LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG

Digital Decade

NATIONAL STRATEGIC ROADMAP FOR LUXEMBOURG

OCTOBER 2023

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Section 1: Analysis of the state of play of digital transformation in the Member State-specific context

Luxembourg fully subscribes to the EU's 2030 objectives and targets for a digital transition, which places human beings at the centre of the digitalization of our European society.

The implementation of the human-centric approach based on European values is translated into concrete actions and measures, as described in this roadmap.

Using the indicators of the Digital Economy and Society Index (DESI) of 2023 and highlighting the main national specificities, this section looks at Luxembourg's digital skills, digital infrastructure, digital transformation of businesses, and digitalisation of public services.

Over the past few years, Luxembourg has seen an increased focus on digital issues and their growing political importance. The country has implemented several strategies and initiatives to improve its digital performance.

Luxembourg stands out in terms of digital skills with 64% (2021) of the population having at least basic digital skills, which is above the EU average of 54% (2021). Nevertheless, Luxembourg has to continue its efforts to reach the European 2030 target, which states that at least 80% of individuals should have at least basic digital skills. When it comes to ICT specialists, Luxembourg has with 7.7% (2022) a higher percentage in its workforce as the EU average of 4.6% (2022). The substantial number of ICT specialists is driven by its banking sector, its digital infrastructure including data centers and the public sector. By 2030, the aim is to have at least 20 million ICT specialists in the European Union, which represents roughly 10% of individuals in employment in the Union. To reach the ambitious EU target by 2030, Luxembourg has to continue working to overcome challenges related to skills shortages, a significant non-resident workforce, housing issues and language barriers affecting the attraction and retention of skilled labour.

In terms of digital infrastructure, and more precisely connectivity, Luxembourg is well above the EU average for the targets "Very high-capacity networks" (VHCN) and "5G coverage". Luxembourg's high-speed VHCN coverage has steadily increased in the last years, which is a crucial step towards achieving the "Gigabit for All" (100%) target at EU level for 2030. 5G coverage (of populated areas) and fixed VHCN coverage reached both 93% by mid-2022, above the EU average of 81% (2022) respectively 73% (2022), putting the country on track to meet the EU's 2030 targets (100%). Besides the ambition to quickly embrace new technologies, Luxembourg's good results are the consequence of its ultra-high speed broadband and 5G strategies that were launched in 2020 and 2018 respectively. Both strategies had the overall objective to drive the nationwide deployment of next-generation telecommunications networks. Luxembourg's geography also makes it relatively easy to upgrade its digital infrastructure. However, even if the coverage is very high, Luxembourg still faces the challenges of geographical whitespots and the uptake rate of 6.7% (2022) of household's subscription to fixed broadband of at least 1 Gbps.

The other targets related to digital infrastructure are "semiconductors", "edge-nodes" and "quantum computing". Following Luxembourg's territorial limitations, the country is unlikely, as many other EU countries, to build up a semiconductor industry on its territory. Nevertheless, Luxembourg's ecosystem hosts innovative companies that provide key value-chain elements in this industry. Furthermore, Luxembourg is setting the scene for its contribution to the achievement of the EU target on quantum computing. Indeed, with the inauguration of the MeluXina supercomputer and the development of the Luxembourg Quantum Communication Infrastructure Laboratory, Luxembourg further strengthens its digital capacities.

Even if challenges related to cryptography, cybersecurity, standardisation and data portability persist, Luxembourg has an outstanding national communication infrastructure linking and securing the autonomous systems in Luxembourg. The fostering of local routing lowers latencies and increases resilience and security of all Internet based communication. On an international level, Luxembourg is well connected with high-speed, very low latency connections to the main capitals and internet exchanges in Europe.

When it comes to the digital transformation of businesses in Luxembourg, digital technologies also become increasingly important. With a score of 66% (2022), the country is slightly below the EU average of 69% (2022) in terms of the basic digital intensity of SME and still quite far from the EU 2030 target, which is that more than 90% of the Union's SME should have at least a basic level of digital intensity. When it comes to the take-up of digital technologies, Luxembourg is with 29% (2021) slightly below the EU average of 34% (2021) for the "cloud" indicator. For "AI" and "big data", Luxembourg is above EU average with 13% (2021) vs. 8% (2021) and 19% (2020) vs. 14% (2020) respectively. All three indicators are still far from the EU target value for 2030, which is set at 75%. However, it has to be noted that the current DESI figures dating from 2021 and 2022 might not entirely reflect the impact of the COVID-19 pandemic on the digitalisation status of SME.

For companies of smaller size, the usage of cloud, big data and AI is often very costly and complex. Indeed, the onboarding of SME into cloud-based solutions is time-consuming and thus expensive. Furthermore, the usage of cloud by SME is often limited to e-mail and eventually storage and manipulation of documents. Accounting software, affordable ERP, e-invoicing or e-archiving services are less often used. For big data and AI, the main challenge is the missing data portability. Most SME use on-site solutions that are managed by local software producers and vendors. These applications mostly have no interfaces to export data sets in order to engage data driven innovation or participate to the data economy.

In the rollout of digital public services for citizens and businesses, Luxembourg is a frontrunner and well above the EU average with 95% (2022) and 97% (2022) respectively. The grand duchy is close to the Digital Decade target of 100% online delivery of key public services. In fact, eGovernment has been a priority long before the emergence of the COVID-19 pandemic. Since 2013, MyGuichet.lu has been part of Guichet.lu, which was launched in 2008, and provides a comprehensive national digital platform for citizens, businesses and the Government to access administrative information. With online procedures, easy form filling, electronic communication and mobile access, MyGuichet.lu has simplified administrative tasks. The creation of a Ministry for Digitalisation after the elections in 2018 also underlines the political will to speed up the digital transformation process. Besides, Luxembourg has a Government IT Centre, which is the administration of the Ministry of Digitalisation responsible for the development and provision of IT services for the Luxembourg Government, ministries and public administrations.

The country's strengths and assets include a centralised Government ICT structure, efficient and interoperable back offices, effective infrastructures (such as GovCloud) for administrations and efficient project management. However, even though Luxembourg has good results when it comes to the digitalisation of public services, the overwhelming amount of data and potential interoperability issues are challenging.

Luxembourg scores 67% (2023) on the eHealth indicator, which is slightly under the EU average of 71% (2023). Luxembourg scores 100% (2023) on the implementation of electronic access to eHealth records for citizens meaning that the national architecture to allow citizens access to eHealth services is in place and functional. This testifies the continuous efforts Luxembourg puts in the digitalisation of medical records. Additional efforts are foreseen from national stakeholders to improve the upload of health data into the electronic health records and the technical interoperability of information systems.

Section 2: National trajectories and target values to contribute to the EU's digital targets

The present section describes the national target values and projected trajectories that Luxembourg has set in order to contribute to achieving each of the EU digital targets.

For the construction of the Digital Decade trajectories, the functional forms recommended in the document "Communication from the Commission establishing Union-level projected trajectories for the digital targets" have been used for the different KPIs (linear vs. s-shaped functional forms). The construction method for S-shaped curves is explained in Annex 1 of this document.

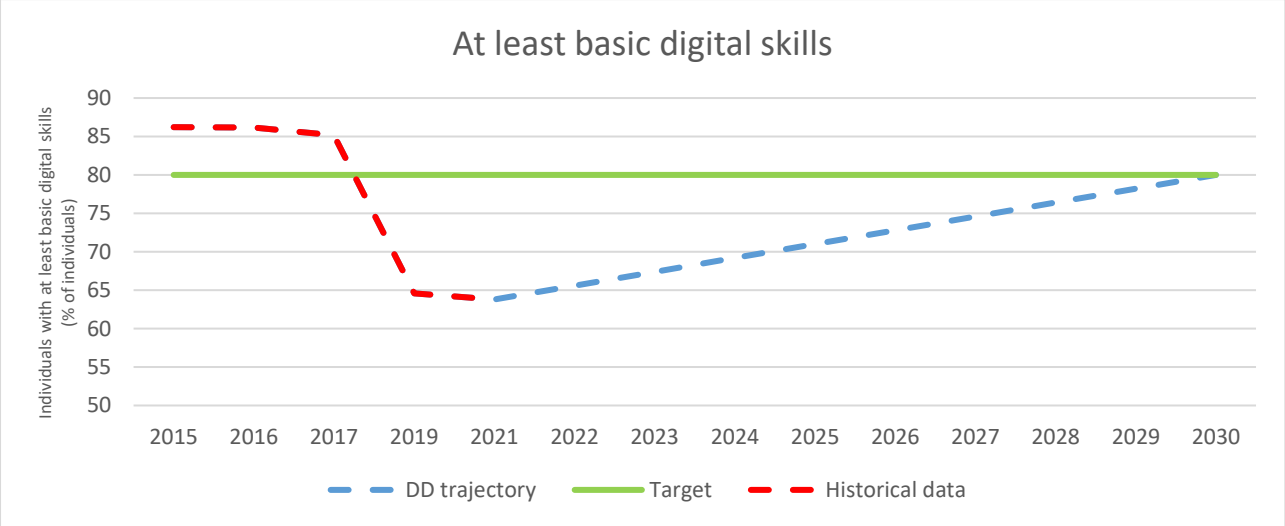
The tables with the numerical values used for the graphs below can be found in Annex 2.

Digital Skills

EU Digital targets: a digitally skilled population and highly skilled digital professionals, with the aim of achieving gender balance, where:

a) at least 80 % of those aged 16-74 have at least basic digital skills;
b) at least 20 million ICT specialists are employed within the Union, while promoting the access of women to this field and increasing the number of ICT graduates.

At least basic digital skills

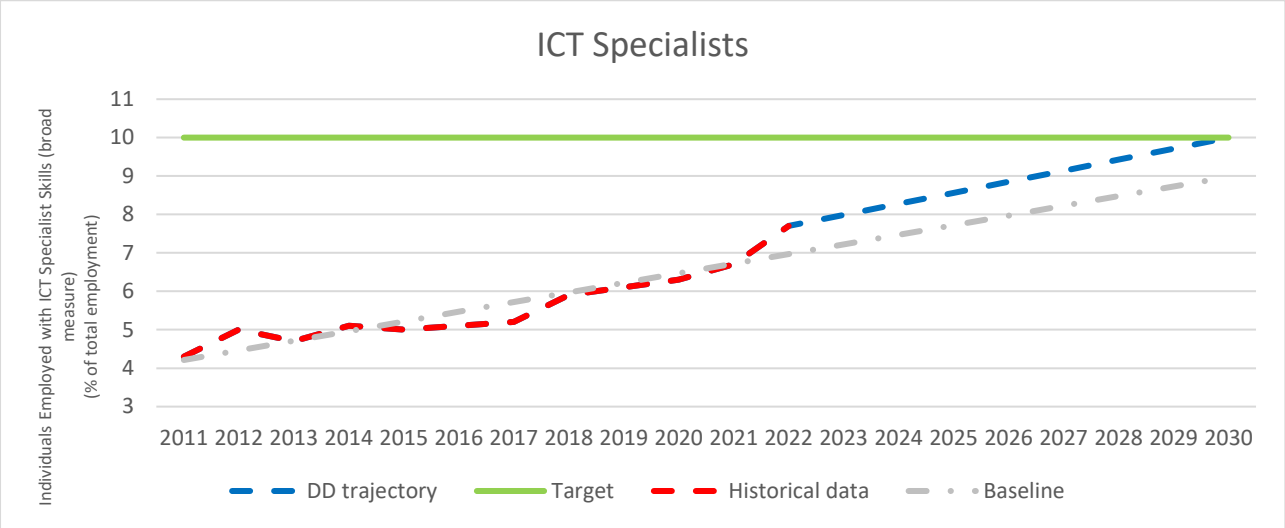


For the construction of the Digital Decade trajectory for "At least basic digital skills", a linear functional form has been used. The EU target for 2030 is that at least 80% of the individuals have at least basic digital skills.

Due to a significant change in the methodology of the Luxembourgish ICT survey in 2018, an important drop in the percentage of individuals with at least basic digital skills can be observed after 2018.

The ongoing efforts of the major public and private education providers as well as vocational education and training providers in digital skills testify from Luxembourg's adaptiveness to changing skills needs in digital work and societal environments. The latter efforts and the financing of digital skills policy actions with corresponding budgets over the next years will lead us to target the provision of at least basic digital skills of 80% of the individuals.

ICT specialists in employment



For the construction of the Digital Decade trajectory for "ICT Specialists", a linear functional form has been used. The EU target for 2030 is that there are at least 20 million ICT Specialists employed within the Union, which represents roughly 10% of individuals in employment age. The national target was therefore also set at 10%.

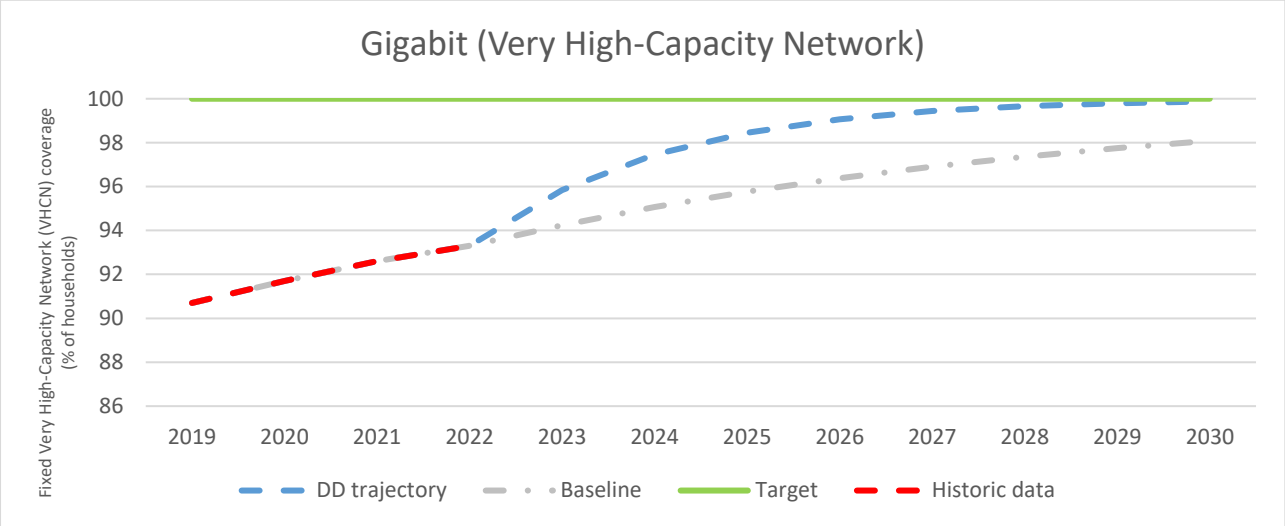
The Digital Decade trajectory is ambitious, but realistic since investment in advanced digital education and training programmes is growing significantly. Online and blended training solutions improved considerably due to the COVID-19 pandemic and jobseekers taking part in advanced IT trainings have strongly increased in the last years and are expected to continue increasing.

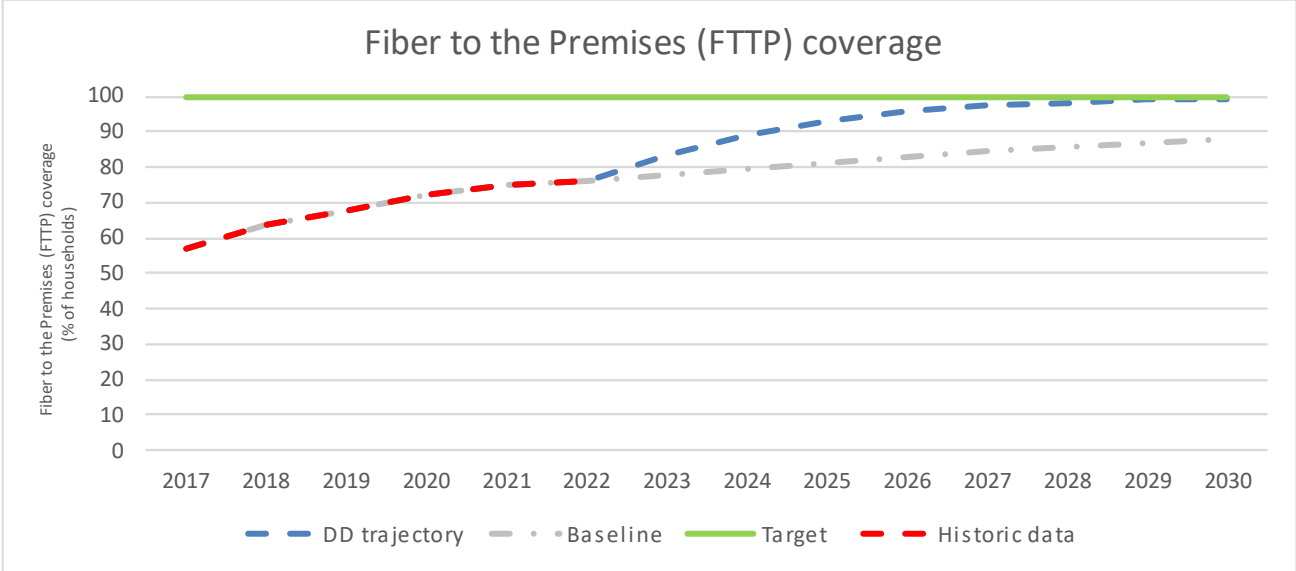
Digital Infrastructure

EU Digital targets: secure, performant and sustainable digital infrastructures:

a) all end users at a fixed location are covered by a gigabit network up to the network termination point, and all populated areas are covered by next-generation wireless high speed networks with performance at least equivalent to that of 5G, in accordance with the principle of technology neutrality;
b) the production, in accordance with Union law on environmental sustainability, of cutting edge semiconductors in the Union is at least 20 % of world production in value;
c) at least 10 000 climate neutral highly secure "edge nodes" are deployed in the Union, distributed in a way that guarantees access to data services with low latency (few milliseconds) wherever businesses are located;
d) by 2025, the Union has its first computer with quantum acceleration, paving the way for the Union to be at the cutting edge of quantum capabilities by 2030.

Gigabit (Very High-Capacity Network)





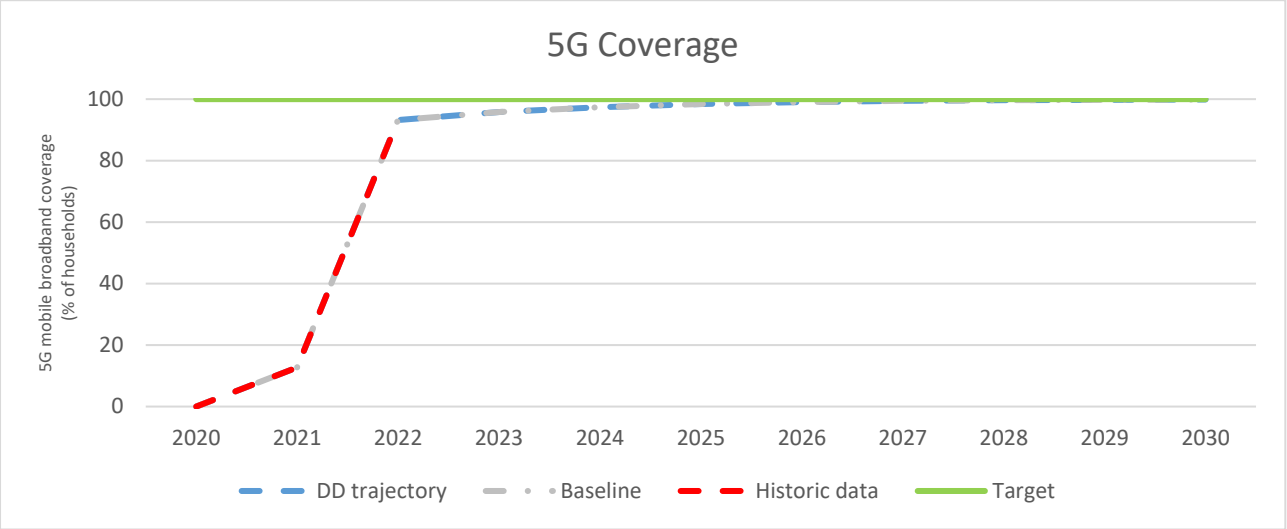
For the construction of the Digital Decade trajectory for "Gigabit", an s-shaped functional form has been used. The national target value has been set close to 100%, which is in line with the EU Target that "all end users at

a fixed location are covered by a gigabit network up to the network termination point". The baseline trajectory is slightly more cautious with a projected 2030 value of between 98% and 99%.

As of 2022, Luxembourg's VHCN coverage ratio is already very high at almost 95%. The remaining uncovered areas are often in harder to reach locations, which makes additional progress more costly.

Nevertheless, covering these remaining white spots as a priority is a key objective of the Government's ultra-high speed broadband strategy 2021-2025, including using public funds if necessary.

Overall 5G Coverage



For the construction of the Digital Decade trajectory for "5G Coverage", an s-shaped functional form has been used. The national target value has been set close to 100%, which is in line with the EU Target that "all populated areas are covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G". The baseline trajectory is the same as the Digital Decade trajectory.

As of 2022, Luxembourg already reached a very high coverage rate. The installation of additional antennas has progressed since then. However, the last few percentages being eventually quite cost extensive to perform, there is a certain slow-down in the actual progress rate to expect. Therefore, it is more cautious to target an almost perfect coverage only by 2030.

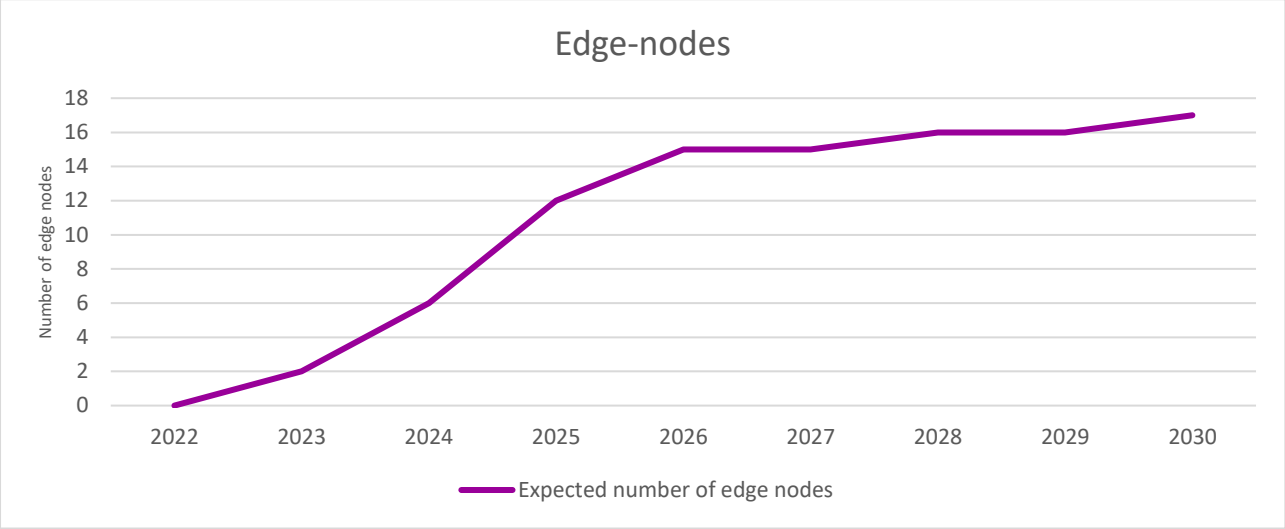
The feedback from mobile network operators (MNOs) indicates that a national coverage of 99-100% of populated areas (all operators combined) could be achieved even before 2030.

Semiconductors

For this digital target, there is no trajectory available yet. However, Luxembourg will contribute to achieving the EU target that is to have "Secure, resilient, performant and sustainable digital infrastructures where the production, in accordance with Union law on environmental sustainability, of cutting-edge semiconductors in the Union is at least 20 % of world production in value".

Currently Luxembourg has two suppliers for the semiconductor industry. Due to the excellence of Luxembourg's industry and research in materials and coating technologies, Luxembourg would like to increase the number of companies, including start-ups, to four in 2030.

Edge-nodes



For this digital target, there is no historical data as there were zero edge-nodes in 2022. Luxembourg will however contribute to the EU target that "at least 10 000 climate-neutral highly secure edge nodes are deployed in the Union" and the number of future edge-nodes has been estimated.

The first two highly secure and resilient edge-nodes in cybersecurity will be created in 2023 to kick-start the open cybersecurity data economy. As the nodes are fully based on open-source technology, they can be replicated in any European region and further strengthen cross-border collaboration in operative cybersecurity and governance (NIS2 directive[1]). In 2024, four more edge-nodes are planned to be added (financial industry and health industry). By 2025, Luxembourg will add additional edge nodes to cover the needs of smart cities, smart mobility, smart grid, space industry and the health devices industry. Further edge-nodes will be added between 2026 and 2030. The estimated number of edge nodes in 2030 is 17.

The number of edge-nodes is expected to increase quite rapidly in the first years, before slowing down until 2030.

Quantum computing

In 2024, Luxembourg will finalize its quantum strategy and foresees to acquire a quantum module combined with a quantum simulator running on its HPC. Even though there are currently not enough stable qubits available on one single machine to solve optimisation problems or boost developments in pharmaceutics and chemistry, Luxembourg wants to gain expertise in working with quantum computers in an HPC environment.

[1] https://eur-lex.europa.eu/eli/dir/2022/2555

Digital Transformation of Businesses

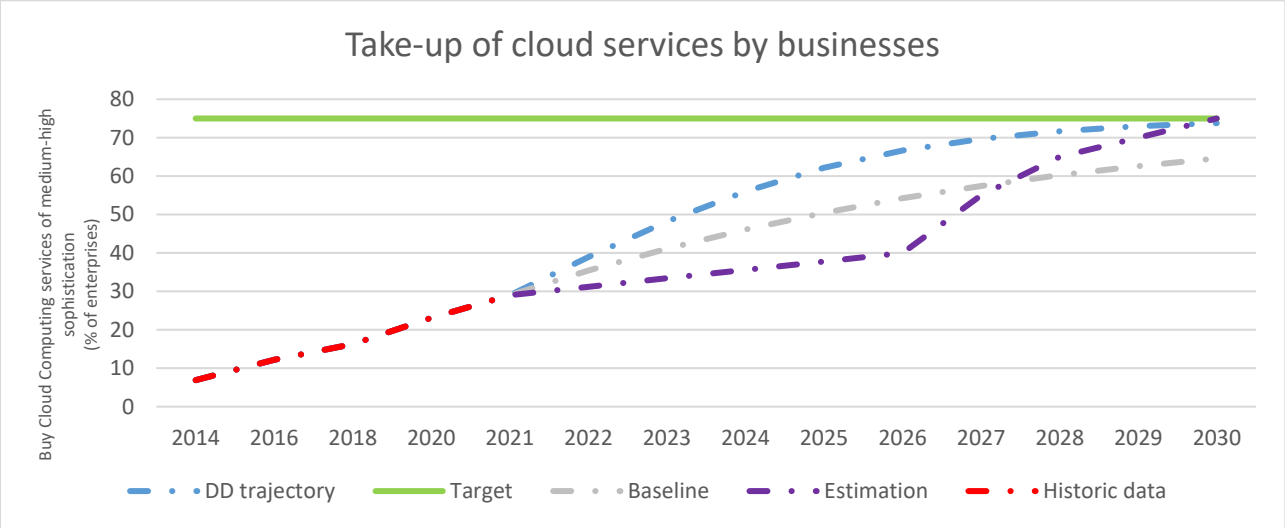
EU digital targets: digital transformation of businesses:

a) at least 75% of Union enterprises have taken up:
   1. cloud computing services;
   2. big data;
   3. artificial intelligence;

b) more than 90% of Union Small and Medium Enterprises ('SME') reach at least a basic level of digital intensity;

c) the Union grows the pipeline of its innovative scale ups and improves their access to finance, leading to at least doubling the number of unicorns.

Take-up of cloud services by businesses



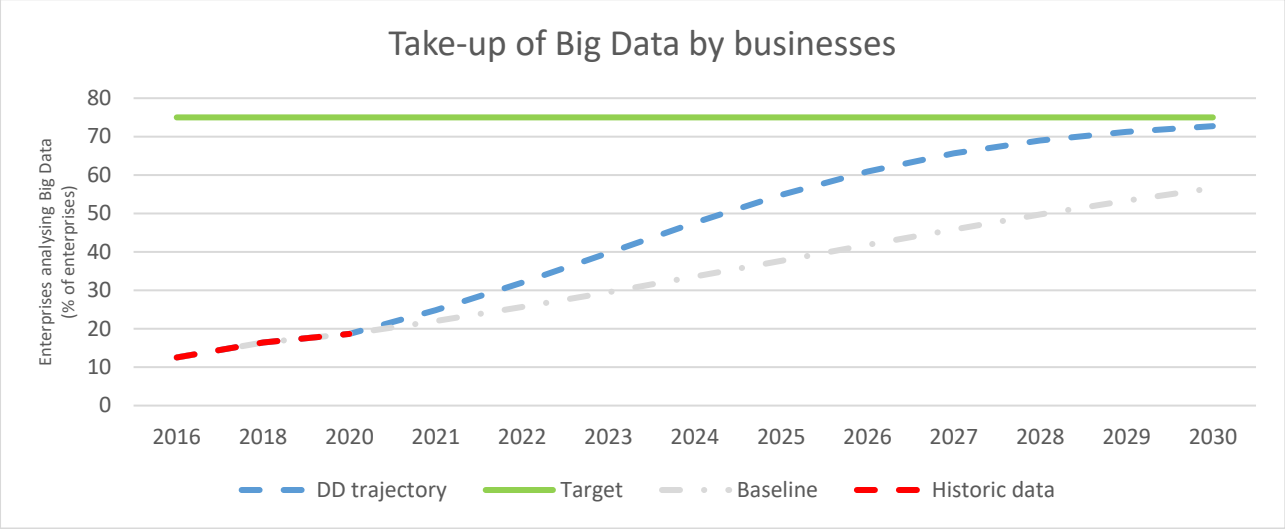
For the construction of the Digital Decade trajectory for the "Take-up of cloud services by businesses", an s-shaped functional form has been used, as recommended in the document "Communication from the Commission establishing Union-level projected trajectories for the digital targets". The national target value is the same as the EU target value. The baseline trajectory is based on historical data and the 2030 value is below the national target value.

In opposition to the gradual growth of the baseline and Digital Decade trajectories, it is however estimated that the trajectory to the target value is rather flat in the coming years and will only increase strongly later.

First measures will take place in 2024, but they will have a delayed impact on SME cloud onboarding and become effective in the following years. By 2025, the first cloud-based services adapted to the Luxembourg context will go online on the Luxembourg cloud providers and the take-up of cloud services by SME are estimated to start (strong increase between 2026 and 2030).

SME will only adopt cloud services if the prices are accessible and if they find the applications that they need. For this reason, the Government will promote the creation of cloud applications for SME assuring interoperability with Government API (Application Programming Interface) and granting data portability rights.

Take-up of Big Data by businesses

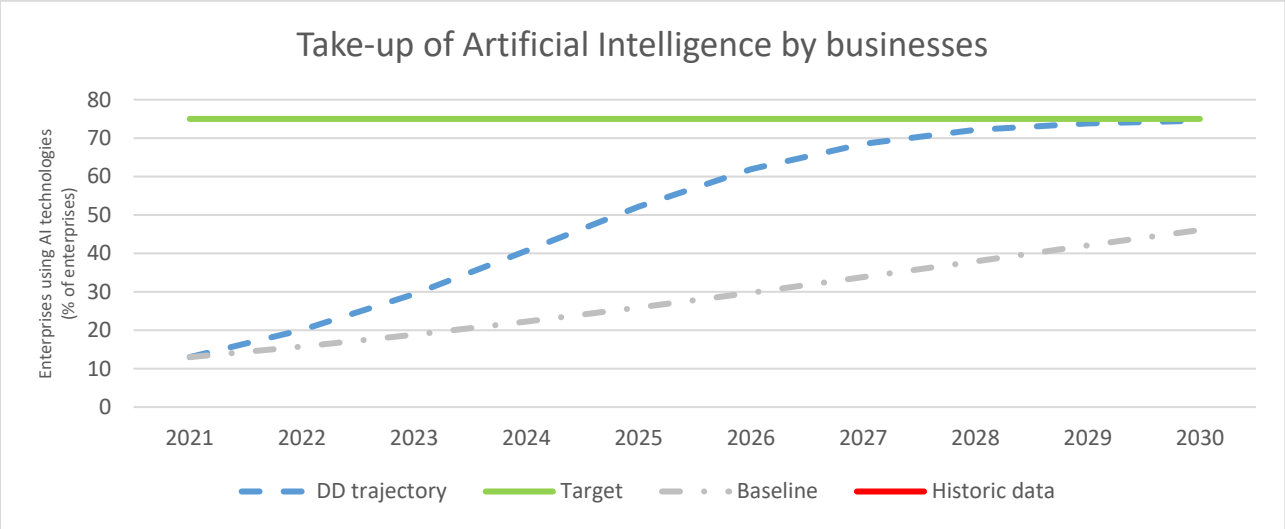


For the construction of the trajectories for the "Take-up of Big Data by businesses", an s-shaped functional form has been used. The national target value is the same as the EU target value. The baseline trajectory is based on historical data and the 2030 value is far below the national target value.

The take-up of Big Data usage is slower in the beginning, but as soon as SME applications, adapted to the Luxembourg context, are available in the cloud, SME will use them, and data will be available for additional services like for instance accounting, tax and ERP services as well as fraud detection in big data applications. This explains the acceleration of the Big Data usage take-up from 2024 to 2027.

The percentage of companies using big data is likely to be similar to the percentage of companies buying cloud services as both indicators are largely connected.

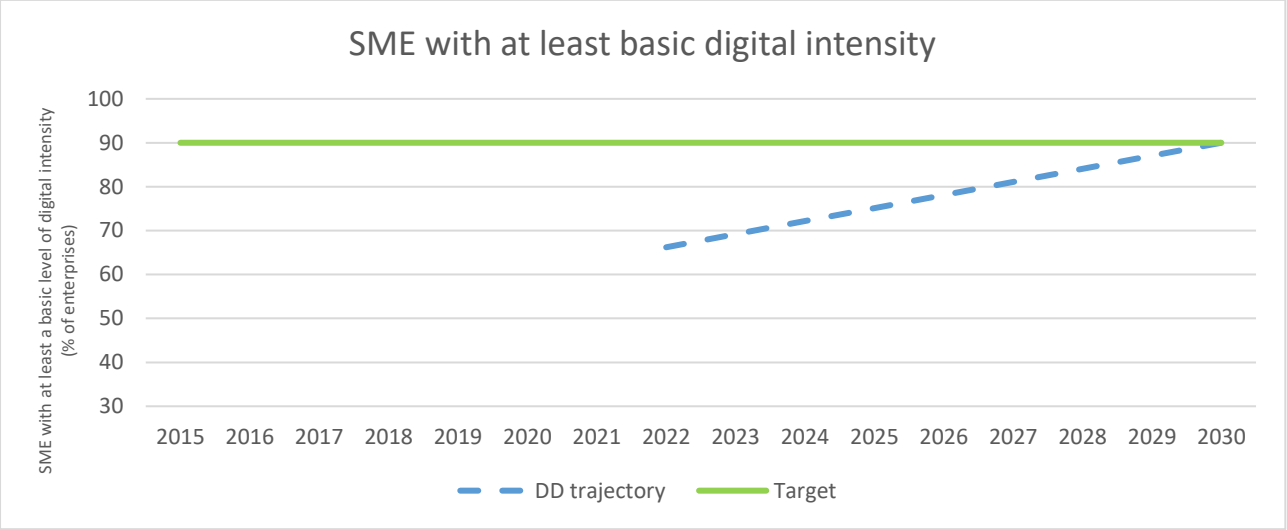
Take-up of Artificial Intelligence by businesses



As for the two previous indicators, an s-shaped functional form is used for the construction of the Digital Decade trajectory for the "Take-up of Artificial Intelligence by businesses". The national target is set at 75%, just like the EU target. There is no historical data for this indicator.

The uptake of AI in companies is expected to be quick due to the usage of Large Language Models (such as OpenAI). The creation of AI applications based on own data however will be slower.

SME with at least basic digital intensity



For the construction of the Digital Decade trajectory for “SME with at least basic digital intensity”, a linear functional form has been used. The national target value has been set at 90% and is in line with the EU target value.

As the pandemic caused an important uptake in digital use and several programmes to support the digitalisation of SME, the importance of SME with at least basic digital intensity will steadily increase over the next years. Due to the digital uptake in the last years, more and more companies will automatically move towards digital tools. Therefore, a target value of 90% seems realistic.

No historical data has been taken for this indicator, as the data from 2022 is not comparable with the previous Digital Intensity Indexes (DIIs). In fact, there has been a change in the composition of the indicator in order to include technologies that are more recent.

Achieving the defined national target is realistic with the current definition of the target.

Number of Unicorns

There is no specific target that Luxembourg will set when it comes to the number of Unicorns. The small size of the country as well as its natural propensity to be a "test bed" for innovative companies that will subsequently grow operations in other larger EU countries points to potentially few Unicorns in number and renders very complex carrying out such a forecasting exercise.

Luxembourg’s commitment to support national and European start-ups and scale-ups is a priority for the country. Since 2013, the Luxembourg Government initiated incorporating the support of its start-up ecosystem in a determined manner within its economic diversification policy. The combination of these active public policies and engaged private players has helped to build an attractive ecosystem. The ecosystem is growing steadily for the past ten years and in its latest mapping of the sector, Luxinnovation, the national innovation agency, identified more than 500 active start-ups. Most of these are active in priority areas for the

country's economic diversification, such as cleantech, healthtech, fintech, space, industry 4.0 and cybersecurity.

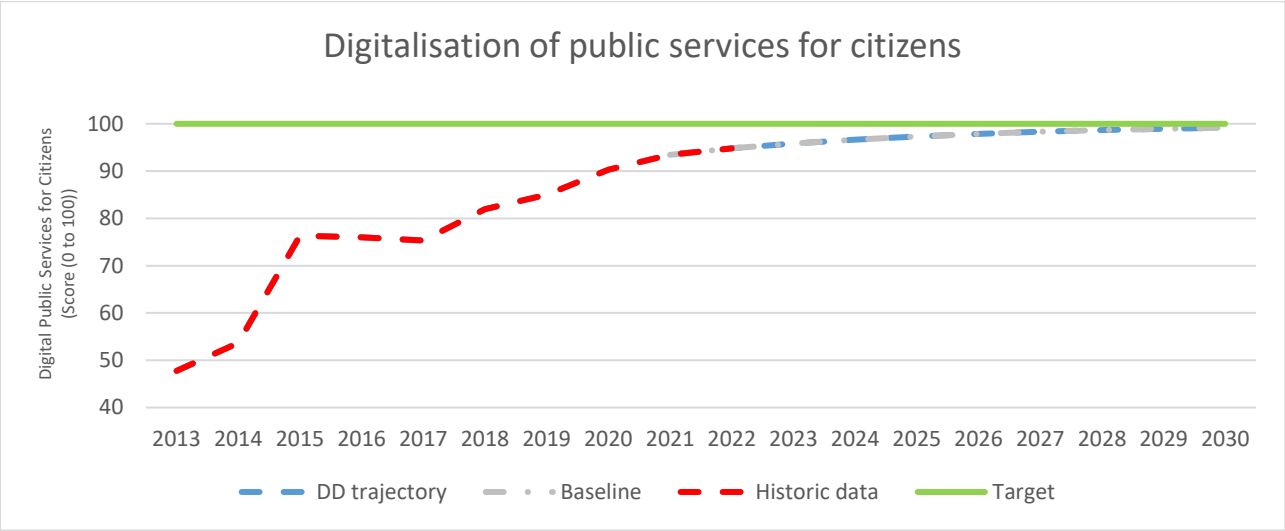
Luxembourg published in June 2023 a startup and scaleup roadmap called “From Seed to Scale” which aims at enhancing Luxembourg ecosystem in order to provide a better environment for start-ups and scale-ups to thrive and contribute to the Digital Decade goals to increase the number of European Unicorns.

Digitalisation of Public Services

EU Targets: digitalisation of public services:

a) 100% online accessible provision of key public services for Union citizens and businesses;
b) 100% of Union citizens have access to their medical records (electronic health records (EHR));
c) at least 80% of Union citizens use a digital identification (ID) solution.

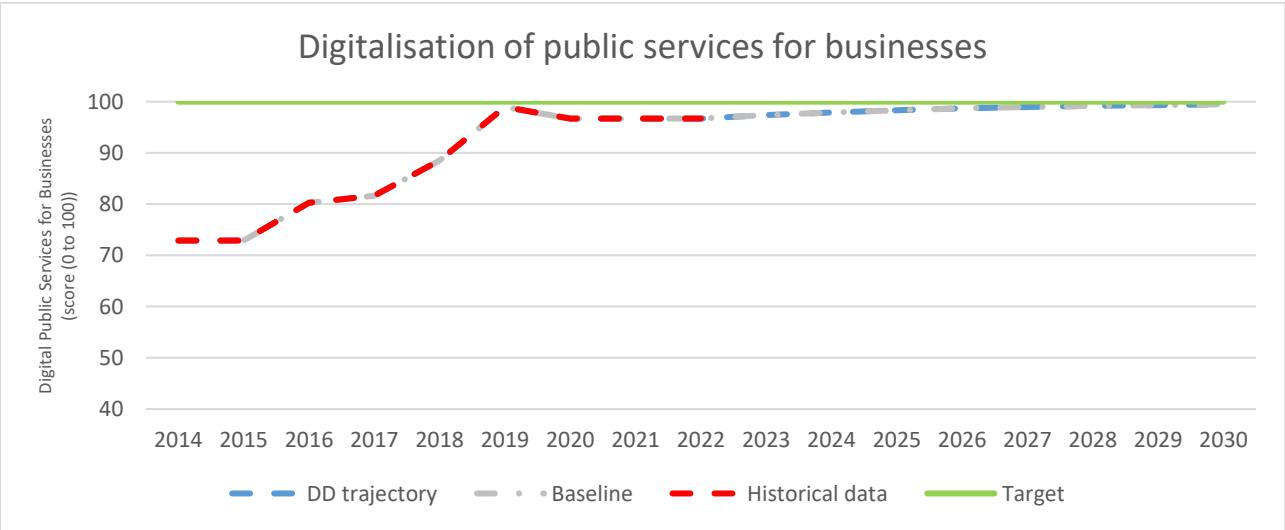
Digitalisation of public services for citizens



An s-shaped functional form has been used to construct the Digital Decade trajectory for "Digitisation of public services for citizens". The national target is the same as the EU target (100%). The baseline trajectory is expected to be the same as the Digital Decade trajectory.

Luxembourg is a front-runner because eGovernment has been a priority for a few years already. With the continuous improvements made to the single digital point of contact platform "Guichet.lu" and the transactional platform "myGuichet.lu", along with the activities of the Ministry for Digitalisation and the increased willingness of ministries and administrations to offer more digital public services, it is expected that Luxembourg will reach the Digital Decade target by 2030.

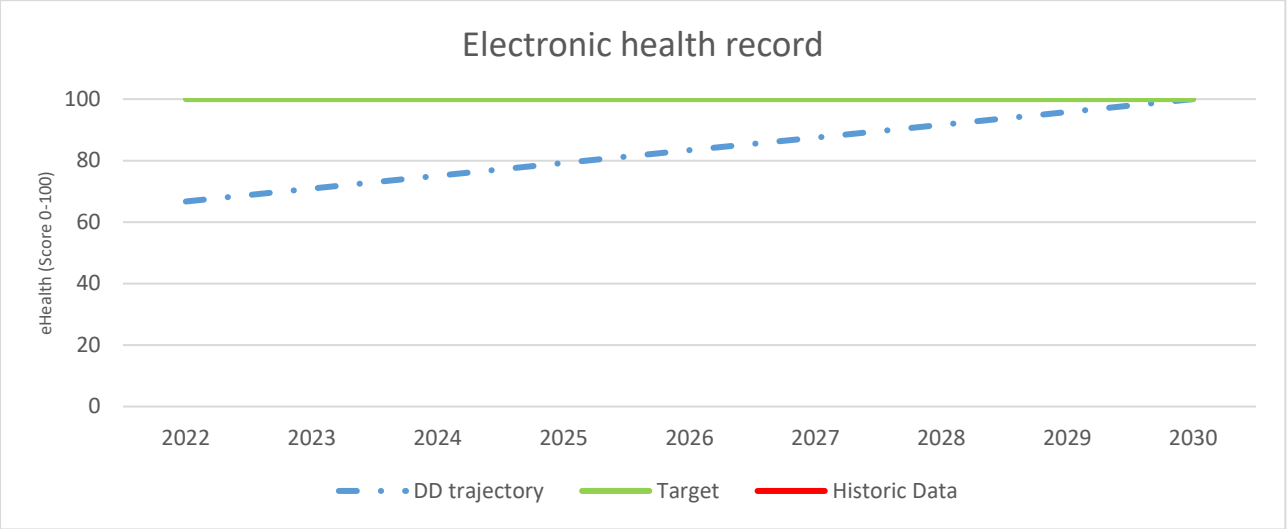
Digitalisation of public services for businesses



For the construction of the Digital Decade trajectory for "Digitalisation of public services for businesses", an s-shaped functional form has been used. The national target value has been set at 100% and is the same as the EU target value. The baseline trajectory and the Digital Decade trajectory are expected to be the same.

Luxembourg has prioritised eGovernment and the development of digital public services for citizens and businesses alike. For methodological reasons and for reasons of data availability, DESI 2020 presents structural changes compared to DESI 2019, which explains the minor score drop between the years 2019 and 2020.[2] Given the ongoing projects and strategic priorities, it is expected that Luxembourg will reach the Digital Decade target by 2030.

eHealth composite indicator on the availability of electronic medical data



A linear functional form has been used for the construction of the "eHealth" Digital Decade trajectory. No business-as-usual scenario could be defined as there is no historical data available.

Theoretically and technically speaking, the target of technical connectivity and uploading of medical data should be reachable, under the condition that other involved actors and stakeholders, such as health care providers (HCP), software vendors, etc. actively contribute.

A joint commitment of all parties involved in rendering electronic health data accessible (patients, HCP, vendors etc.) is required to make this overall objective a complete success. Including further actions with regard to regulatory framework and indispensable components (referential national medication database, use of common semantic terminology, etc.) to enhance the exchange of structured and codified medical data.

A particular note though with regard to the uploading of medical data where 100% will never be reached when taking into account the cross-border workers. Indeed, the cross-border workers will most likely consult HCP in their home country, who are not connected to the Luxembourg Electronic healthcare record.

[2] See methodological manual DESI 2020 at https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2020

Electronic identification (eWallet and eID)

The EU Target, as described in the Communication from the Commission establishing Union-level projected trajectories for the digital targets, is that "100% of Union citizens have access to secure electronic identification means that are recognised throughout the Union, enabling them to have full control over identity transactions and shared personal data".

In order to achieve the target, member states need to issue a digital wallet as well as to notify at least one national eID scheme. Both need to be in accordance with the Regulation (EU) No 910/2014.

As of today, Luxembourg already has a national eID scheme in place to which citizen have access. The national eWallet is currently under development and is estimated to be in place in 2024 (currently in the official legislative procedure).

Section 3: Policies, measures and actions to achieve the digital targets

This section provides an illustration of the policies, measures, and actions that Luxembourg is planning to implement in order to achieve the digital targets for 2030.

For each digital target, a general overview of the measures is given, together with their overall timing. Each measure that contributes to the achievement of the digital targets is described in the present section.

Skills

EU Digital targets: a digitally skilled population and highly skilled digital professionals, with the aim of achieving gender balance, where:

a) at least 80 % of those aged 16-74 have at least basic digital skills;
b) at least 20 million ICT specialists are employed within the Union, while promoting the access of women to this field and increasing the number of ICT graduates.

At least basic digital skills

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: Prepare students for evolving digital work environments								
Measure 2: Safety for children in an online environment								
Measure 3: Digital Skills Partnerships								
Measure 4: Programmes for jobseekers								
Measure 5: Methodology for monitoring the evolution of digital skills needs (skills data)								

Description of the measures

Measure 1: Prepare students for evolving digital work environments

Technologies like AI will change our relationship with work. Luxembourg's Ministry of Education, Children and Youth continuously introduces new study tracks to offer secondary schools' students the opportunity to enter in these study fields.

Since the school year 2018-2019, a new study track has been offered in secondary schools. This track provides access to higher education, particularly in the fields of IT and communication. Course-specific subjects include programming classes, an introduction to modern technologies and a media communication class. In the two last years of the course, financial economics and data management complement the programme.

In addition, a new track was introduced for the school year 2023-2024 focusing on the role of people in a rapidly developing society. Among other disciplines, this new track will offer classes in data science and communication: learning how to analyse data (collection, processing, and interpretation) and communicate it (presentations and reports on the results of analyses).

In 2020, the Luxembourg's Ministry of Education, Children and Youth furthermore adopted a holistic strategy to digital literacy comprising elementary and secondary education: "simply digital - future competences for strong children" ("einfach digital - Zukunftskompetenze fir staark Kanner").

Anticipating the increasing demand for digital skills in both professional and private life, the strategy aims to foster more than just computational skills. It is based on five uniquely human competences: critical thinking,

creativity, communication, cooperation, and coding. The 'simply digital' initiative was developed around three key projects:

1. A general framework for digital literacy: The national reference guide ("Medienkompass") proposes a transversal approach allowing teachers and educators to develop, promote and deepen digital literacy at all educational levels. This guide is based on the European Digital Competence Framework for Citizens, but deliberately comprises non-digital as well as digital media literacy aspects.

2. Coding and computational thinking in elementary education: Coding is introduced as part of mathematics in the last year of elementary education ("Cycle 4", i.e. 10-12 years), starting from the schoolyear of 2020/21. The objective is to teach children numerical reasoning in a pleasurable way at an early age.

3. Digital sciences in secondary education: A new subject has been gradually introduced in the lower classes as from the school year of 2021/22. The objective is to promote and develop creative approaches related to coding and a basic understanding of our digital world including big data, artificial intelligence, automation, etc.

Measure 2: Safety for children in an online environment

BEE SECURE, the Luxembourg Safer Internet Centre, is a Government initiative involving the Ministry of Education, Children and Youth, the Ministry of Economy and the Ministry of Family, Integration and Greater Region. BEE SECURE is coordinated by the National Youth Service (SNJ). It is operated by SNJ in cooperation with the counselling service KJT, in partnership with Luxembourg House of Cybersecurity, the Luxembourg Police and the Public Prosecutor's Office of the Grand Duchy of Luxembourg. BEE SECURE is part of the European networks Insafe (awareness-raising centres and helplines) and INHOPE (the International Association of Internet Hotlines - leads the fight against child sexual abuse material (CSAM) online.)

BEE SECURE aims to raise awareness for a safety-oriented and responsible use of digital technology to the general public, and to particularly empower children, young people and their entourage (parents, teachers, educators and others) through targeted offers and information.

BEE SECURE acts in the following four areas:

1. Awareness and information: BEE SECURE disseminates information and advice through various offers and activities. The focus is on awareness trainings. Like the multi-facetted publication offer, trainings cover a broad range of topics. The initiative also regularly launches thematic campaigns and events.
2. Orientation and advice: The BEE SECURE Helpline is a counselling service. Anyone can consult the service for questions related to the internet and digital media safety. The counselling via phone is anonymous and confidential.
3. Anonymous reporting platform: The BEE SECURE Stopline is an online platform where three categories of illegal content can be reported anonymously: (1) Child sexual abuse material (CSAM), (2) discrimination, racism or revisionism and (3) terrorism. Relevant content is forwarded to the national police or other competent authorities.
4. Trend-Monitoring: BEE SECURE stays abreast of the latest online trends and developments in order to orient its actions. Observations in relation to the use of digital technology of children and young people made by the initiative in the frame of its activities in Luxembourg are published annually in the "BEE SECURE Radar" report.

Furthermore, BEE SECURE coordinates and encourages activities in Luxembourg to mark the Safer Internet Day (SID), an annual theme day organised worldwide with support of the European network Insafe/INHOPE and the European Commission as one of the key elements of the Better Internet for Kids+ (BIK+) Strategy. BEE

SECURE dedicates all school trainings and parents' evenings held in February to SID and calls on national stakeholders to get involved and promote the safe use of digital technologies, shape a more positive online environment for children and young people in Europe and encourage responsible online behaviour through various projects.

The planned budget of BEE SECURE for all four areas of action is 3 003 978€ for a duration of two years (01/01/2022-31/12/2023). BEE SECURE plans to continue and further develop its actions and offers, while orienting on needs and developments in the domain of a safer internet for children.

Additional efforts to fight disinformation and increase individual's safety skills are made, amongst others, by ALIA (Autorité luxembourgeoise indépendante de l'audiovisuel) in collaboration with EDMO BELUX, the regional hub of the European Digital Media Observatory (EDMO) network. EDMO BELUX covers topics such as disinformation and fact-checking, and regularly hosts training events to support media literacy professionals.

Measure 3: Digital Skills Partnerships

The Digital Luxembourg initiative of the Department of Media, Connectivity and Digital Policy (SMC) of the Ministry of State launched the "Digital Skills Matchmaking" (DSMM). DSMM is an initiative with the ultimate goal of encouraging companies to form partnerships with digital skills project owners to accelerate innovation and support digital skills development.

These partnerships come in many forms, and facilitate our digital target by generating mentorship programmes, IT assistance for NGOs, augment volunteering for coding workshops in schools and digital skills information events and digital immersion days in enterprises for students.

The DSMM event has been organised in the premises of the ICT-Spring, a major tech conference since 2020/2021. During a side-event with national and international keynotes, IMS Luxembourg guides companies and digital skills project owners to exchange (speed dating format) and to create win-win digital partnerships. Project owners can be NGOs, public actors, schools, training providers, research organisations, and grassroots initiatives.

To better address Corporate Social Responsibility-ready companies, the SMC decided to consent the implementation of DSMM to an official non-profit CSR organisation, IMS Luxembourg. For best digital skills expertise and coaches, IMS is collaborating with the Luxembourg Digital Skills and Jobs Coalition.

The latest DSMM edition (2023) with additional preparation efforts resulted in 38 partnerships. The consolidation of these partnerships is still ongoing. DSMM will be continued over the next years.

DSMM 2023 and 2024 benefit from a European Social Fund co-financing where a budget of 270 000€ (81 000€ from the SMC) allowed to targeted preparation workshops for both CSR decision makers and digital skills project owners as well as ex-post workshops to guide formed partnerships in the implementation of their new positive impact initiatives.

Measure 4: Programmes for jobseekers

Through a long-standing strategic partnership between the National Employment Agency (ADEM) and the Luxembourg Chamber of Commerce, enhanced by the internal House of Training's expertise, various training programmes have been established. They aim to facilitate the (re)integration of jobseekers into the labour market.

Skills4Job has three main objectives:

1. Define a professional project in line with the needs of the job market and identify the applicant's upskilling or reskilling needs
2. Optimise the applicant's professional profile and application file to increase efficiency in the job search
3. Reinforce transversal skills and develop the technical knowledge necessary for a successful reintegration or professional retraining.

This training programme was launched in October 2022 and continues throughout 2023. It is in line with the FutureSkills training programme, initiated by ADEM and the Ministry of Labour, Employment and the Social and Solidarity Economy, and developed by the Luxembourg Chamber of Commerce, the House of Training and the Luxembourg Chamber of Employees. The aim was to develop the "skills of tomorrow", in order to better match the profiles available with those sought on the labour market.

The skills selected were soft skills, digital skills (e.g. office automation, cybersecurity, etc.) and project management skills, which are the most demanded skills on the job market. During the period between autumn 2020 and the end of 2021, nearly 500 jobseekers participated in FutureSkills.

Skills4Job has a total cost of 1 561 500.00€ that is co-financed by the European Social Fund and the Employment Fund (624 600.00€) and the Luxembourg Employment Fund of the Ministry of Labour, Employment and the Social and Solidarity Economy (936 900.00€).

Next to Skills4Job, there are a few other programmes that develop digital skills, such as "Basic Digital Skills", "Fit4DigitalFuture" and "Fit4 Project Management".

- "Basic Digital Skills" is a project run by ADEM in collaboration with the Chamber of Employees (CSL). It is aimed at jobseekers with little or no IT skills. Launched in 2020, the project ended at the end of 2022 and benefited a total of almost 140 jobseekers.
- "Fit4digitalfuture" is aimed at people with an affinity for IT and digital tools and who wish to develop their skills in this area. Launched for the first time in 2017, this project ended at the end of 2021. It benefited a total of 129 jobseekers.
- "Fit4 Project Management" aims to develop project management skills, particularly for digital projects. Launched in 2020, the project ended at the end of 2022 and benefited a total of over 80 jobseekers.

The continuation of these three digital skills training programmes for jobseekers offered by the National Employment Agency (ADEM) together with the Chamber of Commerce and the Chamber of Labour is planned within the recent FSE Call. The 2024/2025 FSE project proposals for "Basic Digital Skills", "Fit4 Project Management" and "Fit4digitalfuture" are in preparation.

Similar digital skills training projects for jobseekers are important and are to be continued within the FSE Program in the long term, if possible

Measure 5: Methodology for monitoring the evolution of digital skills needs (skills data)
ADEM is developing a systematic method to identify skills demanded in the job vacancies reported by employers. More specifically, ADEM is developing a combined model of natural language processing and machine learning to extract structured skills data from the descriptions included in job vacancies. The skills extracted are classified according to the European classification for occupations and skills (ESCO), and digital skills are particularly identified by using the ESCO's definition of digital skills.

After an initial proof of concept was realised with an external provider in 2021, ADEM has started in 2023 to develop an in-house model. No particular budget is allocated to this measure, except for time investment of

ADEM's personnel. The model is planned to be operational for statistical purposes by 2024 and for operational purposes (to help the matching of jobseekers and job vacancies) by 2026.

The goal of this measure is to understand what skills are really needed on the job market (by sector, occupation) and how these needs evolve. This is essential in order to strengthen the relevant (basic digital) skills.

ICT specialists in employment

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: Digital Learning Hub								
Measure 2: University of Luxembourg as a prime provider of digital skills programmes								
Measure 3: Short cycle higher education programmes (BTS)								
Measure 4: ICT START								
Measure 5: Educate future digital leaders								
Measure 6: ElementsofAI.LU" (EoAI): MOOC with online study accompaniment and extensive targeted in-person support								
Measure 7: "Google certificates" personalised and accompanied upskilling offers for jobseekers								
Measure 8: ICT specialists and gender convergence: addressing gender differences in digital upskilling								
Measure 9: ICT mentoring programmes for female students								

Description of the measures

Measure 1: Digital Learning Hub

Launched in May 2022, the Digital Learning Hub is an initiative of the Ministry of Education, Children and Youth and was created to contribute to the Government's mission to reduce the digital skills gap in Luxembourg (and the Greater Region). The Digital Learning Hub aims to further expedite the digital transformation of the country by way of continuous professional education and to help fill the severe need for skilled IT-trained professionals on the job market. As such, the Digital Learning Hub is embedded in the Adult training department (Service de la formation des adultes) of the Ministry of Education.

Generally speaking, the Digital Learning Hub targets three types of audiences: professionals wanting to improve their skills in IT, job seekers considering a professional reorientation into IT, and young people who are looking for an alternative teaching to acquire digital competences.

The Digital Learning Hub offer three training formats:

1. Individual short courses mainly target professionals and are tailored to impart a precise skill in a relatively short period of time (4h – 30h max.). The reasoning being that some IT skills can be acquired in just a few hours and professionals can attend these courses while also being able to keep up with their tasks at work without too many hindrances.
2. A learning track is a set of different courses that make up a comprehensive and well-rounded program, which in turn culminates into a specific skillset. This training format mainly targets job seekers.
3. Ecole42 is a coding school that originated in Paris in 2013 and has over 40 campuses worldwide. The Luxembourg campus shares its residence with the Digital Learning Hub and is currently the only full

curriculum counted as part of the trainings offer. Ecole42 specialises in educating the next generation of software developers. Through its unorthodox pedagogy led by the principles of gamification, project-work and peer-to-peer learning, participants learn to code on a practical level, rather than theoretical. Divided into two parts, the training programme starts with the common core where learners acquire the fundamentals in programming. Building on these skills, they can choose to continue to the second part, the specialisation, where they will progress into the field of their choosing, such as web development, cybersecurity or AI.

Between June 2022 and June 2023, the Digital Learning Hub has offered 300 courses and welcomed 2000 learners.

The yearly budget of the Digital Learning hub is 1 million € (national budget).

Measure 2: University of Luxembourg as a prime provider of digital skills programmes

The Strategy Framework 2020-2039 of the University of Luxembourg includes Digital Transformation as one key area of development with key areas in the strategic framework as guiding principles. The Ministry of Higher Education and Research and the University of Luxembourg have signed in 2022 a new multi-year contract covering the period 2022-2025. The ambition of the University's strategic framework is to embody academic and research excellence by providing digital activities that promote innovation and support for the country and the world. Part of this ambition is for the University to become a prime destination for students and teachers who seek a degree and career in digital skills and digital transformation.

The University has a number of programmes (e.g. Computer Science, Applied Information Technology, Cybersecurity …) that train specialists in the broader area of ICT and that have a direct relationship with the jobs market. These programmes are listed in Annex 4.

The University of Luxembourg organises several activities and initiatives that integrate measures in the area of digital skills and digital transformation. These activities and initiatives are further developed in Annex 5.

Measure 3: Short cycle higher education programmes (BTS)

Higher education programmes at short cycle level (BTS - Brevet de technicien supérieur) are professionally oriented courses at higher education level (Level 5 NQF/EQF), which comprise on average between 120 and 135 ECTS credits and take four semesters to finish. They are offered in secondary schools. BTS programmes primarily prepare for the job market but graduates also have the opportunity to pursue further studies. Depending on the study field and upon decision of the given higher education institution/university, they can receive a partial or full recognition of their short cycle programme.

The eleven BTS programmes that are currently offered in the ICT areas of study are listed in Annex 6.

In the academic year 2022/2023, a total of 103 first-year students (provisional data) were registered.

There are no rules or limits set at national level as to the creation of new programmes. The assessment of their relevance and opportunity, as well as feasibility, is an integral part of the programme accreditation procedure.

Regarding the creation and offering of higher education programmes at short cycle level in any study field, it is important to note that each programme originates from a school's initiative. A school can submit a programme for accreditation and, upon a positive ministerial decision, is allowed to offer the programme and issue national diplomas.

Measure 4: ICT START

ICT Start is an existing measure that was launched by Luxembourg's National Employment Agency (ADEM) and the professional training department of the Ministry of Education (SFP - Service de la Formation Professionnelle) in December 2022.

ICT Start targets jobseekers in Luxembourg registered with ADEM who wish to direct their careers towards the new professions in web and mobile technologies. It is a 10-day (40h/week) introduction training to get in touch with the IT sector and gives the possibility to discover the different IT jobs as well as to acquire basic IT skills, especially in coding and web development. After completion, the learners are able to decide whether they would like to reskill for an IT job and enrol in one of the more complete trainings as a follow up.

There are no specific prerequisite qualifications for admission to the course, except for having a good understanding of English (the course's primary language) and very basic computer skills.

ICT Start aims to train 300 jobseekers a year, with training sessions planned every two months. There is currently no end date to this programme and the project can be renewed as long as the ADEM expresses the need for this type of training.

No specific budget is foreseen for this measure. The SFP makes the engagements for the different training courses and then submits them to the Ministry of Labour, Employment and the Social and Solidarity Economy, which funds these engagements. In 2023, about 132 000€ have been invested in the ICT Start project so far.

Measure 5: Educate future digital leaders

Luxembourg Tech School (LTS) is an extra-curricular educational program co-financed by the Luxembourg Government and the private sector to drive the development of future digital leaders.

Motivated 12-19 years old students learn and apply technology in a real business context. Starting with coding, big data and management lessons, students are later taught to link technologies to business and society purposes within three modules: Space Ressources, AI and Finance (FinTech) and AI Creativity and Arts.

Students learn to pitch their final LTS project within hackathons and start-ups sessions.

The program also supports student job opportunities and mentorships, with the goal to increase tech and science employability.

LTS is a public-private objective-oriented partnership to enlarge the number of students, promote student job and mentorship opportunities, greater participation in recognized competitions and hackathons.

LTS is offered within nine secondary schools throughout the country; 24 neighboring schools also have access to the nine premises; and 825 students graduated from LTS so far (2017-July 2023)

The technology purpose of the LTS program is adapted on a biannual basis, to reflect digital transformation in business and society.

LTS' annual budget is 600 000 € where the Government comes in for 40% and the private sector for 60%. The LTS program is to be continued over the next years.

Measure 6: "ElementsofAI.LU" (EoAI): MOOC with online study accompaniment and extensive targeted in-person support

In 2021 and 2023, the Government initiative Digital Luxembourg joined forces with the University of Luxembourg Competence Centre (ULCC), the Ministry of Education, Children and Youth, the University of Luxembourg, the National Institute of Public Administration (INAP), to implement a free and hybrid version of the online MOOC "Elements of AI" with virtual and in-person options.

Launched 2019 and co-financed by the European Commission, "Elements of AI.com" is a free online course created by MinnaLearn and the University of Helsinki. Luxembourg uses this famous MOOC to equip at least 1% of its working-age population, and strongly encourages individuals outside of the tech industry, with the knowledge of how AI can be applied to real-life applications, LLM, and what the implications of this technology are. On top of that, it also serves as a refresher to experts in the field.

The "embedded" Luxembourg version of Elementsofai.lu features additional targeted study accompaniments to drive its success: seven webinars throughout the accompanied course duration of the course, and three study group formats dedicated to teaching professionals, women-only and all other participants.

This hybrid version of EoAI drives even further the quantity and quality of learners.

During the 2023 edition of elementsofAI.LU the provision of a multitude of additional targeted study accompaniments were deployed to drive its success. There are also three targeted support groups (professionals, women-only study groups and study groups for all other interested). The aim of the support group is to continuously exchange, to review the content of the MOOC, discuss use cases and hold Q&A sessions.

An EoAI 2024 and 2025 edition is planned.

EoAI Licence, operational costs and a half PhD come at a yearly budget of 85 000€.

Measure 7: "Google certificates" personalised and accompanied upskilling offers for jobseekers

The Google Certificates programme is a collaboration between the University of Luxembourg Competence Centre (ULCC) and Luxembourg's National Employment Agency (ADEM). The 2023 Google Certificates training partnership started in 2021 and was readapted in 2023.

The training project's goal is to provide important IT-related skills to facilitate the professional integration and/or reintegration of jobseekers and to facilitate recruitment for employers in Luxembourg. Google Certificates learning packages are available online on the Coursera website. Designed for beginner learners, they are based on online learning principles, with a maximum duration of six months. This allows learners to progress at their own pace, with guidance from the ADEM counsellor.

The different areas in which the Google Certificates are offered are listed in Annex 3.

Measure 8: ICT specialists and gender convergence: addressing gender differences in digital upskilling

Gender differences evident in education extend to the labour market, with women representing only a small fraction of ICT specialists. In light of the objective of a high percentage of women and men occupying jobs with a whole-day use of digital devices[3] and considering a differentiated access to the growing opportunities in the

[3] https://ec.europa.eu/eurostat/documents/4187653/16179935/Job+Skills.png/13800c39-ec1d-5cda-ee2e-819fcedd710e?t=1687439428694

ICT field, Luxembourg aims to implement dedicated assessment and targeted guidance in digital training that take into account gender differences. The ultimate digital target of this measure consists in training a growing number of women in advanced digital thematics.

In 2023, the workstream is internal and does not yet require an additional budget.

Measure 9: ICT mentoring programmes for female students

Together with the National Research Fund, Luxembourg Tech School and in the frame of the Digital Skills Matchmaking program, the Luxembourg Government is actively promoting and co-financing IT Mentoring Programmes for female students like Women Cyber Force or the Luxembourg Girls in Tech association.

The Women Cyber Force Mentoring Programme provides the opportunity to connect with experienced mentors who can offer valuable career guidance and share their insights. One of the main objectives is to enhance women's involvement in the cybersecurity sector by promoting professionals and facilitating access to professions in this field.

Girls in Tech Luxembourg is a local community of women in tech who can support and encourage each other. The goal is to build a diverse and inclusive tech workforce. Girls in Tech Luxembourg organises conferences, bootcamps, workshops and job boards, just to name a few.

These measures will help to reduce the gender gap in ICT.

Digital Infrastructure

EU Digital targets: secure, performant and sustainable digital infrastructures:

a) all end users at a fixed location are covered by a gigabit network up to the network termination point, and all populated areas are covered by next-generation wireless high speed networks with performance at least equivalent to that of 5G, in accordance with the principle of technology neutrality;
b) the production, in accordance with Union law on environmental sustainability, of cutting edge semiconductors in the Union is at least 20 % of world production in value;
c) at least 10 000 climate neutral highly secure "edge nodes" are deployed in the Union, distributed in a way that guarantees access to data services with low latency (few milliseconds) wherever businesses are located;
d) by 2025, the Union has its first computer with quantum acceleration, paving the way for the Union to be at the cutting edge of quantum capabilities by 2030.

Gigabit (Very High-Capacity Network)

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: Ultra-high-speed broadband strategy								

Description of the measures

Measure 1: Ultra-high-speed broadband strategy

In 2021, the Government published its new ultra-high-speed broadband strategy for the time horizon 2021-2025. One of the objectives of said strategy is to cover the remaining whitespots in the country with at least one VHCN capable infrastructure. To assist in the implementation of the strategy, "MyConnectivity" was created. This is a Government backed entity whose mission it is among others to facilitate the deployment of VHCN cabling. One if its main objectives is to establish roadmaps for each commune that has a significant number of whitespots to accelerate the necessary infrastructure works.

The current strategy targets that every household of the country should have access to a network delivering at least 100 Mbps by 2025. In addition, the strategy defines targeted measures to accelerate the build-out of VHCN networks by 2025, by identifying white spots and defining specific solutions in pilot areas.

The measures will improve the coordination between the concerned municipalities and the different infrastructure providers to prioritise the remaining whitespots areas. This may be complemented by state-aid measures in the future.

The total budget of the Ultra-high-speed broadband strategy is about 9.1 million €.

The "MyConnectivity" entity has an allocated yearly budget of about 1.2 million €. 1 million € have already been allocated in 2022.

The budget law also contains an additional total amount of 4.5 million € in funds that may be used within a state aid scheme to rollout VHCN networks. Using this budget would require an implementation law, which may be introduced to parliament this year (2023). Nothing has been allocated yet.

There is currently no reliable estimate available of the funding gap. Based on initial pilot projects, data that are more reliable should be available by 2025.

In 2023, the Luxembourg Regulatory Institute launched an information campaign on the ongoing copper switch-off by the mobile network operators. The copper switch-off is expected to be definitive by around 2030. The copper-switch off is very likely to lead to an increase in the uptake of very high-capacity networks in the coming years.

Overall 5G Coverage

The national 5G coverage is not driven by the demand-side, but by the offering parties: mobile network operators (MNO). The network relies on the interest of the MNOs and the feasibility to cover all populated areas.

Based on the feedback received from the MNOs, specific national measures to support the roll-out of the 5G network seem not appropriate in the context of the Digital Decade.

Semiconductors

Luxembourg has no specific measures in place, apart from keeping a watchful eye on company innovation projects (suppliers for the semiconductor industry). This falls under the RDI state aid regime (European Regulation General Block Exemption Regulation – GBER).

Edge-nodes

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: Creation and large publication of the necessary open-source technology and governance models								
Measure 2: Edge-cloud calls reusing published open-source technologies and governance models								
Measure 3: Legislative measures								
Measure 4: GAIA-X								

Luxembourg intends to speed-up the digital transition and boost the altruist, economic and scientific valuation of available interoperable data. The data driven innovation strategy of 2019[4], updated by "ons Wirtschaft vu Muer"[5] fosters capacity and competence building of all actors in the areas of data governance, data processing and data analytics by promoting affordable technologies and services running on trustworthy processing capabilities granting very low latencies.

Luxembourg wants to democratise the cloud-edge technology via spillovers and positive externalities generated through its participation in the IPCEI-CIS creating a European cloud-edge continuum based on European values.

The main challenge is to lower the technical knowledge and financial entry barriers for any entity wanting to join a data economy by promoting open-source technologies, data space governance models and GAIA-X standards for technical and semantical interoperability.

[4] https://gouvernement.lu/en/publications/rapport-etude-analyse/minist-economie/intelligence-artificielle/data-driven-innovation.html
[5] https://meco.gouvernement.lu/fr/publications/strategie/strategie-ons-wirtschaft.html

Description of the measures

Measure 1: Creation and large publication of the necessary open-source technology and governance models
The open-source technology for the creation of the first highly secure edge-nodes will be published between 2025 and 2026. The expected overall timing for this new measure is from 2024 to 2027. This includes the technical stack, the API (Application Programming Interface), user management, contracts and the governance model (GDPR, Data Act, Data Governance Act and AI Act). The publication of these information will greatly lower the individual invest necessary to create private, semi-public and public nodes. The technology is designed to foster cross-border collaboration within the European cloud-edge continuum ramped-up with the help of the IPCEI-CIS (see Section 5 for more information about ICEI-CIS).

The measure intends to create an affordable and easily manageable technology granting the necessary rights (for instance data portability) and necessary security features needed for the deployment of a data economy in Europe.

Especially in cybersecurity, this open technology is necessary to overcome the manifest market failures in cloud and cybersecurity addressed by the IPCEI-CIS.

The budget from 2023 to 2027 is 4 million € (national budget – GBER and research budgets).

Measure 2: Edge-cloud calls reusing published open-source technologies and governance models
Luxembourg fosters the deployment of edge nodes to provide low latencies and specialised services to entities with a high level of digitization and a great need for safe AI and/or collaboration based on technical interoperability. The Luxembourg data driven innovation strategy fosters the participation of all entities in a data economy. Yet the necessary and most of all trusted infrastructures providing the necessary services have to be available.

Luxembourg will publish RD&I calls in the different segments of the economy it wishes to develop. These calls will include references to the open cybersecurity node technologies and governance models to lower the individual investments and efforts and increase interoperability. The calls will refer to GAIA-X compatible standards and data spaces to enhance operative collaboration. The calls will foster cloud boosting to provide maximum efficiency while granting the necessary levels of security.

The measure is planned to start in 2024 and the yearly budget is estimated at 3-5 million € (national budget – GBER).

Measure 3: Legislative measures
Luxembourg will legislate in GDPR – secondary usage of data for the health sector to further enhance efficiency and effectiveness of collaboration in research. This is a new measure and the expected timing is from 2024 to 2025.

Luxembourg will legislate in cybersecurity (DORA – Digital Operational Resilience Act and NIS2 – Network and Information Security) and further strengthen legal clarity for the exchange of security relevant data (cybersecurity, fraud detection, mule accounts …) and boost collaboration in this area to enhance creation of effective AI enhanced solutions for fraud detection and cybersecurity measures.

This measure is particularly fostering the creation of data spaces in health, energy and smart cities.

Measure 4: GAIA-X

Luxembourg will create the cybersecurity GAIA-X stream to further enhance interoperability of cybersecurity threat information (based on MISP[6] technology – Malware Information Sharing Platform) and operative cybersecurity telemetry.

GAIA-X is an existing measure that is expected to be extended from 2025 to 2030.

The GAIA-X initiative, which encourages and coordinates the creation, validation and publication of sectoral and cross-border data interoperability frameworks is a powerful catalyst for boosting the data economy. Yet with the complex regulation that is being put in place to strengthen the trust of all data economy stakeholders necessitates guidance for the implementation of interoperable data spaces and the ramping up of trustworthy data intermediaries and data processing infrastructures. For this reason, the Luxembourg Government foresees to increase the number of experts working in this area. They should on the one side encourage companies to get involved in the data economy and on the other side identify potential synergies and publish guidance for stakeholders.

The yearly budget of the measure is 2/3 million € (national budget).

Quantum computing

The measures that directly or indirectly impact the "Quantum Computing" digital target are described in Sections 4 and 5.

The measure planned in the context of the Multi-Country project (MCP) "EuroHPC" has a direct impact on the "Quantum Computing" digital target. This measure is described in Section 5.

The "Luxembourg Quantum Communication Infrastructure" (LuxQCI) has an indirect impact on the digital target but helps achieve the general objectives. It will therefore be described in Section 4 of the national roadmap.

[6] https://www.misp-project.org/

Digital Transformation of Businesses

EU digital targets: digital transformation of businesses:

d) at least 75% of Union enterprises have taken up:
   1. cloud computing services;
   2. big data;
   3. artificial intelligence;

e) more than 90% of Union Small and Medium Enterprises ('SME') reach at least a basic level of digital intensity;

f) the Union grows the pipeline of its innovative scale ups and improves their access to finance, leading to at least doubling the number of unicorns.

Take-up of Cloud, Big Data and Artificial Intelligence by businesses

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: Development of Luxembourg cloud application and services for SME								
Measure 2: Financial security services								
Measure 3: OSPO - Open Source Programme Office								

To increase the uptake of cloud services by Luxembourgish companies, Luxembourg will implement multiple measures to increase the creation of suitable, affordable and secure cloud services for companies and especially SME.

Description of the measures

Measure 1: Development of Luxembourg cloud application and services for SME

The Government will publish GBER (General Block Exemption Regulation) – experimental development financed calls for the creation of cloud enabled accounting, tax and ERP services for SME that foster interoperability, data portability, data export capabilities and fraud detection and prevention technologies that can be used by multi-tenant service providers specialised in SME needs.

This is an existing measure that is planned to be extended until 2027.

By 2025, the first cloud-based services adapted to the Luxembourg context (social security, taxing, e-invoicing, banking, eIDAS services such as digital signatures, digital wallet and e-archiving) will go online on the Luxembourg cloud providers.

Luxembourg is preparing the implementation of a national Health Information System which aims to connect all hospitals to a unique system and which foresees connection with medical cabinets and long-term care establishments. The roll-out of the first phase of this system is foreseen for 2026. This system will respond to the requirements of the European Health Data Space and will provide a high level of security and especially confidentiality. By 2027, the Government will have put in place API for services used by SME for taxation, social security. These API will further enhance the uptake of SME of cloud services. The majority of private medical cabinets will be connected to their virtual highly secure and collaborative workspace.

The developments will have to respect data interoperability criteria (GAIA-X), data portability rights and provide the possibility to export anonymised data in order to create additional services in the data economy.

The yearly budget for this measure is 3 million € (public (GBER) and private budgets).

Measure 2: Financial security services

The further developments of open banking and instant payment, fraud detection and fraud prevention will be of utmost importance. Those are planned between 2025 and 2027. Luxembourg will in a collective effort create a GAIA-X compliant data space that makes available timely information about fraudsters.

Accounting and ERP softwares will be linked to this data space to consume data on malicious account numbers, domain names and wallet-ids used by mules or fraudsters.

This measure directly targets the challenges of insecure platforms.

The yearly budget 0.5 million € (public (GBER) and private budgets).

Measure 3: OSPO - Open-Source Programme Office

The Service eHandwierk[7] of the Chamber of Skilled Trades and Crafts is counselling small companies in their digitization process and has gathered a great knowledge about the recurrent problems and pitfalls. This measure started in 2018 and is thus ongoing. Together with the Chamber, an Open-Source Programme Office will be created to test and recommend the usage of open-source software within small companies. The ecosystem of service providers will be coached in the usage and maintenance of this software.

This measure directly affects the "Take-up of cloud services by businesses" Digital Target and addresses the challenges of lacking SME skills as well as discriminatory pricing.

The yearly budget is 150 000€ (public budgets) and it is planned to have the OPSO operational in 2025.

SME's with at least basic digital intensity

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: Letzshop.lu								
Measure 2: SME Packages - Digital								
Measure 3: Fit 4 Digital								
Measure 4: E-Invoicing								
Measure 5: Dedicated workshops and practical guidelines								

The measures related to this digital target are all existing ones that will be adapted to new market trends and business needs.

Description of the measures

Measure 1: Letzshop.lu

Letzshop.lu is an online marketplace supported by the Government and a number of partners who co-finance the project. It is aimed at all local businesses, regardless of their size, that wish to offer their customers a quick and easy way to order products. Retailers can present their complete range of products in this showcase. For retailers, it is also a way to sell online and digitise their business, be placed among the first search results in search engines, acquire new customers and benefit from personalised assistance.

[7] https://services.cdm.lu/gestion-entreprise/digitalisation

Investments in helping SME on the road to digitalisation will be maintained. In order to increase “online selling”, SME active in the retail sector can benefit from support from the national online platform Letzshop. This is an ongoing measure and efforts will be maintained to attract as many businesses as possible by offering them personalised assistance.

The budget of Letzshop includes an annual membership fee from the members of the Economic Interest Group, its partners (e.g. the communes) and a contribution per participating company depending on their license level. The communes pay 1.5€ per resident.

The planned contribution from the Ministry of the Economy from 2023 to 2026 (the budget for 2026 – 2030 is not determined yet) in thousands of euros is:

2023	2024	2025	2026
500€	400€	300€	200€

The overall budget for the Economic Interest Group for 2023 is 1.7 million €.

Measure 2: SME Packages – Digital

The "SME Packages - Digital", aim to implement a digital tool to boost performance in areas such as digital marketing (including the creation, development and improvement of websites and running social media campaigns), management systems (including cash register and software tailored to the industry) and electronic invoicing (such as an ERP). This is an ongoing measure and was previously known as “Fit 4 Digital Packages”. If the company is eligible and interested, it can apply and ultimately benefit from a financial aid by the Government of up to 5000€ and invest in a digital project with an approved service provider.

As part of the SME Packages – Digital support programme, companies receive assistance for implementing a digital tool that allows you to establish better online communication with customers and to achieve better business management. Companies can deploy a digital solution with the assistance of a professional and receive guidance from an adviser as they implement their digital strategy.

The House of Entrepreneurship from the Chamber of Commerce and the service “e-Handwierk” from the Chamber of Skilled Trades and Crafts and offer companies an initial digital checkup in order to identify their digital maturity and identify priority actions. They will then guide the companies through the implementation process and conducts a final meeting to evaluate the work that has been achieved.

The planned total budget for “SME Packages – Digital” and “Fit 4 Digital” (described below) for 2023 is 3 million € and 2024 is 3.5 million €. This is State Aid and the budget depends on the number of requests by companies. Companies are guided to the most suitable of both programs.

In 2022, new packages were available “SME Packages – Sustainability” which slightly decreased the number of Digital Packages. The evolution of the number of requests and the corresponding amounts can be found in Annex 7.

Measure 3: Fit 4 Digital

The "Fit 4 Digital" programme enables SME to diagnose their state of digital maturity and draw up a digital transformation roadmap using experts accredited by Luxinnovation.
“Fit 4 Digital” is a programme offering guidance and co-funding to businesses. It is spearheaded by Luxinnovation and supported by the Ministry of the Economy and comprises two phases:

- Phase 1: businesses have the option of having a consultant provide an assessment of their level of digital maturity, in terms of IT infrastructure, cybersecurity and software. The assessment is accompanied by a detailed plan listing various costed actions (consultancy and investment in hardware/software) that could be implemented to improve the business's digital readiness. State aid is provided, in the form of a capital grant, to cover the cost of the assessment.
- Phase 2: the company then chooses whether or not to implement all or some of the recommendations listed in the detailed plan. The investments made in furtherance of the digital readiness plan may be eligible for investment aid. In addition, the fees charged by the consultant accompanying the business through the implementation phase may be eligible for aid for consultancy services.

The planned total budget for "SME Packages – Digital" and "Fit 4 Digital" for 2023 is 3 million € and 2024 is 3.5 million €. This is State Aid and the budget depends on the number of requests by companies. Companies are guided to the most suitable of both programs.

In 2022, new programmes were available ("Fit 4 Sustainability") which slightly decreased the number of Fit 4 Digital projects. The evolution of the number of requests and the corresponding amounts can be found in See Annex 8.

Measure 4: E-invoicing

Since March 2023, it is mandatory for all economic operators to issue and transmit electronic invoices compliant to the legal obligations in public procurement and concession contracts. Economic operators can transmit their electronic invoices either in an automated way via the international eDelivery network Peppol (peppol.org) or via two alternative non-automated technical solutions on MyGuichet.lu:

- Online form allowing to manually fill in the data of an invoice and to submit the invoice[8]
- Online form allowing to upload an already compliant electronic invoice[9]

Furthermore, SME can benefit from the "SME Packages – Digital" to implement an e-invoicing system within their companies (see above).

All public sector bodies (all contracting authorities and entities) must be able to receive compliant electronic invoices via the international eDelivery network Peppol. The growth in use of electronic invoices in Luxembourg has been quite considerable following the introduction of this new obligation for economic operators and has gone up from a few dozen invoices in 2021 to around 1 million electronic invoices in 2023.

Electronic invoicing is already significantly, and will even more in the future, contribute to the automatisation and digitalisation of the business processes linked to invoicing, procurement and accounting in general in the private sector.

The yearly budget for E-invoicing is around 350 000€.

Measure 5: Dedicated workshops and practical guidelines

Since 2018, the Luxembourg Chamber of Commerce and the Chamber of Skilled Trades and Crafts offer SME support in their digitalisation process to identify the right tools to implement within their companies. They

[8] https://guichet.public.lu/en/entreprises/commerce/marches-publics/facturation/emission-facture-electronique-marche-public-contrat-concession.html
[9] https://guichet.public.lu/en/entreprises/commerce/marches-publics/facturation/transmission-facture-electronique-marche-public-contrat-concession.html

also offer, usually free of charge, awareness-raising workshops and conferences for business to highlight opportunities linked to digital transformation.

They are currently actively involved in preparing companies and especially SME for the new legal framework on electronic invoicing. This legislation makes it mandatory for economic operators to send their invoices electronically to the State in the context of public procurement and concession contracts. Together with the Luxembourg Ministry of Digitalisation, awareness-raising workshops are being organised and a day dedicated to electronic invoicing was held on 21st February 2023.

In addition to these workshops, numerous practical guidelines have been elaborated by the Luxembourg Chamber of Commerce on digital transformation (electronic invoicing, e-commerce, cybersecurity, etc.).

In the context of the new legislative framework on electronic invoicing in Luxembourg, the digitalisation service of the House of Entrepreneurship put in place a helpline for all questions relating to this new legal framework.

Number of Unicorns

In March 2023, building on the success and on the foundation of prior policy programmes for start-ups, the Government announced a new roadmap for start-ups and for scale-ups called “From Seed to Scale”. This roadmap continues to provide much-appreciated support for the creation of start-ups, which has demonstrated its usefulness and quality, and encourages their development into scale-ups.

Relative to its size Luxembourg will actively contribute to the development of unicorns in Europe by consolidating the elements of support for the Luxembourg start-up ecosystem and putting in place specific measures for scale-ups.

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: “Seed to Scale” Roadmap								
Measure 2: Fit4Start Accelerator								
Measure 3: Luxembourg Future Fund 2 (LFF 2)								

Description of the measures

Measure 1: “Seed to Scale” Roadmap

In June 2023, the Luxembourg Government presented the roadmap for the future development of Luxembourg's start-up ecosystem. The aim for Luxembourg’s Ecosystem is to reach a new stage of maturity, with a particular focus on the transition of young start-ups to the scale-up level. The roadmap proposes a series of measures specifically adapted to the Luxembourg ecosystem and structured around five main axes:

1. Continuing early-stage start-up support
2. A national ecosystem that is better connected, stronger and more visible
3. Improving access to talent for start-ups and scale-ups
4. Creating the right environment for scale-ups
5. A start-up ecosystem anchored at the heart of the European Union

This roadmap will guide Luxembourg’s future action in favour of the start-up ecosystem. It aims at further strengthening the economic environment in Luxembourg by building on the dynamism of start-ups and scale-ups.

Measure 2: Fit4Start Accelerator

Fit4Start is the flagship acceleration programme In Luxembourg supported by the Ministry of the Economy and managed by Luxinnovation. Launched in 2015, the national acceleration programme Fit4Start has now reached its 14th edition. The programme, that is organized around three verticals, digital technologies, Space and Health Technologies, provides coaching and grant funding (up to 150 000 €) to start-ups. In 2022, some 303 projects from over 58 countries were submitted to the programme. This accelerator contributes to identifying, financing and supporting high potential start-ups contributing therefore to build the pipeline of future European grown scale-ups.

Measure 3: Luxembourg Future Fund 2 (LFF 2)

The LFF 2 was created in March 2023 as the successor initiative to the existing Luxembourg Future Fund (LFF 1), which reached the end of its active investment period. The LFF 2 will target risk-adjusted financial returns whilst simultaneously stimulating the diversification and sustainable development of the Luxembourgish economy with investments across a range of sectors including climate technologies, Fintech, cybersecurity, energy resilience, life science and medical technologies, as well as new space technologies.

With €200 million in total financing commitments split between Société Nationale de Crédit et d'Investissement and the European Investment Fund, the LFF 2 provides additional firepower in support of innovative projects in Luxembourg.

In line with the existing LFF 1 initiative, investments under LFF 2 will continue to take place in the form of fund commitments and/or co-investments. However, compared to LFF 1 the investment scope has been broadened and will now:

- Include investment funds and businesses already established in Luxembourg, thereby allowing these entities to expand local operations further
- Target more mature innovative businesses by providing hybrid debt-equity investments. These less dilutive investment instruments may appeal to companies unwilling to give up further equity stakes. Thus, the addition of hybrid debt-equity investments will allow LFF 2 to invest into companies at different stages of development.
- As such, investments will also be considered for more mature companies, facing complex and uncertain market environments, including businesses currently exposed to changes in digitalisation, supply chain disruptions or companies transitioning to a low-carbon business model.

Digitalisation of Public Services

EU Targets: digitalisation of public services:

a) 100% online accessible provision of key public services for Union citizens and businesses;
b) 100% of Union citizens have access to their medical records (electronic health records (EHR));
c) at least 80% of Union citizens use a digital identification (ID) solution.

In order to achieve Digital Decade targets, Luxembourg is working on implementing several actions on a national level.

The reaching of these targets pre-supposes a robust internal system that is interoperable and efficient. Some of the actions below reflect these pre-conditions and building blocks in order to achieve end-to-end digitalisation. It is also important to note that the Government IT Centre focuses on the implementation of standardised platforms according to the "as a service" model.

N.B.: The internal costs mentioned throughout this section are always estimations.

Digitalisation of public services for citizens and for businesses

The targets “Digitalisation of public services for citizens” and “Digitalisation of public services for businesses” have been combined as the measures described below target both, citizens and businesses, at the same time.

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: National strategy on electronic governance 2021-2025 (eGovernance Strategy)[10]	■	■	■					
Measure 2: Draft law on the electronic signature of administrative documents and secure platform for public documents[11]		■						
Measure 3: Electronic signature verification and validation platform	■							
Measure 4: MyGuichet.lu app: omni-channel delivery of public services (improvements)	■							
Measure 5: GovTech Lab Innovation partnerships	■	■	■	■	■	■	■	■
Measure 6: Conseil à la Digitalisation – Digital Advisory Service	■	■	■	■	■	■	■	■
Measure 7: Once Only Principle	■	■	■					
Mesure 8: MyGuichet.lu Virtual Meeting Room		■						

Description of the measures

Measure 1: National strategy on electronic governance 2021-2025 (eGovernance Strategy)

The 'Electronic Governance 2021-2025' strategy, drawn up jointly by the Ministry for Digitalisation and the Government IT Centre, was adopted by the Government Council in 2021 and is thus an ongoing measure.

One of the key areas of focus of the Ministry for Digitalisation aims at reinforcing eGovernment and enabling the transition to digital Government, a concept that covers the use of technologies as part of the strategies to modernise the State, the purpose being to create genuine added value for citizens, businesses, and public authorities. The eGovernance strategy is part of this approach, determining the essential elements of the

[10] To be renewed for the years 2026-2029.
[11] This is only an estimation, given the nature of the legislative process and the fact that there are parliamentary elections in October 2023, potentially delaying parliamentary work.

State's successful digital transition in order to provide the citizens with access to high quality digital services and ensure the gradual transition to digital governance and a data-driven public sector, as advocated by international bodies.

To deliver high quality online public services, the Government emphasises user-centred services, digital accessibility and adherence to six key principles: Once Only, Digital by Default, Inclusion and Accessibility, Openness and Transparency, Reliability and Security, and Interoperability and Standardisation. These principles are in line with the Tallinn and Berlin declarations.

Two of these principles, Once-Only and Digital by Default, specifically address the implementation of base registries. These registers provide citizens and businesses with transparency and control over their data held by public authorities and allow them to update their information.

This measure addresses the challenges with interoperability of administrations and the use of data.

Efforts to analyse the progress on the goals set out in this strategy are ongoing, and concrete actions to propose an updated plan for the years 2026-2030 will start in 2024. It is foreseen to continue to align this strategy with the Digital Decade targets and goals where possible.

Measure 2: Draft law on the electronic signature of administrative documents and secure platform for public documents

In order to facilitate and accelerate the transmission of documents in administrative matters, between the Government and the various administrations, and between administrations and citizens, it has been proposed to introduce the possibility of affixing the electronic signature and the electronic seal in administrative matters. The draft law has been submitted to the Parliament and is undergoing the official procedure. It is estimated that the law will come into effect in 2024.

The costs for the secure platform for public documents amount to 382 000€.

The (draft) law and the accompanying platform will further contribute to the digitalisation of administrative processes, as they will enable administrative acts to be concluded in digital format. This means that many of the processes that are based on a signed document can be carried out in their entirety in digital form which will lead to faster processing and less waiting time for citizens and businesses.

In addition, digital inclusion will also be enhanced by the functionality of affixing a digital identifier on public documents, which will allow any citizen to access the original acts stored on the platform simply by knowing the corresponding identifier, thereby enhancing trust.

Measure 3: Electronic signature verification and validation platform

This platform will allow state agents to verify and validate electronic signatures in accordance with the requirements of the eIDAS regulation. The user uploads the document to the platform that validates the signatures, stamps and electronic timestamps present on the document on the basis of the European trusted lists and presents the results of the validation to the user in a simplified way. The platform will further allow to download a detailed report and print the validation summary in a print-friendly format. The document is destroyed automatically on the platform after the validation report is issued.

With the aforementioned law and the aforementioned platform for public documents referenced above, the needs in terms of verification of electronic signatures will increase and this new platform for electronic signature verification will address those needs.

The platform will allow state agents to receive electronically signed documents from citizens and companies and validate the electronic signature on the document. Citizens and businesses will be able to submit more electronic documents (e.g. supporting documents) to administrations and more administrative procedures can be redesigned to be end-to-end digital.

The platform is under development and foreseen to be operational by the end of 2023.

The foreseen budget for this platform is 59 000€.

Measure 4: MyGuichet.lu app: omni-channel delivery of public services

The MyGuichet.lu app exists since 2021 and is constantly improved. Currently, people must have a private eSpace on MyGuichet.lu and pair it with the app before they can use all the features of the app. In order to enable more citizens to use MyGuichet.lu, developments are underway to make the pairing between the private eSpace and the app optional, so that the user can then authenticate directly in the app and hence use all features of the app, and to allow new users to register and create their private eSpace directly in the app.

These developments address new trends in society where mobile equipment is increasingly replacing conventional computers. This measure is directly in line with the e-Governance strategy 2021-2025, which provides for the cross-media development of online public services and supports an omni-channel policy for the delivery of public services. The aim is to give citizens the opportunity to carry digital certificates on their smartphones. This is a first step in order to be able to exchange later verifiable credentials established on the basis of digital certificates.

These efforts are expected to conclude at the end of 2023.

It is challenging to budget this measure as there are different workstreams and the self-register feature, for example, is being developed as part of a larger project.

Measure 5: GovTech Lab innovation partnerships

The GovTech Lab is a technological innovation accelerator for the Luxembourg State. It uses open innovation to work with internal and external actors on the development of the digitalisation of public services and integration of new technologies. It organises events around GovTech and aims to create a real GovTech community in Luxembourg. The GovTech Lab is a joint initiative of the Ministry for Digitalisation and the Government IT Centre.

This measure is about creating and implementing innovative, technological solutions that contribute directly to providing online public services to citizens. The GovTech Lab is a permanent initiative created in November 2021 that launches a minimum of two innovation partnerships per year. The total budget attributed to this measure amounts to 0.47 million €.

Measure 6: Conseil à la Digitalisation – Digital Advisory Service

In 2022, the Ministry of Digitalisation developed a concept to create an internal Digitalisation Advisory Service (“Conseil à la Digitalisation”), which was officially launched at the beginning of 2023. This unit is now operational and is responsible for analysing and assessing the maturity of public administrations in terms of the digital transition, which is measured using a "Digital Maturity Assessment". This unit also provides support to ministries and public authorities in implementing a personalised digital roadmap, taking into account the

objectives and principles set out in the eGovernance Strategy and the technological standards applied by the Government IT Centre.

This initiative is ongoing and directly contributes to developing better online public services for citizens and businesses.

Currently, the department consists of one fulltime employee and is expected to grow in the coming years.

Measure 7: Once Only Principle

As part of the implementation of the National Interoperability Framework, the National Committee for Interoperability ("Comité national d'interopérabilité" – CNI) mandated the thematic and transversal Working group – Once Only Principle (Groupe de travail thématique transversal - Once Only Principle, GTTT OOP) to "systematise and accelerate the Once Only approach". This working group is composed of representatives of the CNI sectors as well as representatives from the Ministry for Digitalisation and other public sector bodies (PSOs) specifically chosen for their expertise in this area. In addition, there are members of the Interministerial Committee for Digitalisation, which has also included the Once Only principle in its roadmap as a priority action. The coordination of the GTTT OOP as well as the secretariat are provided by the Ministry for Digitalisation.

In 2022, Luxembourg set up three working groups:

1. a subgroup "législation" (legislation) to evaluate the legal aspects of the Once Only Principle in the public sector,
2. a subgroup "Automated/Proactive eGovernment Subgroup" focusing on the automation of procedures, starting with four life events, and
3. a subgroup MyGuichet.lu OOP by Design increasing transparency and accountability in administrative processes.

It is expected that this Working Group will continue its work in the coming years.

Measure 8: MyGuichet.lu Virtual Meeting Room

One of the axes of the digitalisation of public services is to enable citizens to carry out as many procedures as possible using IT tools. However, it may be essential that a live exchange can take place between an agent in charge of a case and the citizen.

The aim of this project is to enable public administrations to offer virtual appointments by video conference. Citizens and businesses will be able to have an appointment with an administration virtually by video conference without travelling to a physical counter. This allows to bring processes online that need a direct and human interaction between a citizen and a civil servant.

The Virtual Meeting Room will be available as a new functionality of MyGuichet.lu in 2024.

The budget for this project is approximatively 250 000€.

Electronic identification (eWallet and eID)

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: National eWallet								

Description of the measures

Measure 1: National e-Wallet

The development of a national e-Wallet allowing users to manage and present digital attestations of official documents (principle of Self Sovereign Identity) on their smartphones as a successor of "GouvID" is ongoing.

The "GouvID" application was launched in 2022 and can be used as a mobile eID reader app for authentication to specific online services (the citizen portal myGuichet, the platform for electronic gathering of financial data, and Luxembourg's business registry).

As of today, Luxembourg has one eIDAS-notified eID scheme, the national identity card. The identity card is equipped with two digital certificates that can be used for accessing online services and for digital signatures. To make use of the eID, Luxembourgish citizens require either a card reader device or they can install the GouvID app on their smartphone. The smartphone then works as a card reader.

The Government IT Centre plans to carry out a proof-of-concept to change the algorithm used to generate the cryptographic certificates of the Luxembourgish identity card. The goal is to change from an RSA-based algorithm to elliptic curve cryptography (ECC). Due to higher cryptographic strength of the ECC-keys, the validity period of eID certificates could be increased from 5 years to 10 years.

A first version of the eWallet will support an attestation of the identity card. To this end, an amendment for the law of 19/06/2013 on the identification of natural persons is currently in the official legislative procedure and is expected to pass in 2023/2024. The amendment should particularly define the legal value of the digital attestation of the ID card in offline scenarios. While the technical work on the solution has been completed, the launch of the app will be planned as soon as the law has been amended.

We estimate the total budget to be +/- 600 000€ (internal costs and outsourcing costs on the side of the Government IT Centre). In addition to that, there are personnel costs on the side of the Ministry for Digitalisation.

eHealth composite indicator on the availability of electronic medical data

Overview of the measures and timing

	2023	2024	2025	2026	2027	2028	2029	2030
Measure 1: organise meetings with and for software vendors and healthcare institutions' CIOs								
Measure 2: organise (in)formation meetings for HCP + invite them to work groups								
Measure 3: continuous assessment of need for functional evolutions								
Measure 4: roll out medical ePrescription/eDispensation service on national level								
Measure 5: offer information sessions on the DSP for different patient target groups								
Measure 6: implement further accessibility improvements to eSanté portal								

Following the Luxembourg results for the eHealth composite indicator, four major issues have been identified:

- **Observation 1**: some healthcare data can be exchanged / held available but are not yet timely (and automatically) updated
  Some of the healthcare data mentioned in the survey to support a Study for Digital Decade eHealth Indicators Development (e.g. hospital discharge letter, essential healthcare data sets) are not timely and automatically updated by the HCP. This despite the fact that the latter has the technical possibility to do so and that the technical specifications of the data to be exchanged have been made available to the software editor (independent HCP) or IT department (HCP institution).
  The underlying reasons for this gap between what is technically possible and if/what data is effectively shared are twofold: the available relevant technical specifications have not been implemented by the software vendor / IT department or the HCP does not adhere.

- **Observation 2**: healthcare professionals (HCP)'s connectivity is in place, but cannot upload health data timely (and automatically) because the service is not yet available
  This is specifically the case for the medication ePrescription/eDispensation service. The measure foreseen to tackle this issue is the roll-out of the ePrescription/eDispensation use case on national level (and later on also on cross-border level as foreseen in Agence eSanté's participation in the EU programme "MyHealth@EU").

- **Observation 3**: some HCP institutions are not yet connected to the national eHealth platform
  Some of the types of HCP institutions listed in the survey are not yet connected to the national eHealth platform. More precisely, the current status for the institutions listed in the survey is as follows:
  - public/private rehabilitation centre: none are connected
  - public/private geriatric nursing homes : some private ones are connected
  - private mental health facilities: public ones are connected , no private ones are connected

- **Observation 4**: absence of legal basis and/or provision of additional measures to support equal access opportunities for disadvantaged groups (citizens with low digital and health literacy, disabled citizens, elderly)
  Three major factors that enhance equal access opportunities for all citizens are:
  1. digital, more specifically eHealth, literacy, i.e. the ability to use eSanté services, more particularly the DSP in this case
  2. availability of assistance (helpdesk e.g.) to assist citizens with the access to and management of their DSP
  3. inclusive health data access services that comply with the Web Content Accessibility Guidelines to facilitate access for disabled citizens for example.

To tackle these hurdles, measures are proposed around two major action areas:

a) contribute to the development of digital (eHealth) literacy
b) improve the accessibility to eSanté services (a.o. for disabled persons).

Taking into consideration that our Helpdesk can be contacted for assistance on weekdays from 8:00 until 18:00 by email and telephone, and various types of information material (such as user guides) are held available on eSanté's website www.esante.lu (in French, English, Luxembourgish and German).

The following measures are proposed to overcome the hurdles related to the four major issues:

Description of the measures

In response to **observation 1 and 3**:

Measure 1: organise meetings with and for software vendors and healthcare institutions' CIOs
This measure intends to incite software editors / IT departments to implement the technical specifications and foster action from both parties involved, meaning software vendor/IT department and HCP respectively.

In order to keep software editors / CIOs informed about ongoing and new projects, Agence eSanté will continue to hold at least two "group" information sessions per year, and have individual meetings on an ad hoc basis.

This measure is an existing and continuous one that is part of Agence eSanté's missions and is included in its budget (total annual budget for organisation of all types of info meetings: 32 000 € + the average HR cost related to meetings for software vendors/IT departments: 17 600€).

It will help incite software editors/IT departments to implement the technical requirements allowing the data exchange.

In response to **observation 1:**

Measure 2: organise (in)formation meetings for HCP + invite them to work groups
This measure intends to incite healthcare professionals (HCP) to adhere to upload/update data in the DSP.

Keeping HCP informed about the eSanté services, here particularly the DSP, and inviting them to work groups is a way to raise their awareness about the service, reinforce/underline the importance of their role as producer of data that must be uploaded into the DSP, and will foster their uptake.

This is an existing measure that Agence eSanté will continue to put in place. The measure is part of Agence eSanté's missions and budget (total annual budget for organisation of all types of info meetings: 32 000€ + the average HR cost related to meetings for HCP: 15 050€).

In response to **observation 1:**

Measure 3: continuous assessment of need for functional evolutions (so as to reply to HCP needs)
Through group and individual meetings with HCPs, Agence eSanté will continue to assess whether additional new functionalities are to be put in place to make the DSP responsive to the HCP's needs in their daily practice and evaluate the additional investment required for the respective functional evolutions.

This is an existing measure that Agence eSanté will continue to put in place. The budget is inherent to Agence eSanté's missions and included in Agence eSanté's budget.

In response to **observation 2**:

Measure 4: roll out medical ePrescription/eDispensation service on national level
It is an existing measure as it is foreseen in Agence eSanté's roadmap.

Timing : starting 2024 - the timing of the effective launch of the general roll-out will depend upon a successful pilot phase, the due implementation by editors/IT departments and the adherence of HCP)

Foreseen in Agence eSanté's missions and budget (total budget of 2 750 000€ for the works related to the deployment of the four foreseen use cases of which medical eP is one).

Additional general information: the national multimodal ePrescription service is foreseen to be deployed for the following use cases (in chronological order of expected timing of roll out): for laboratory tests (starting 2024), medication (starting 2024), nursing care (starting S2 2024), medical imaging (starting 2025). Since ePrescription is the basis of the majority of healthcare acts, this will have an important positive impact on the uptake of the DSP.

In response to **observation 4**, action area a):

Measure 5: offer information sessions on the DSP for different patient target groups
Agence eSanté will continue to hold information sessions on the DSP at its own initiative and at the initiative of and in collaboration with relevant stakeholders and associations, for example at the occasion of congresses, exhibitions, at associations' assemblies, etc.

This is an existing measure that Agence eSanté will continue to put in place. The measure is foreseen in Agence eSanté's missions and budget (total annual budget for organisation of all types of info meetings: 32 000€ + the average HR cost related to patient information sessions: 15 050€).

In response to **observation 4**, action area b):

Measure 6: implement further accessibility improvements to eSanté portal
In June 2023, Agence eSanté implemented in the national eSanté portal a first series of measures to facilitate health data access for disabled citizens, mainly for people with vision impairment.

In order to further enhance accessibility for disabled persons (e.g. with hearing problems) and compliance with the law "*Loi du 28 mai 2019 relative à l'accessibilité des sites internet et des applications mobiles des organismes du secteur public*" additional actions will be undertaken to put in place functions that facilitate accessibility for all citizens.

This is a new measure, starting in 2024 and having an estimated budget of 40 000€.

Section 4: Main policies, measures and actions to contribute to the general objectives

This section describes the main policies, measures and actions that Luxembourg is planning on a national level and that will help to achieve the general objectives listed in Article 3 of the Decision establishing the Digital Decade Policy Programme 2030.

This chapter refers only to measures that are complementary to the targets and are considered to also contribute to the achievement of the objectives listed in Article 3. Measures from Section 3 will therefore not be repeated.

Digital citizenship

Actions, policies and measures related to general objective (a)

(a) Promoting a human-centred, fundamental-rights-based, inclusive, transparent and open digital environment where secure and interoperable digital technologies and services observe and enhance Union principles, rights and values and are accessible to all, everywhere in the Union.

Development of a new version of Guichet.lu for better accessibility

A new version of the Guichet.lu information portal (single digital point of contact for all information about administrative procedures between citizens, businesses and the Luxembourg Government) is currently being developed.

The focus lies on a better structure of the website and better visibility through the use of a clear and simple language.

More than 1 700 administrative procedures are described. Each administrative procedure is described according to the same structure: who is concerned, costs, preliminary steps, practical modalities of the application, links to forms and online procedures on MyGuichet.lu (transactional platform of Guichet.lu), contact bodies, feedback module to evaluate the content of the procedure.

All descriptions are written in plain and simple French by the editorial team and validated by the competent administrations. Guichet.lu is completely translated into three languages (French, German, English). French and German are also available in a clearer and simpler language (“Facile à lire” and “Leichte Sprache”). This is intended to help people with reading and comprehension difficulties. The goal is to make the content of Guichet.lu as accessible as possible for everyone.

The new developments are intended to help citizens understand their rights and obligations regardless of their level of education.

The new version of Guichet.lu is planned to be finalised by the end of 2023. The approximate budget (internal and external costs) is of 900 000€, exclusive of VAT.

Organisation of Digital Inclusion events

The Ministry of Digitalisation organises a National Digital Inclusion Day every year on 17 May, coinciding with the World Telecommunication and Information Society Day. The second National Digital Inclusion Day took part in 2023. The event includes participatory workshops for associations with an inclusion focus and an

interdisciplinary forum on digital inclusion. The forums foster collaboration, knowledge sharing and the development of solutions to digital inclusion challenges.

In addition to the national day dedicated do digital inclusion, the Ministry for Digitalisation organises an interdisciplinary forum on digital inclusion. The first forum was organised this year and featured a round table discussion on digital accessibility and inclusive design. This forum brings together representatives of ministerial departments, actors active in digital inclusion and stakeholders supporting people that are isolated from the digital world. This first edition of the forum, which will be held every six months starting next year, was a great success, bringing together more than 120 representatives of associations and organisations whose target groups are potentially affected by digital exclusion.

The budget varies depending on the nature and scope/size of event and is approximatively of 60 000€ each year.

Actions, policies and measures related to general objective (b)

(b) Reinforcing Member States' collective resilience and bridging the digital divide, achieving gender and geographic balance by promoting continuous opportunities for all individuals, developing basic and advanced digital skills and competencies, including through vocational and professional training, and lifelong learning, and fostering the development of high-performing digital capacities within horizontal education and training systems.

Adaptations to the changing nature of work and societal environment

Over the next decade, Luxembourg's national digital skills policy aims to continuously adapt to the changing nature of work and societal environments.

With the launch of the Government initiative Digital Luxembourg[12] in 2014, broader public and private outreach, more flexible funding of projects, and most of all whole-of-Government digital skills policy and actions coordination became largely facilitated ever since. Digital Luxembourg is taken charge of by the Ministry of State's Department of Media, Connectivity and Digital Policy's (SMC) team. The yearly budget of Digital Luxembourg situates between 0.8 and 1 million €. Luxembourg's integrated Governmental approach as regards digital skills policy guided by the SMC was illustrated within the "Structured Dialogue for Digital Education and Skills" – process with the European Commission. Today's Skills roadmap for the Digital Decade is a natural follow-on process in this inter-ministerial cooperation.

Examples of key digital skills providers that testify from Luxembourg's adaptiveness of education and training offers to address digital transformation in work and societal environments can be found in Annex 9 of the roadmap.

ICT Specialists and Gender Convergence

Luxembourg is one of the 26 Member States that signed the December 2019 EU Council Declaration to encourage women to play an active and prominent role in the digital and technology sectors. Together with the Luxembourg Ministry of Equality between Women and Men, the SMC since addresses the need of girls and women in digital skills and jobs.

The Digital Decade Policy Programme provides us with a strong political instrument to deploy further means as regards ICT specialists and gender convergence: together with key ministerial stakeholders (the SMC, the

[12] https://innovative-initiatives.public.lu/

Ministry of Equality between Women and Men, the National Emplyment Agency (ADEM), other ministries will join) addressing the digital gender gap in ICT job skills and access to digital skills assessment and training guidance. The ultimate objective is to generate more digitally skilled women over the next years.

Digitalskills.lu: the platform dedicated to developing digital skills and talent

The Digital Skills and Jobs Coalition platform initiated by the European Commission in 2016 is an appropriate concept going hand in hand with Luxembourg's integrated approach to national digital skills policy.

Since 2019, Digital Luxembourg of the SMC, together with the Chamber of Commerce and the Chamber of Skilled Crafts, are governing the Luxembourg Digital Skills and Jobs Coalition, that is coordinated by a non-for-profit organisation WIDE (Women in Digital Empowerment). This coordination task is co-financed via a mutually shared yearly budget of 50 000€.

With a 155 000€ budget granted via the CEF (Connecting Europe Facility) Telecom 2 programme in 2022, the SMC co-financed the new version of the Digitalskills.lu platform from scratch. The goal is to promote and develop digital skills for everyone - from primary school students to ICT professionals. DigitalSkills.lu serves as a "matchmaking" platform for digital skills and jobs stakeholders. The platform informs people of training opportunities and the latest news and events relating to digital themes. Moreover, this tool is directly linked to initiatives in European Union member states thanks to an interoperability system with the European Digital Skills and Jobs Platform[13].

In addition to the platform, the Digital Coalition regularly organises thematic meetings and webinars for its members. Examples: Meetings about themes like AI, digital skills in non-tech sectors, DEP Call Information for Luxembourg, visits of the Luxembourg XR Pavilion where XR tech meets creatives and crafts, Visits of the University's AI Lab and the Digital Learning Hub, information sessions on specific training offerings at the Chamber of Commerce's House of Training, ….

The platform currently has 70 members. The medium-term objective of the DigitalSkills Platform is to accompany newer digital skills trends. A revision of the older Digital Skills and Jobs Coalition format from 2019 is planned to start in 2024.

Actions, policies and measures related to general objective (g)

(g) Ensuring that online participation in democratic life is possible for everyone, and that public services, health and care services are also accessible in a trusted and secure online environment for everyone, in particular for disadvantaged groups including persons with disabilities, and in rural and remote areas, offering inclusive, efficient, interoperable and personalised services and tools with high security and privacy standards.

Digital skills initiatives to foster digital inclusion of all citizens

The current National Action Plan for Digital Inclusion (2021-2024) brings together 40 concrete initiatives to foster the digital inclusion of all citizens. One of the action plan's three priorities is the development of basic digital skills and 18 of the plan's initiatives aim to improve the basic digital skills of Luxembourg's citizens. In 2024, a new plan will be elaborated within an inter-ministerial working group where experiences from various non-state actors close to populations isolated from the digital world also flow in.

The budget depends on the individual initiatives.

[13] https://digital-skills-jobs.europa.eu/en/about/national-digital-skills-and-jobs-coalitions

This Action plan is budgeting a yearly call for projects to promote digital inclusion in Luxembourg. The projects shall allow the development of basic digital skills in general and address people with difficulties to apprehend digital Government applications, in particular. Twelve of the thirteen projects funded over the past two years have focused specifically on developing basic digital skills and digital citizenship. It is expected that this initiative will continue in the future.

The annual budget for this is 250 000€.

Since 2021, the Ministry for Digitalisation has developed 13 specifically tailored vocational training modules in basic digital skills in collaboration with a continuous vocational training establishment (ErwuesseBildung ASBL – Adult Education). The various training courses are made available free of charge to actors operating in the social sector in order to make them accessible to as many people as possible throughout the Grand Duchy. It is expected that this initiative will continue in the future.

The annual budget for this initiative is 60 000€.

Feasibility study for and development of a "digital proxy"

In the context of the National Action Plan for Digital Inclusion, the Ministry for Digitalisation and the Government IT Centre launched a legal and technical feasibility study for the possible introduction of a digital proxy to enable a third party to carry out digital administrative procedures on behalf of a relative, which are accessible in a trusted and secure online environment for everyone. The proxy would be emitted for specific procedures and not for all at the same time. For example, separate mandates would need to be emitted for procedures related to employment, and for fiscal procedures, respectively.

A report was submitted by an independent law firm in December 2022, which will serve as the legal framework for the introduction of a digital proxy. Further specific technical analyses are needed to determine the specificities needed for the subsequent development of the proxy. The anticipated availability of the actual proxy is 2025 or 2026.

Digital strategy for cultural heritage and the arts

Since its inception in 2016, the mission of the Ministry of Culture's digital strategy service has been to define, coordinate and implement the national digital strategy for the cultural heritage and the arts sector. In 2024, the service will build on the foundations and achievements of the previous period, whilst taking into consideration the complexities of new and emergent technologies, and how these affect the cultural heritage and arts sector.

Indeed, the ecosystem of digital cultural heritage has a very visible part, that of publication platforms, mobile applications, 3D representations, virtual exhibitions or even scientific or educational projects. However, cultural institutions are faced with a growing demand from different audiences and users for digital objects and cultural heritage data, and are thus particularly affected by the digitalization of society.

For digitalization to become an integral part of work processes, which have become significantly more complex in recent years, teams must expand, new skills must be integrated, management, publication and preservation systems must be put into place or evolve. Capacity building is one of the major concerns in the sector. Digital transformation is not only a technological upheaval, but also involves a profound cultural change in cultural institutions. Professions and technologies are changing rapidly and the investments made today risk no longer being adequate if their evolution is too slow, if the number of specialists remains too small or if the skills are not adapted.

Building on the previous period, the next phase, between 2024 and 2030, will focus on creating the necessary foundations within cultural institutions to ensure the development of a sustainable and evolving digital ecosystem, in order to be able to respond to societal changes efficiently and to continue to offer a relevant and up to date public service.

The strategic orientations are in line with the recommendation at European level, including the Commission Recommendation of 27 October 2011 on the digitization and online accessibility of cultural material and digital preservation, replaced by Recommendation (EU) 2021/1970 of 10 November 2021 relating to a common European data space for cultural heritage[14]. The Ministry also participates in the European Commission's group of experts responsible for monitoring the implementation of the recommendation.

[14] https://eur-lex.europa.eu/legal-content/FR/TXT/HTML/?uri=CELEX:32021H1970&from=EN

Fostering leadership and sovereignty

Actions, policies and measures related to general objective (c)

(c) ensuring the Union's digital sovereignty in an open manner, in particular by secure and accessible digital and data infrastructures capable of efficiently storing, transmitting and processing vast volumes of data that enable other technological developments, supporting the competitiveness and sustainability of the Union's industry and economy, in particular of SMEs, and the resilience of the Union's value chains, as well as fostering the start-up ecosystem and the smooth functioning of the European digital innovation hubs;

Luxembourg National Data Service (LNDS)

At the end of 2022, on the initiative of the Ministry of Higher Education and Research (MESR), the national platform for data exchange (PNED: Plateforme Nationale d'Échange de Données), now called Luxembourg National Data Service (LNDS), was founded with the following missions:

1. to support the entire data value chain in a federated manner, with a central structure for the provision of enabling services;
2. to enable stakeholders in the public and research sector to use multiple, combined data sources, while respecting data protection regulations;
3. to be able to offer strong data partnerships to corporate partners in the context of public-private partnerships, with a view to developing new and innovative data-driven services and products.

In 2023, the LNDS has hired more than 30 co-workers with plans to hire up to 60.

The planned budget from the Luxembourg Government is 5 000 000€ for 2023, 6 000 000€ for 2024, 7 000 000€ for 2025 and 10 000 000€ for 2026, next to supplementary funding from other sources (primarily European Commission).

Luxembourg Digital Innovation Hub

The Luxembourg Digital Innovation Hub (LDIH) is implemented by a Luxembourgish consortium and is co-funded by the European Commission. It is part of the network of European Digital Innovation Hubs. Luxembourg has one hub, which supports the digital transformation of the manufacturing sector.

Starting in 2025, Luxembourg plans du extend the services provided by the Digital Innovation Hub to services linked to the data economy in order to facilitate and promote the usage of edge cloud services and technologies, particularly fostering the creation of data spaces in health, energy and smart cities.

The national planned budget is 500 000€ per year.

Actions, policies and measures related to general objective (e)

(e) Developing a comprehensive and sustainable ecosystem of interoperable digital infrastructures, where high performance, edge, cloud, quantum computing, artificial intelligence, data management and network connectivity work in convergence, to promote their uptake by businesses in the Union, and to create opportunities for growth and jobs through research, development and innovation, and ensuring that the Union has a competitive, secure and sustainable data cloud infrastructure in place, with high security and privacy standards and complying with the Union data protection rules

Tax measures

Luxembourg will widen tax credit measures for substantial efforts of companies, including SME, in digitalisation. These tax credit measures will cover a certain percentage of CAPEX and OPEX costs to foster the use of edge cloud technologies.

In the context of the digital transformation and the ecological and energy transition, the bill proposes to abolish the tax bonus for additional investment and to introduce the possibility for companies to benefit from an income tax bonus with specific rates for investments and operating expenses made as part of the digital transformation or the ecological and energy transition. Investments in tangible depreciable assets made as part of a digital transformation or an ecological and energy transition will be entitled to a total tax credit of 18% (12% + additional tax credit of 6%).

Under the bill, operating expenses (e.g. employee training costs, diagnostic or audit costs, cloud computing, software licences, etc.) incurred as part of such a digital transformation or ecological and energy transition will also be eligible for the 18% investment tax credit. This is a major adaptation of the reform and was decided together with the social partners at the Tripartite Coordination Committee meetings in September 2022. The current legal framework excludes operating expenses in general from the investment tax credit.

The bill lists specific objectives that investments and operating expenses must meet in order to fall within the scope of this new 18% tax bonus. Digital transformation must, for example, redefine a company's entire production process so as to substantially improve productivity, or implement an innovative business model within the company so as to create new value for the company's stakeholders.

The yearly budget is estimated at 5-10 million € (national budget, reduced tax income).

Fostering the development of the startup ecosystem

The Luxembourg startup and scaleup roadmap called “From seed to scale” will enhance Luxembourg and Europe’s leadership and sovereignty by empowering startups and scaleups to contribute to reaching the Digital Decade goals.

Luxembourg will continue to cultivate diversity within its start-up ecosystem while improving connectedness and the exchange of best practices between its various players, to increase the effectiveness of the entrepreneurial environment as a whole. The Government is seeking to make the start-up ecosystem ever more sustainable and inclusive, to give as many people as possible the same desire and the same opportunities to become entrepreneurs. Luxembourg wants to continue to enrich its community of innovative entrepreneurs, while enabling them to put together multidisciplinary and multilingual teams to deploy their start-up or scale-up solutions on the European market.

Luxembourg Quantum Communication Infrastructure (LuxQCI)

In the context of the European initiative EuroQCI, Luxembourg has started the national project called LuxQCI, with the aim to develop and build a quantum communication infrastructure in Luxembourg that will then be interconnected with the EuroQCI. In order to develop and implement this infrastructure, the Government of Luxembourg and the University of Luxembourg have signed a convention in March 2022 aiming at setting up a national experimental testbed. Luxembourg expects to connect at least two geographically distant points on the ground with an end-to-end encryption by using Quantum Key Distribution (QKD).

After successfully connecting two points within the laboratory using a 50 km fiber optic cable coil, the University of Luxembourg / Interdisciplinary Centre for Security, Reliability and Trust (SnT) realized the

connection of two geographically distant points in the country in the course of Q3 2023, namely the connection of the campus of the University of Luxembourg in Luxembourg-Kirchberg and the campus of the University of Luxembourg at Belval. This connection has been achieved by using a dark fiber spanning a distance of 33 km.

Luxembourg has dedicated 10 million euros from the Recovery and Resilience Facility (RRF) to the LuxQCI project, considering that a part of the RRF funds is allocated to the experimental testbed that has been set up by the University of Luxembourg. Luxembourg also submitted a proposal to obtain additional cofunding under the Digital Europe Programme (DEP), allowing Luxembourg to extend the research and development activities for the terrestrial segment. This proposal was retained by the European Commission and the Grant Agreement was signed in December 2022.

The upcoming programme that we will be looking into are the Connecting Europe Facility (CEF) Calls in order to secure further cofunding for the cross-border dimension of the infrastructure. In this context, Luxembourg intends to use these funds for cofunding works and related costs for the cross-border connections, and also for the development and construction of the first national optical ground station, necessary to establish the link between the terrestrial segment and the first European quantum satellite Eagle-1. This satellite is currently the only way to bridge long distance quantum key distribution.

Under the DEP Calls, the University of Luxembourg has set up Quantum communication classes for professionals as from September 2023, which is a further step in creating a new ecosystem in Luxembourg in this specific domain. A collaboration with the Digital Learning Hub (DLH) has also been set up in order to provide specific courses in the field of Quantum communications to professionals.

Besides the aforementioned sources of funding, the Luxembourg Government supports the project by providing additional funding, considering that the remaining funds will stem from the private industry.

In a first step, the measure is intended to strengthen the security of the communications of the public sector and of critical infrastructures and in a later step the communications of private sector entities as well. This is realized by adding a security layer based on Quantum technologies.

The national project started at the end of 2019 and is expected to run until the end of 2026, and even beyond.

The total budget attributed to this measure, including the DEP Call, amounts to 37.2 million €.

New development approach at the Government IT Centre based on CICD (continuous integration / continuous deployment)

Efficient online public services are essential to achieve their general objectives and the Digital Decade targets. This efficiency depends on administrations having the necessary tools to process online requests in a timely manner. A new development approach is being adopted to ensure that administrations can use state-of-the-art back-office systems that can be adapted quickly, especially when changes in the regulatory framework require adjustments. The Government IT Centre is constantly reviewing the standards that underpin the development of its back-office applications to incorporate the latest trends and ensure rapid, high-quality development in line with customer requirements.

One of the key initiatives in this modernisation effort is the adoption of continuous integration/continuous deployment (CI/CD), a central tenet of DevOps. This approach automates the development, testing and deployment of applications. It includes a development framework that provides standardised components for user interfaces (Vue.js) and back-end operations (Quarkus), both of which are open source. It also uses an application container management platform to manage isolated application environments and streamline the

deployment of applications built using the new development framework. In addition to the benefits in terms of development quality and speed, the CI/CD approach also improves deployment efficiency. In the future, this platform will be extended as a platform-as-a-service to other administrations, giving them more autonomy in deploying their developments while adhering to the quality standards of the Government IT Centre.

Actions, policies and measures related to general objective (k)

(k) improving resilience to cyberattacks, contributing to increasing risk-awareness and the knowledge of cybersecurity processes, and increasing the efforts of public and private organisations to achieve at least basic levels of cybersecurity.

Situational awareness

Resilience to cyberattacks is achieved when all stakeholders have at least a basic understanding of the threat landscape and implement cybersecurity measures accordingly, following the principle of proportionality and necessity. To help all stakeholders to achieve this goal, the Luxembourg Government will publish three times a year a situational awareness based on incidents and threats intel gathered in MISP (Open Source Threat Intelligence and Sharing Platform). This situational awareness should help all stakeholders to assess their risks in a more objective way.

The measure will start in Q1 2024 and has a budget of 60 000€ per year. Situational awareness will be published three times a year.

Risk management for SME

SME are part of most supply chains. To increase resilience of operators of critical infrastructures and operators of essential services, the members of the supply chains have to be secured as well. Luxembourg will continue to provide risk management tools and diagnostic tools for SME in order to help them implement the correct cybersecurity measures and in order to help them demonstrate their compliance. Luxembourg will interface these tools with the Luxembourg risk management platform and the risk governance platform MONARC.

The measure will start in Q2 2024 and most probably end Q4 2027 with a yearly budget of 150 000€

Rescue Chains

Luxembourg will implement the German model of "Rettungsketten "[15] (rescue chains) deployed in Saarland. The creation of these rescue chains foresees the training of the first, second and third level of support concerning cybersecurity incidents of SME. Luxembourg will set-up a training program for the first and second level of support at the Digital Learning Hub. The third level of support will be handled by already established public or private CSIRT. It is also foreseen to exchange operational knowledge about this approach with Saarland.

The measure will start in Q1 2025, an end-date is not yet foreseen. The yearly budget is of 200 000€

[15] https://www.bsi.bund.de/DE/Themen/Unternehmen-und-Organisationen/Informationen-und-Empfehlungen/Cyber-Sicherheitsnetzwerk/DRK/DRK.html

Digital Learning Hub

The activities of the Digital Learning Hub are already described in this document. There are specific trainings to upskill personnel in cybersecurity. This learning program will also be promoted via the chambers to the SME.

Contributing to the green transition

Actions, policies and measures related to general objectives (h) and (j)

(h) Ensuring that digital infrastructure and technologies, including their supply chains, become more sustainable, resilient, and energy- and resource-efficient, with a view to minimising their negative environmental and social impact, and contributing to a sustainable circular and climate-neutral economy and society in line with the European Green Deal, including by promoting research and innovation which contribute to that end and by developing methodologies for measuring the energy and resource efficiency of the digital space

(j) ensuring that all policies and programmes which are relevant to achieving the digital targets set out in Article 4 are taken into account in a coordinated and coherent way to fully contribute to the European green and digital transition, while avoiding overlaps and minimising administrative burdens;

Energy data platform

In 2021, an obligation for the Transmission System Operator, CREOS, was introduced in the electricity market law to develop and deploy a National Energy Data Platform (NEDP) for the electricity and gas markets. The long-term objective of the platform is to provide a central point for storage and exchange of energy market data between distribution system operators, suppliers, customers, generators, aggregators, energy communities and authorities, which is expected to bring a wide range of benefits to stakeholders and participants in the Luxembourg energy sector, such as:

- A high degree of competition with low barriers to entry
- Easy customer access to their own data for consumption and self-generation
- considerable improved data quality, in particular for customer master data
- Efficient collection and distribution of metering values
- Streamlined market communication processes through hub based communication
- Efficient reporting to regulatory authorities

Smart energy system

Smart energy systems will allow to address the challenges and to reap the benefits related to the energy transition. Specifically, an increasing number of market participants will need to be integrated and coordinated, such as small scale electricity producers, electric vehicles, or electrolyzers, closely aligned with grid infrastructures and markets. A number of activities has been initiated to facilitate and enable these developments:

- The rollout of smart meters started in 2016 and is about to be completed. 15-minute data for electricity and gas is communicated to markets actors daily via the centralised systems of Luxmetering, and further to the above described energy data platform.
- Grid operators are developing their networks into a smart grid, with digitalized and controllable transformer stations, predictive maintenance programs, or enhanced operational planning procedures.
- Energy suppliers and third party energy service providers are developing products and services to allow inter alia for energy sharing between prosumers, energy efficiency and dynamic pricing models.
- Several research and innovation projects in the field of smart energy systems are underway, proposed and carried out by consortia involving the University, research institutes, private companies and startups.

Infrastructure and platforms on an as-a-service basis

A centralised as-a-service-offer fits perfectly into a policy of cost rationalisation as well as energy savings since administrations do not operate their own infrastructures. The Government IT Centre's strategy focuses on the implementation of as-a-service offers for infrastructure, platforms and software.

Example: GovCloud, the private sovereign cloud hosted and operated by the Government IT Centre provides infrastructure as a service to the public administrations. GovCloud is hosted in data centres that are highly efficient in terms of energy use and cooling. Another key benefit of operating a cloud is the flexible provisioning of resources based on current needs, which means that only the necessary resources are utilised at any given moment.

Reduction of energy costs related to the workplace

The Government IT Centre is responsible for the centralised acquisition of office equipment for all ministries and administrations.

The Government IT Centre has implemented three key measures to reduce energy costs and improve the efficiency of office equipment management. Firstly, they have replaced small office printers with large centralised multifunction printers in administrative offices, incorporating secure printing systems to prevent unnecessary document printing. Personal printers are also being replaced with more energy-efficient inkjet printers. Secondly, through the introduction of the Digital Workplace concept, agents are provided with standardised equipment, including laptops and telephony software, which promotes flexible working while reducing the energy consumption associated with desktop computers. Finally, they encourage equipment donations in line with circular economy principles, ensuring that surplus equipment benefits people in need.

These ongoing measures are in line with the broader eGovernance strategy, creating a more sustainable and cost-effective IT environment for administrations.

Section 5: EU level cooperation

5.1 Multi-Country projects and Joint commitments

This section describes the multi-country projects (MCP) and joint commitments in which Luxembourg is implicated. It provides an overview of existing and potential future projects between Member States that would contribute to the achievement of the digital targets and general objectives.

Seamless cross border mobility 5G DeLux

In the domain of connectivity, Luxembourg is currently active in the multi-country project "Seamless cross border mobility 5G DeLux". In this project, Telekom Deutschland, POST Luxembourg, and BMW are pairing up in form of a consortium, aiming to go beyond existing LTE/4G roaming services between Germany and Luxembourg.

The objective is to enable 5G on an identified roaming corridor of a highway connecting both countries. Enabled by a Proof-of-Concept, this will progressively ensure seamless cross-border handover and service continuity. The corridor has a length of 98 km, between Saarbrucken (Germany) and Frisange (Luxembourg), covered by both MNOs.

The supported high-level use-cases encompass high bandwidth content services, map collecting/sharing, as well as voice and video calls, and will be carried out within a 36-month time frame.

The total project cost is 12 676 651€. The project is co-financed by the European Commission and the consortium.

5G Melusina

The second connectivity related multi-country project in which Luxembourg is active is "5G MELUSINA". The goal is to deliver an inception study to prepare implementation of 5G infrastructure along a rail cross-border section of North Sea Mediterranean between Metz (France) and Luxembourg City (Luxembourg), for the benefits of train passengers' connectivity and digitalisation of rail operations.

The study will be carried out by a consortium of 9 members involving two rail infrastructure managers and seven Mobile Network Operators (MNO) from both countries.

Currently, the consortium partners are preparing for the submission of a new project under the "works" category for the upcoming deadline.

Both aforementioned corridors are extremely valuable for achieving the digital targets. The topology along transportation corridors can be sometimes challenging (hills, tunnels). The MCPs allowed a simultaneous installation effort on both sides of the borders. Furthermore, these projects can contribute to a quicker harmonisation of the hand-over of active mobile connections once devices cross such borders. As of today, there is not yet an overall seamless hand-over.

The total project cost is 510 754€. The project is co-financed by the European Commission and the consortium.

EuroHPC

Luxembourg is one of the Member States that is actively participating in acquiring supercomputers and quantum computers, which is included under point (d) in the list of areas of activities for MCP in the Annex of the Decision[16].

The EuroHPC Joint Undertaking has already procured eight supercomputers across Europe. With MeluXina, Luxembourg already has one of the six most powerful supercomputers in Europe. It is of a large family of supercomputers linked across Europe as part of the EuroHPC network. This initiative is co-funded by the European Commission. The aim is to develop a continental supercomputing ecosystem and infrastructure.

Starting in 2024, Luxembourg will invest in a quantum computer simulator for its HPC and a small European Quantum Computer connected to the HPC.

This measure contributes to achieving the digital target "Quantum Computing" and helps reach the general objective (e) of the Digital Decade Policy Programme 2030[17].

The MCPs and supporting activities in this area aim to develop, deploy, extend and maintain a world-leading federated, secure and hyper-connected supercomputing, quantum computing, services and data infrastructure in the EU.

IPCEI-CIS

Luxembourg is one of the twelve Member States participating in the Important Project of Common European Interest for Next Generation Cloud Infrastructure and Services (IPCEI-CIS[18]) in the field of cloud computing, which is part of the multi-country Common Data Infrastructure and Services project.

The IPCEI-CIS aims to create a cloud-edge-continuum and grant the right for applications and data to freely "roam" from one cloud-provider to another cloud provider (data portability right granted by GDPR) with a special focus on edge-cloud computing. The aim of the IPCEI-CIS is to equip the European Union with the next generation of advanced, distributed, secure, sustainable and innovative cloud-to-edge capabilities that citizens and businesses need.

Luxembourg contributes to this IPCEI with a special focus on open source cybersecurity tools like SOC (Security Operations Centre) and CSIRT (Cyber Security Incident Response Teams) tools for Cloud and edge cloud generating important positive externalities in terms of synergies. Luxembourg will also provide privacy and trade secrets preserving technologies for cloud that are capable of running on edge nodes. Luxembourg has put a special focus on cross-company and cross-border collaboration and the capitalisation of synergies. To achieve this, all documentation, API, products and services will be published in open source via a resource centre becoming the first Luxembourg Open Source Promotion Office (OSPO). The OSPO measure is described in Section 3 of this document.

EDIH Network

The Luxembourg Digital Innovation Hub, as mentioned above, is part of a European Network.

[16] DECISION (EU) 2022/2481 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 December 2022 establishing the Digital Decade Policy Programme 2030
[17] Article 3 and 4 - AREAS OF ACTIVITY, DECISION (EU) 2022/2481 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 December 2022 establishing the Digital Decade Policy Programme 2030
[18] https://www.bmwk.de/Redaktion/EN/Artikel/Industry/ipcei-cis.html

Digital Skills and Jobs Platform

With Digitalskills.lu, Luxembourg is participating in the EU initative “Digital Skills and Jobs Platform”. The platform can be described as a “one stop shop” for digital skills in Europe and helps to bring the digital skills community, resources and various initiatives together[19]. Digitalskills.lu is described in Section 4 of the national roadmap.

POTENTIAL

The Ministry for Digitalisation and the Government IT Centre participate in the Consortium "Pilots for European digital identity wallet"[20] (POTENTIAL). They submitted a project that was selected in December 2022 by the European Commission to pilot new European prototypes around the "European Digital Identity Wallet". 148 participants from 19 European Union (EU) Member States and Ukraine joined forces in the POTENTIAL Consortium to pilot the new prototypes of the EU Digital Identity Wallet (EUDIW) through six use cases (e-Government services, bank account, mobile driving license and remote qualified electronic signature). This multi-country project aims at improving citizens' access to reliable and secure electronic identity means and services such as electronic signatures or digital attestations. This allows citizens to store their identity data in a secure digital wallet valid across borders. The mission is to shape and implement scenarios to test the European digital identity portfolio launched by the European Commission.

Thus, Luxembourg is testing between 2023 – 2025 cross border scenarios including the mobile driving licence, authentication, identification for private and public services and remote qualified signature in cross border scenarios. The project allows to extend the initial “GouvID” mobile app to a fully compliant EUDI wallet.

This project is co-financed by the European Commission. The total budget over two years is 1.2 million €, which also includes about 550 000€ in in-kind costs (personnel costs). EU-provided co-financing will be 50% of the eligible project costs, amounting to approximately 600 000€.

EBSI EDIC

Luxembourg is supporting the creation of the European Digital Infrastructure Consortiums (EDICs) that will contribute towards the goals formulated for the digital decade. The creation and assuring the financing of EDICs will help to create the right foundation for assuring the long-term success of various initiatives. Between February 2021 and February 2023, the Ministry for Digitalisation, Infrachain, the Luxembourg Institute of Science and Technology (LIST) and the Interdisciplinary Centre for Security, Reliability and Trust (SnT) partnered to develop the EBSILUX project. Co-funded by the European Union, the EBSILUX project integrates Luxembourg into the European Blockchain Services Infrastructure (EBSI). EBSI is part of the European Blockchain Partnership (EBP), a partnership between 29 countries (EU Member States, Norway and Liechtenstein) and the European Commission.

Luxembourg has voiced its intention to become a founding member of the EBSI EDIC. To that end, the Government has engaged in-kind and financial contributions in the amount of 250 000€ (before VAT, in total) to be disbursed over three years (2023, 2024, 2025).

[19] State of the Digital Decade Report Annex I: MCP Implementation
[20] https://www.digital-identity-wallet.eu/

Cross-border ePrescription exchange

As Luxembourg's National Contact Point for eHealth, AeS participates in the EU4Health programme, which aims to put in place the cross-border electronic exchange of a certain number of health data containing documents with a healthcare professional in another EU country.

In the context of this programme, AeS will put in place the cross-border ePrescription exchange in the course of 2026, and of original clinical documents (i.e. hospital discharge report, laboratory results and medical imaging report) starting 2025.

Genome EDIC

Building on the 1+MG initiative, the Genomic Data Infrastructure (GDI) project was launched as a multi-country project in November 2022 to develop, deploy and operate sustainable data-access infrastructures within each participating country including the legal frameworks, operational procedures and ethics principles required to foster and maintain citizens' trust in cross-border access to highly sensitive personal data. The new 40 million € GDI project, coordinated by ELIXIR, is jointly funded by the European Commission under the Digital Europe Programme and through co-funding from participating Member States. After the end of the project, sustainability is envisaged to be ensured by the members, EU funding as well as use-dependent income, depending on the legal framework, the governance model and the business/financial plan. The project will contribute to realising the ambitions set out in the 1+MG declaration. The GDI project brings together national agencies, research organisations, and technology providers in 22 countries out of the 26 signatory countries to start the deployment of a digital infrastructure to support the goals of the 1+MG initiative. Luxembourg has agreed to host the Genome EDIC during the Genome EDIC WG meeting on 26th May 2023. The decision on Luxembourg as a host country is preliminary and the final decision will be taken during the development of the Genome EDIC application.

Luxembourg has currently lined up the following financial and in-kind contributions:

- 1 405 568 EUR for the deployment of the genomic data infrastructure through the GDI project.
- 500 000 EUR to build tools to be used in the Genome EDIC such as a citizen information portal and a secure processing environment beyond the funds committed in the context of GDI.
- 500 000 EUR for creating reference genomes that will subsequently feed as data contribution to the Genome EDIC, envisaged as part of the Genome of Europe project.
- 1FTE for two years for data curation and characterisation to make them fit for purpose in the Genome EDIC

5.2 Facilitating factors at EU level

In this section, stakeholders describe elements and actions that could be supported by the EU in order to help member states to reach the digital targets and general objectives.

5G seamless handover

Unless a standard solution for a seamless hand-over gets implemented by the MNOs themselves within a reasonable timespan, it would be extremely valuable if additional support or incentives in the harmonisation of this hand-over gets promoted on the EU level. Still, the actual standardisation will be driven by the industry (e.g. within 3GPP).

Open Cybersecurity dataspace

Examples of current market failures in cybersecurity are coordination failure, asymmetry of information, lack of incentives, and absence of supply.

Especially due to the future massive onboarding of cloud technologies and due to the possibility of these actors to freely roam through the cloud-edge continuum (IPCEI-CIS), collaborative cross-border incident response and SOC technologies and services have to be developed for the cloud.

Furthermore, cybersecurity incidents in cloud can quickly scale and effective and efficient collaboration of CSIRT (Computer Security Incident Response Team) and SOC (Security Operation Center) are essential for resilience. To be effective, these private sector entities have to closely collaborate in an operative way, share threat intelligence, forensic evidence and take advantage of the obvious synergies of cybersecurity.

Luxembourg proposes other member states to join the open cybersecurity dataspace initiative to increase the effectiveness of their SOC or CSIRT activities, as, the data in the open cybersecurity data space can be used to train AI models used for unattended cybersecurity tools and services for SME..

Section 6: Stakeholder feedback

The national roadmap for Luxembourg is mainly based on existing national strategies, for which numerous private and public stakeholders were implicated.

The digital skills part was coordinated by the Department of Media, Connectivity and Digital Policy (SMC) with contributions mainly from the University of Luxembourg (Uni.lu), the National Employment Agency (ADEM), the Ministry of Higher Education and Research, the Ministry of Education, and the Department of Vocational Training (SFP).

In the area of digital infrastructure and digitalisation of businesses, different chambers (e.g. Chamber of Crafts, Chamber of Commerce) are regularly consulted, as well as ICT Luxembourg, the voice of Luxembourg's Industry (FEDIL) and various private service provider companies.

In terms of connectivity, relevant ministries, network operators, B2C and B2B Telecom service operators were mainly consulted. For the present feedback on the digital targets, a consultation round was performed, covering the regulator (ILR) and the MNOs already operating an active 5G network: ILR (regulator), Post Luxembourg, Tango (Proximus Luxembourg), Orange Luxembourg.

The stakeholders involved in the digitalisation of public services, and especially in the development of the eGovernance Strategy, are the various ministries (most of them) and administrations represented in the Inter-ministerial Committee for digitalisation. The ministries and administrations represented in this committee can be found in Annex 10. Last but not least, the High-level Committee for Digital transformation, a central body of the digital governance adopted by the Government Council in February 2020, brings together various ministries, representatives of civil society and experts from different backgrounds.

The input for the part regarding the "eHealth indicator on the availability of electronic medical data" was coordinated by Agence eSanté with contributions of the Ministry of Health, and is among others based on the feedback obtained through various meetings with major healthcare stakeholders (work groups with healthcare professionals, meetings with software editors, work groups for the elaboration of AeS' national roadmap - schéma directeur des systèmes d'information de santé, etc.).

Section 7: Overall impact and conclusions

Luxembourg's national Digital Decade strategic roadmap illustrates Luxembourg's willingness to help achieve the general objectives and the digital targets and more generally a successful digital transformation by 2030.

A number of Luxembourg's new or existing measures are linked to digital citizenship, especially the ones linked to the digital targets of people having at least basic digital skills, the digitalisation of public services for citizens and businesses, and the access to electronic identification as well as to electronic health records.

In Luxembourg, access to basic digital trainings is easy and the country is taking measures to ensure the development of basic digital skills for different age groups. Concrete measures target children, job seekers and older people. Measures help develop basic digital skills, teach online risks and contribute to a safer internet for citizens.

When it comes to the access to digital public services, Luxembourg is one of Europe's frontrunners and is very close to the target of 100%. The platforms Guichet.lu and MyGuichet.lu already allow people to take a whole range of procedures online and new measures will strengthen this.

Connectivity related measures are intended to help citizens get access to an ultra-high-speed network, which will provide them with an improved access to the digital economy.

A reliable and secure connectivity forms the backbone of our ecosystem, enabling individuals, businesses and societies to thrive and adapt in an increasingly interconnected world. Appropriate development and use of infrastructure, data and connectivity are essential to drive progress, efficiency and success.

With measures contributing to secure and resilient digital infrastructures, and an increased number of ICT specialists, Luxembourg actively contributes to fostering leadership and sovereignty in the EU.

Several measures contribute to Luxembourg becoming a pool of attraction for talents seeking a degree and career in digital skills and digital transformation. Measures aim to increase the offer and improve the overall quality of Luxembourgish study programmes. In fact, Luxembourg is proposing advanced digital skills trainings on different levels, such as university degrees, short cycle higher education programmes or training programmes.

In addition to measures helping to increase the number of ICT specialists in the country, Luxembourg has numerous ongoing and new measures that contribute to tackling the remaining challenges of an open cybersecurity and data economy.

Education and lifelong learning are of crucial importance, as the speed of technological advances requires that citizens are constantly learning new skills to stay competitive and adapt to professional requirements. In addition, recruiting talent is becoming a major challenge due to constantly evolving skill requirements and increased global competition and talent shortages in the emerging fields of digital technology.

On the Business side, there are measures that incentivise companies, and especially SME, to invest in digitalisation projects, which improves the companies' competitiveness and thus contributes to fostering leadership and sovereignty.

Luxembourg is, in addition to national initiatives, also actively participating in several large-scale multi-country projects that are crucial to combine efforts as Member States to reach the EU digital transformation by 2030.

The measures that contribute to the green transition concentrate for example on efficient energy use and on creating a more sustainable and cost-effective IT environment for administrations.

Digital inclusion is essential in today's interconnected world and plays a vital role to bridging the digital divide. By promoting access to technologies, digital inclusion encourages innovation, collaboration and knowledge sharing, creating thus a more inclusive and equitable society.

We remain convinced that the success of digitalization in Europe will largely depend on the degree of confidence of European citizens in the development and deployment of new digital technologies and services. To achieve this objective, it is essential to make Europe's citizens more responsible and to create a participatory European enlightened society that is aware of its rights and obligations in the digital space.

ANNEX

Annex 1: Construction method for s-shaped curves (Section 2)

For the creation of S-shaped curves, a Bass model has been used.

The Bass model is a mathematical model used to describe the adoption of a new product or innovation by a population over time. It is often used in marketing and innovation research to create S-shaped curves that represent the cumulative adoption of the product, with some people adopting it early (innovators) and others adopting it later (imitators, because they adopt the product after seeing others using it). The model helps predict how quickly an innovation will be adopted and when it will reach its saturation point in the market.

More information can be found here: *https://www.numberanalytics.com/tutorials/bass-model-new-product-diffusion*

Annex 2: Numerical values used for the graphs of trajectories (Section 2)

Digital Skills

At least basic digital skills

Period	DD trajectory	Baseline	Target
2015	86,21		80
2016	86,15		80
2017	85,18		80
2019	64,58		80
2021	63,79		80
2022	65,59		80
2023	67,39		80
2024	69,19		80
2025	70,99		80
2026	72,80		80
2027	74,60		80
2028	76,40		80
2029	78,20		80
2030	80,00		80

ICT specialist in employment

Period	DD trajectory	Baseline	Target
2011	4,30	4,21	10
2012	5,00	4,46	10
2013	4,70	4,71	10
2014	5,10	4,96	10
2015	5,00	5,22	10
2016	5,10	5,47	10
2017	5,20	5,72	10
2018	5,90	5,97	10
2019	6,10	6,22	10
2020	6,30	6,47	10
2021	6,70	6,72	10
2022	7,70	6,97	10
2023	7,99	7,22	10
2024	8,28	7,47	10
2025	8,56	7,72	10
2026	8,85	7,97	10
2027	9,14	8,22	10
2028	9,43	8,47	10
2029	9,71	8,73	10
2030	10,00	8,98	10

Digital Infrastructure

Gigabit (VHCN)

Period	DD trajectory	Baseline	Target
2019	90,70	90,70	100
2020	91,70	91,70	100
2021	92,60	92,60	100
2022	93,30	93,30	100
2023	95,85	94,24	100
2024	97,46	95,06	100
2025	98,45	95,77	100
2026	99,07	96,38	100
2027	99,44	96,91	100
2028	99,66	97,36	100
2029	99,80	97,75	100
2030	99,88	98,08	100

Fiber to the Premises (FTTP) Coverage

Period	DD trajectory	Baseline	Target
2017	57,18	57,18	100
2018	63,40	63,40	100
2019	67,50	67,50	100
2020	72,10	72,10	100
2021	75,20	75,20	100
2022	76,20	76,20	100
2023	83,45	78,01	100
2024	88,98	79,73	100
2025	92,90	81,34	100
2026	95,54	82,86	100
2027	97,24	84,28	100
2028	98,32	85,61	100
2029	98,98	86,84	100
2030	99,38	87,98	100

Overall 5G Coverage

Period	DD trajectory	Baseline	Target
2020	-	-	100
2021	12,69	12,69	100
2022	93,21	93,21	100
2023	95,79	95,79	100
2024	97,42	97,42	100
2025	98,43	98,43	100
2026	99,05	99,05	100
2027	99,43	99,43	100
2028	99,66	99,66	100
2029	99,79	99,79	100
2030	99,88	99,88	100

Edge-nodes

Period	Expected number of edge nodes
2022	-
2023	2
2024	6
2025	12
2026	15
2027	15
2028	16
2029	16
2030	17

Digitalisation Transformation of Businesses

Take-up of cloud services by businesses

Period	DD trajectory	Baseline	Estimation MECO	Target
2014	6,91	6,91	6,91	75
2016	12,21	12,21	12,21	75
2018	16,27	16,27	16,27	75
2020	23,09	23,09	23,09	75
2021	29,00	29,00	29,00	75
2022	38,94	35,41	31,20	75
2023	48,16	41,09	33,40	75
2024	56,01	46,09	35,60	75
2025	62,17	50,45	37,80	75
2026	66,64	54,22	40,00	75
2027	69,71	57,47	55,00	75
2028	71,71	60,24	65,00	75
2029	72,98	62,61	70,00	75
2030	73,77	64,61	75,00	75

Take-up of Big Data by businesses

Period	DD trajectory	Baseline	Target
2016	12,53	12,53	75
2018	16,38	16,38	75
2020	18,66	18,66	75
2021	24,83	22,03	75
2022	31,97	25,67	75
2023	39,74	29,54	75
2024	47,57	33,57	75
2025	54,80	37,70	75
2026	60,91	41,82	75
2027	65,63	45,85	75
2028	69,00	49,71	75
2029	71,27	53,31	75
2030	72,72	56,61	75

Take-up of Artificial Intelligence by businesses

Period	DD trajectory	Baseline	Target
2021	13,00	13,00	75
2022	20,07	15,77	75
2023	29,44	18,86	75
2024	40,63	22,24	75
2025	52,14	25,90	75
2026	61,91	29,78	75
2027	68,52	33,82	75
2028	72,14	37,95	75
2029	73,82	42,07	75
2030	74,53	46,09	75

SME with at least basic digital intensity

Period	DD trajectory	Baseline	Target
2022	66,20		90
2023	69,18		90
2024	72,15		90
2025	75,13		90
2026	78,10		90
2027	81,08		90
2028	84,05		90
2029	87,03		90
2030	90,00		90

Digitalisation of Public Services

Digitalisation of public services for citizens

Period	DD trajectory	Baseline	Target
2013	47,76		100
2014	53,64		100
2015	76,35		100
2016	76,00		100
2017	75,31		100
2018	81,98		100
2019	84,99		100
2020	90,28		100
2021	93,43	93,43	100
2022	94,80	94,80	100
2023	95,84	95,84	100
2024	96,68	96,68	100
2025	97,35	97,35	100
2026	97,89	97,89	100
2027	98,33	98,33	100
2028	98,67	98,67	100
2029	98,95	98,95	100
2030	99,17	99,17	100

Digitalisation of public services for businesses

Period	DD trajectory	Baseline	Target
2014	72,89	72,89	100
2015	72,89	72,89	100
2016	80,25	80,25	100
2017	81,64	81,64	100
2018	88,54	88,54	100
2019	98,96	98,96	100
2020	96,67	96,67	100
2021	96,67	96,67	100
2022	96,70	96,70	100
2023	97,37	97,37	100
2024	97,91	97,91	100
2025	98,34	98,34	100
2026	98,68	98,68	100
2027	98,96	98,96	100
2028	99,17	99,17	100
2029	99,35	99,35	100
2030	99,48	99,48	100

eHealth composite indicator on the availability of electronic medical data

Period	DD trajectory	Baseline	Target
2022	66,71		100
2023	70,87		100
2024	75,03		100
2025	79,19		100
2026	83,35		100
2027	87,51		100
2028	91,68		100
2029	95,84		100
2030	100,00		100

Annex 3: Google Certificates (Section 3)

Google Certificates are offered in the following areas:

- Google IT Support Professional Certificate (Online training for people wanting to work as an IT Support/Helpdesk operator)
- Google IT Automation with Python Professional Certificate (Online training for people wanting to work as an IT Support Specialist or a Junior Systems Administrator)
- Google Project Management : Professional Certificate (Online training for people wanting to work as a junior Project Manager or an assistant Project Manager)
- Google Data Analytics Professional Certificate (Online training for people wanting to work as a junior Data Analyst, Database Administrator, Data Scientist or SQL Developer.
- Google UX Design Professional Certificate (Online training for people wanting to work in UX Design or UX Testing.
- Digital Marketing & E-commerce Certificate (Online training for people wanting to work as a Marketing coordinator, Media Planner or an Email Marketing Specialist)

The working methodologies, content and training programmes resulting from this cooperation are the property of Google LLC and Coursera Inc.

Annex 4: University programmes (Section 3)

The University has a number of programmes that train specialists in the broader area of ICT and that have a direct relationship with the jobs market. These programmes are:

- Bachelor in Computer Science (BICS): 40 study places, 180 ECTS
- Bachelor in Applied Information Technology (BINFO): 75 study places, 180 ECTS
- Bachelor in Applied Information Technology – Continuing Education Programme (BINFO-FC): 25 study places, 80 ECTS
- Master in Information and Computer Sciences (MICS): 60 study places, 120 ECTS
- Interdisciplinary Space Master (ISM): 20 study places, 120 EC*TS*
- Master in Information System Security Management (MISSM): 20 study places, 60 ECTS
- Master in Development et Validation du Logiciel (MDVL) : 20 study places, 120 ECTS
- Master in Technopreneurship (MTECH) : 20 study places, 60 ECTS
- Master in Cyber*security (in preparation; Erasmus Mundus, with Uni Libre de Bruxelles, Bretagne Sud, from 2023)*
- Certificate programme in Cyberpolicy (in preparation)
- Doctoral Programme in Computer Science and Computer *Engineering (CSCE)*

Annex 5: Initiatives taken by the University (Section 3)

The following initiatives and activities at the University integrate measures in the area of digital skills and digital transformation:

- High-Performing Computing (HPC) and data science aims to foster frontier research and education in computational and data science. Educational activities include the HPC School, a Doctoral Programme in Computer Science and Computer Engineering, and the Master Programme in Information and Computer Sciences.
- The Centre for Digital Ethics (in preparation), which will address ethical, cultural, and legal questions around digitalisation in teaching and research.
- Media Centre of the University of Luxembourg is an entity aiming at supporting e-learning, remote, hybrid, and co-teaching at the University. It supports teaching activities in the Bachelor in Animation within FHSE.
- Luxembourg Open Science cloud (in preparation) is a commitment of the University to the digitalisation of research outputs as open science.
- University experts are active participants in the FinTech programmes aiming at providing skills for a digital economy, including digital finance and digital procurement. FinTech programme is integrated in the teaching curriculum of the Master in Sustainable Finance, the Doctoral School in Economic and Finance, the Doctoral School in Law, and the Certificate in Law and Regulation of Inclusive Societies.
- Space technology and telecommunication skills are part of our Master in Space, Communication and Media Law.
- Data driven medicine and innovative digital tools are part of our Digital Medicine Group that aims to shape the digitalisation processes in Medicine.
- The Luxembourg Centre for Educational Testing (LUCET) is working towards digital assessment and testing in technology-rich multilingual environments.
- The Luxembourg Learning Centre provides digital archives and learning sources to students and staff, in support of their studies and research.

Annex 6: BTS programmes (Section 3)

We currently have the following BTS programmes in ICT study areas:

- Communication Technologies
- Connected Building and Cities
- Informatics
- Internet of Things
- Cloud Computing
- Game Programming and Game Design
- Game Art and Game Design
- Cybersecurity
- Digital Content
- Genie technique
- Building Information Modeling (new as of 22/23) – The objective of this programme is to educate BIM modelers regarding the significance of interoperability and provide hands-on experience using BIM software that integrates all advanced construction technologies.

Annex 7: Digital Packages (Section 3)

	2019	2020	2021	2022
Amount granted (Fit 4 Digital Packages)	110 000€	404 000€	1 308 000€	1 047 000€

Annex 8: Fit 4 Digital projects (Section 3)

	2016	2017	2018	2019	2020	2021	2022
Amount granted	50 000€	55 000€	335 000€	558 000€	455 000€	575 000€	215 000€

Annex 9: Examples of key digital skills providers testify from Luxembourg's adaptiveness of education and training

Examples of key digital skills providers testify from Luxembourg's adaptiveness of education and training offers to address digital transformation in work and societal environments:

- The University of Luxembourg has the ambition to become a prime destination for students and teachers who seek a degree and career in digital skills and digital transformation. The University of Luxembourg has a number of key programmes and continues to grow its learning offer
- The Ministry of Education foresees appropriate adapting of learning tracks in secondary and primary schools
- The Luxembourg Chamber of Commerce in its mission to empower Luxembourg business has partnered with the Luxembourg Bankers' Association (ABBL) to deploy a platform, the House of Training, for the provision of high-quality vocational training. Strategic partnerships with organisations like Key Job and HEC Liège Luxembourg allow the House of Training to adapt and offer state-of-the-art training courses for digital skills. Key Job training courses are based on 2 pillars: an IT pillar and a best practice pillar. A wide range of training courses is offered and include both traditional office courses, multimedia systems and high-level technical courses, such as SharePoint, Power BI, Linux, cyber and data security.
- The HEC Liège Luxembourg partnership offers an "International MBA" program. In order to adapt to medium term economic and technological challenges, its programme is continuously adapted. New certificates in "Private Equity & Other Alternative Asset Classes" and "Leading Disruptive Innovation" are introduced in autumn 2023.

Annex 10: Ministries and administrations represented in the interministerial committee for digitalisation

Ministry for Digitalisation; Government IT Centre; Ministry of Internal Security; Ministry of Finance; Ministry of Justice; Ministry of Education, Children and Youth; Ministry of Home Affairs, Ministry of Mobility and Public Works; Ministry of State; Ministry of Agriculture, Viticulture and Rural Development; Ministry of Health; Ministry of Culture; Central Legislation Service; Ministry of the Economy; General Directorate for Tourism and Small and Medium-sized Enterprises; Ministry of Family Affairs, Integration and the Greater Region; Ministry of Higher Education and Research; Ministry of Energy and Spatial Planning; Ministry of Sport; Ministry of the Civil Service – State Centre for Human Resources and Organisation Management; Ministry for Consumer Protection; Ministry of Housing; General Inspectorate of Social Security; Ministry of Equality between Women and Men; Ministry of the Environment, Climate and Sustainable Development; Ministry of Labour, Employment and the Social and Solidarity Economy; Ministry of Foreign and European Affairs; Directorate of Immigration.

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