing conditions; although annual growth was still 10%, house prices declined in the fourth quarter. Mortgage credit increased steadily, with household debt reaching 180% of disposable income in 2022. High fiscal support to home ownership, including deductibility of mortgage interest, partly explained the higher credit growth compared to other Member States. Furthermore, given the persistent housing shortage, tax relief and subsidies can be capitalised into higher house prices.

While house price growth should moderate in the near future, structural drivers are likely to continue driving house prices up over the medium term. Structural demand pressures and supply constraints have been key drivers underlying the strong long-lasting trend of house price growth over the last decade. In the short

term, cyclical factors should drive a moderation in house price growth, as mortgage interest rates rise and real household income growth moderates due to inflation. The risk for banks is mitigated because a large share of debt is owed by wealthy households. Furthermore, the proportion of mortgages at adjustable rates has decreased in recent years and stands around 40%. Most of this debt is held by five domestically oriented banks, in general banks are well capitalised and liquid, while buffers appear sufficient to absorb potential shocks. With the level of credit-to-GDP remaining below its long-term trend, these vulnerabilities are expected to entail a low associated risk. Luxembourg activated both capital and borrower-based (loan-to-value limits) macroprudential measures with effect from 1 January 2021, which seem to have had some dampening effect on household debt.

Luxembourg implemented measures in response to the continuous house price increases, but further structural challenges remain. The government has presented a package of three tax measures which address the main factors underlying the structural undersupply of housing, land and unoccupied dwellings, and therefore is a step in the right direction. However, it will take a few years to implement. Meanwhile, fiscal support to owner-occupied property was increased in 2023. Fiscal support contributes further to the already high structural demand and elevated household indebtedness, in addition to favouring ownership over rental tenure. The implementation of the reviewed spatial planning policy needs can support supply. While efforts to increase the low share of social and affordability rental housing can reduce the affordability issue. In addition, the densification of urban areas concentrated around transport network centres can encourage the use of public transport. There are additional planned policy measures in the pipeline; the rental market reform and to improve affordability. However, it is too early to assess their effectiveness and impact on the vulnerabilities.

Based on this assessment, the Commission considered in its communication European Semester – 2023 Spring Package (COM(2023) 600 final) that Luxembourg does not experience imbalances.

⁽¹²⁸⁾ European Commission (2023), In-Depth Review for Luxembourg, Commission staff working document (COM(2023) 638 final), in accordance with Article 5 of Regulation (EU) No 1176/2011 on the prevention and correction of macroeconomic imbalances.

Table A22.1: **Assessment of macroeconomic imbalances matrix**

	Gravity of the challenge	Evolution and prospects	Policy response
	Unsustainable trends, vulnerabilities and associated risks		
Household debt	Household debt as percentage of GDP is 65.7% and below the benchmark value in 2022. However, household debt as percentage of disposable income is very high and reached 180% of disposable income in 2022. This is 61% above its long-term average and one of the highest deviations among EU member states. Some 80% of this is mortgage credit, which has increased steadily due to strong house price increases and fiscal support to home ownership, explaining the higher credit growth compared to other Member States. In combination with a large share of variable rate mortgages this increases vulnerabilities.	Household debt to GDP fell to 65.7% in 2022 from 69.5% in 2020. After peaking in 2021Q1, a downward trend was confirmed in subsequent quarters. The same trend applies to household debt as percentage of disposable income which increased strongly in the last two decades from 107% in 2003-2007 to a peak of 180% in 2021-2022. As the housing market seems to have peaked in 2021, cyclical factors are expected to lower this ratio in the short-term although it is expected to remain at relatively high levels in the medium-term. In particular, the demand for new mortgages is projected to continue falling in 2023, while the labour market is expected to remain solid. However, the high inflation environment and the tightening of financing conditions weigh on debt service capacity of households, mainly those with variable rate debt. Several factors can mitigate the risks associated with household debt: a large share of debt is owed by wealthy households and covered by liquid financial assets, around 60% of the mortgages and most granted in recent years have fixed rates. Bank buffers appear sufficient to absorb potential shocks from the residential real estate market and mortgage debt. In addition, the structural supply shortage is expected to support house	Some progress has been made in addressing high household debt. Luxembourg implemented both capital and borrower-based (loan-to-value limits) macroprudential measures with effect from 1 January 2021. These seem to have had a dampening effect considering the decline in the average loan-to-values. No new macro-prudential measures are expected at this stage also because of the cyclical turn in the market due to higher interest rates. However, one of the main drivers of mortgage demand, the fiscal support, has been increased in 2023. The reduction of fiscal support to owner-occupied property can contribute to contain the already high household debt (as % of disposable income). Improving the balance in the housing market, by taking measures not to support demand and to increase supply, contribute to house price moderation and can have a positive impact on household indebtedness.
Housing sector	Between 2012 and 2022, house prices increased by 118% with half of this increase taking place over the last four years. Following the strong economic and demographic dynamics, housing supply (below 4000 units per year) lagged persistently demand (more than 7000 households per year), resulting in a chronic housing shortage, leading to sustained price increases. These long-term price dynamics have led to an overvaluation in the housing market according to the standard metrics and worsening of affordability. Despite the relative abundance of constructible land, supply is a limiting factor for housing. The price of constructible land, which accounts for 20%-40% of the house price, increased by 136.5% in the same period. High ownership concentration enabled by fiscal and institutional frameworks created incentives to hoard land, and to seek profit maximisation through the pace by which land is released and dwellings are placed on the market.	The rise in interest rates has led to a turn in the housing market, with house prices falling in the last quarter of 2022, but a sharp correction in house prices is not expected. While some correction is taking place, the underlying structural drivers should lead to house price increases returning over the medium term. The population increase is estimated at 445,059 inhabitants by 2060, which is required to achieve a 3% GDP growth rate and to ensure the sustainability of the pension system. This corresponds to a potential housing demand between 5,600 and 7,500 units per year. This greatly exceeds the number of dwellings completed, even at the peak year in 2008 (4,444 dwellings). The housing shortage is being partly mitigated by the increasing cross-border housing market, with around 204,6 thousand (42% of employment) persons in 2021 commuting across borders every day, from Germany, France and Belgium. However, this generates other problems. Traffic congestion and transport is the main factor of air pollution and greenhouse gas emissions in Luxembourg. The risks associated with the persistent undersupply of housing may have economic and social consequences for households, public finance and the competitiveness of the national economy in the medium- to long-term.	Some efforts have been made to effectively boost housing supply and address the affordability issue, but structural challenges remain. The government's strategy to address the housing situation consists of two pillars. The first pillar dedicates more resources to increase the supply of affordable and social housing, and to incentivise the mobilization of existing land and dwellings. The second pillar increases assistance to enhance housing affordability. In the first category, the new 'Housing Pact 2.0' is henceforth applicable with the adoption of the Law of 30 July 2021 with the aim of supporting municipalities to increase the availability of affordable and sustainable housing. Moreover, the government has presented a package of tax measures to tackle the housing supply shortage and mobilise existing inventories of dwellings and plots. In December 2021, the government followed up with a draft 'affordable housing law', which is still under discussion in the Parliament, proposes a continuum of affordable and low-cost housing. On 9 November 2020, the government also presented amendments regarding the draft law to reform residential renting tabled on 31 July 2020.

Source: European Commission