Digital Economy and Society Index (DESI) 2021

Estonia

About the DESI

The European Commission has monitored Member States' progress on digital and published annual Digital Economy and Society Index (DESI) reports since 2014. Each year, the reports include country profiles, which help Member States identify areas for priority action, and thematic chapters providing an EU-level analysis in the key digital policy areas.

In 2021, the Commission adjusted DESI to reflect the two major policy initiatives that will have an impact on digital transformation in the EU over the coming years: the Recovery and Resilience Facility and the Digital Decade Compass.

To align DESI with the four cardinal points and the targets under the Digital Compass, to improve the methodology and take account of the latest technological and policy developments, the Commission made a number of changes to the 2021 edition of the DESI. The indicators are now structured around the four main areas in the Digital Compass, replacing the previous five-dimension structure. 11 of the DESI 2021 indicators measure targets set in the Digital Compass. In future, the DESI will be aligned even more closely with the Digital Compass to ensure that all targets are discussed in the reports.

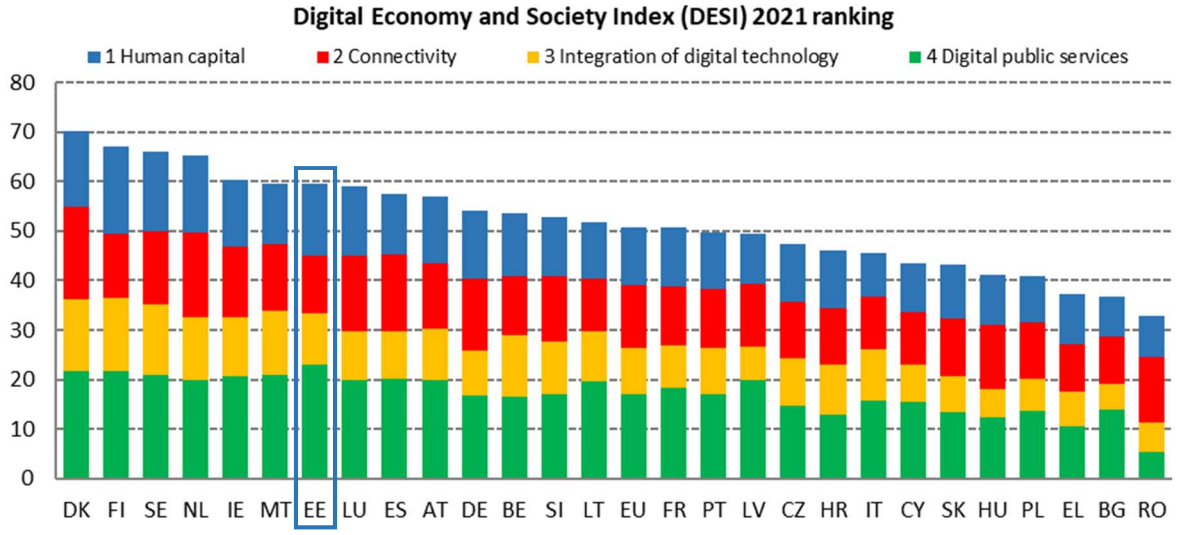
In addition, DESI now includes an indicator measuring the level of support that adopted ICT technologies provided companies in taking more environmentally-friendly measures (ICT for environmental sustainability) and the take up of gigabit services, plus the percentage of companies offering ICT training and using e-invoicing.

The DESI scores and rankings of previous years were re-calculated for all countries to reflect the changes in the choice of indicators and corrections made to the underlying data.

For further information, see the DESI website: https://digital-strategy.ec.europa.eu/en/policies/desi.

Overview

	Estonia		EU
	rank	score	score
DESI 2021	7	59.4	50.7



Estonia ranks 7th in the DESI 2021, with a score of 59.4 (higher than the EU average of 50.7). The country is a front-runner in Digital public services, and performs very well on Human Capital. Estonia remains a medium performer in Connectivity and still lags behind in the deployment of 5G. Not all businesses in Estonia take advantage of digital technologies, although innovative start-ups are flourishing.

The country will release soon its new digital strategy for the period until 2030. This new strategy will be the cornerstone of future digital developments in the country. It will encompass ambitious targets for digital, with a strong focus on digital public services, connectivity and cybersecurity.

The country performs well on the digital skills of its population. With a relatively high score for basic digital skills, people in Estonia can benefit from increasingly digitalised government services and digital services more generally. In addition, the country is taking measures to: (i) strengthen advanced digital skills among its people; and (ii) upskill and reskill the working population to make sure the skills of the labour force are future-proofed. Estonia is nurturing its pool of Information and Communications Technology (ICT) specialists (who accounted for 6.5% of the active population in 2020) with an increased number of ICT graduates in 2020 compared to 2019. This population of ICT specialists contributes to the active and innovative tech ecosystem in the country.

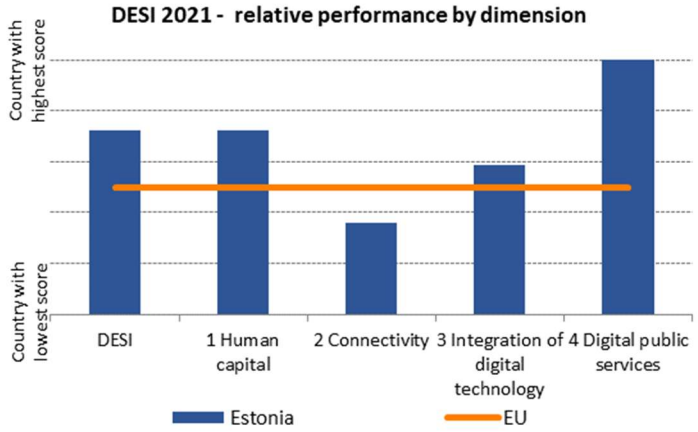
On Connectivity, both fixed- and mobile-broadband take-up are high. Estonia has high overall coverage of fixed Very High Capacity Network (VHCN) connectivity, except in rural areas where additional investments are needed. The country lags behind in providing 5G commercial service because the spectrum resources necessary to operate 5G networks have not been allocated yet. Nevertheless, Estonia's ambition for 5G connectivity is to cover major cities by 2023 and transport corridors by 2025. Estonia has not yet met the Gigabit Society[1] targets, and its ability to meet these

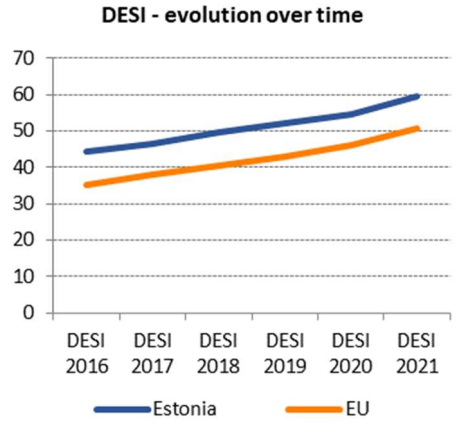
[1] https://digital-strategy.ec.europa.eu/en/library/connectivity-european-gigabit-society-brochure

targets will depend on the timely adoption of its digital strategy 2030 and the allocation of the 5G 'pioneer' bands.

On the Integration of digital technologies by businesses, significant potential remains untapped. Despite a very active start-up scene in the country, including some 'unicorns' (IT companies that are not yet listed on the stock-market, but which are privately valued at more than USD 1 billion), not all Estonian businesses are taking full advantage of digital technology and the online economy. Estonia needs to continue its efforts to better integrate digital technologies, particularly in Small and Medium-sized Enterprises (SMEs) and more traditional businesses.

On Digital public services, Estonia is already well-known for being a top performer in the digitalisation of its administration. It has well-developed e-government systems, with all central government functions and municipalities providing services online. Despite already being a front-runner in this area, Estonia continues to significantly invest in its e-government services to make sure the country offers the latest technologies to its citizens. Similarly, the COVID-19 pandemic has also demonstrated that Estonia could take a leading role in Europe in implementing innovative solutions for e-health.





Digital in Estonia's Recovery and Resilience Plan

In the Estonian Recovery and Resilience Plan (RRP), EUR 208 million is devoted to digital objectives. This represents 21.5% of the total allocation, and thus exceeds the target of 20% set by the Regulation establishing the Recovery and Resilience Facility[2]. The contribution to the digital transition comes mainly from two out of the six components of the plan, with a total of 13 measures addressing digital transformation in the country.

The contribution of Estonia's RRP to the digital transition focuses mainly on two priorities: (i) the digitalisation and further modernisation of public services, which will benefit from EUR 97.43 million in spending; and (ii) the digital transformation of enterprises, which will receive funding of EUR 76 million. The plan also includes a smaller investment to improve broadband access in more remote areas of the country (around EUR 24 million) and actions to support the development of digital skills (EUR 10 million). More details on the digital aspects of the country's RRP are discussed in the bullet points below.

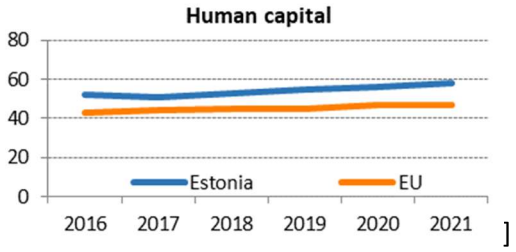
[2] REGULATION (EU) 2021/241 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 February 2021 establishing the Recovery and Resilience Facility.

- The RRP's Component 3 'Digital State' (with an overall estimated budget of EUR 97 million for the digitalisation of public services) builds on the already successful deployment of digital technologies in delivering public services in Estonia. This component aims at making the delivery of public services more efficient. It also aims at making the underlying digital infrastructures and systems more resilient and sustainable.
- Component 1 'Digital transformation of enterprises' (overall estimated value: EUR 116.2 million) aims at fostering the digital transformation of Estonian companies and strengthening their competitiveness in export markets. This will target SMEs and micro-enterprises from all sectors.
- On digital connectivity, the support for deploying VHCNs in rural areas (part of Component 3 'Digital State' with a EUR 24.3 million budget) is expected to ensure broader access to online services. It is also expected to contribute to the further digital transformation of the country more generally.
- Amongst the measures supporting the digital transformation of companies in Component 1, Estonia plans to target EUR 10 million in spending to ensure the availability of sufficient ICT professionals with up-to-date skills and knowledge to help Estonian companies to seize the opportunities offered by the digital transition.

The Estonian RRP does not include any budget for participation in any Multi-Country Project, but includes a cooperation with Finland on one of the planned measures.

1 Human capital

1 Human capital	Estonia		EU
	rank	score	score
DESI 2021	5	57.9	47.1



	Estonia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills % individuals	**60%** 2017	**62%** 2019	**62%** 2019	**56%** 2019
1a2 Above basic digital skills % individuals	**35%** 2017	**37%** 2019	**37%** 2019	**31%** 2019
1a3 At least basic software skills % individuals	**61%** 2017	**62%** 2019	**62%** 2019	**58%** 2019
1b1 ICT specialists % individuals in employment aged 15-74	**5.7%** 2018	**6.0%** 2019	**6.5%** 2020	**4.3%** 2020
1b2 Female ICT specialists % ICT specialists	**22%** 2018	**23%** 2019	**22%** 2020	**19%** 2020
1b3 Enterprises providing ICT training % enterprises	**13%** 2018	**17%** 2019	**17%** 2020	**20%** 2020
1b4 ICT graduates % graduates	**7.4%** 2017	**6.7%** 2018	**8.0%** 2019	**3.9%** 2019

On Human capital, Estonia ranks 5th, making it one of Europe's leading countries for digital skills. With 62% of Estonians having at least basic digital skills, the country is comfortably above the EU average on this measure. On advanced digital skills, Estonia also performs well compared to other EU countries. In 2020, ICT specialists accounted for 6.5% of the employed population (EU 4.3%) and ICT graduates represented 8% of total graduates in 2019, significantly above the EU average of 3.9%. However, only 17% of Estonian companies provided ICT training to their employees in 2020 (the same percentage as in 2019), below the EU average of 20%. In Estonia, there is a slightly higher share of female ICT specialists than in the rest of the EU, although the gender gap remains wide: only 22% of ICT specialists are women (although higher than the EU average).

The consequences of the school closure provoked by the COVID-19 pandemic in Estonia was mitigated by good digital infrastructures in both general and vocational schools. People in Estonia were also able to rely on both a good level of digital skills among teachers and readily available educational materials that could be delivered digitally[3]. Previous investments in digital educational infrastructure paid off during the crisis by helping the country's schools, students and teachers to adapt swiftly to new circumstances and teaching arrangements.

The education strategy 2035 will be approved by autumn 2021, and will be an 'umbrella' strategy for further modernising the Estonian education system. By 2035, it is expected that: (i) 90% of 16-24-year olds will have above-basic digital skills; and (ii) the share of the population with above-basic digital

[3] Explained by Heli Aru-Chabilan, Director for Internationalization, Estonian Education and Youth Board: https://futurescot.com/futurescot-live/edutech2021/

skills will increase to 60% from the 37% in 2019. In addition, Estonia expects to train an additional 7,000 ICT specialists between now and 2027.

In 2020, the Ministry of Education and Research supported lifelong learning by focusing on digital skills training courses, based on the recommendation of the OSKA study[4]. Moreover, to alleviate the effect of the COVID-19 crisis on the workforce, the Ministry offered online trainings to more than 11,000 people, of which a third participated in ICT-related training.

To tackle the shortage of ICT experts, the government took a number of measures. One such measure was the IT Academy[5], a cooperation programme between the government, universities and companies in the ICT sector. The IT Academy aims at raising the quality of ICT education and developing research in ICT. New masters' programmes to train qualified ICT specialists were created, as were new Massive Open Online Courses (MOOCs) to give young people the right skills for future jobs. As part of the National Artificial Intelligence Strategy 2019-2021, Estonia's first master's degree programme in data science was initiated, and it is expected to educate 50 new highly skilled data-science specialists by 2023.

To reduce the gender imbalance in the ICT sector, the Estonian Ministry of Social Affairs is developing projects, supported by European funds, to increase the share of women among students and employees (including in managing positions) in the sector.

The Estonian National Digital Skills and Jobs Coalition was set up in 2017 and is currently coordinated by the Ministry of Education and Research and is under a major revamping.

Estonia has been an active participant in EU Code Week in recent years. In 2020, around 670 events were organised, reaching more than 20,000 participants in the country. 34% of participants were women. In addition to participation in EU Code Week, education institutions in Estonia can rely on the ProgeTiger programme[6], which helps educational institutions to buy ICT equipment.

Overall, Estonia is performing relatively well on digital skills compared to other EU countries. Ambitious actions are underway to maintain this front-running position, starting in Estonian schools, and continuing in universities and vocational training. The high number of ICT graduates is likely to reduce the shortage of ICT specialists in the country. Attention should be paid to rural and remote areas of the country to make sure all Estonians can benefit from the advantages of digitalisation.

Human capital in Estonia's Recovery and Resilience Plan

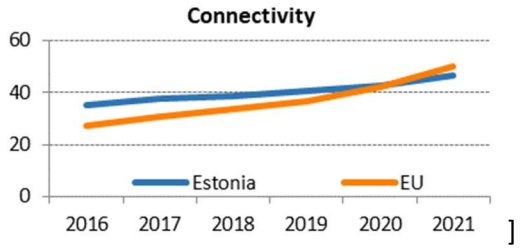
The Estonian RRP only includes one measure supporting the acquisition of digital skills for the Estonian population with a budget of EUR 10 million (representing 5% of the digital budget allocation) and consists of the following four parts:

- training managers in companies (SMEs in particular) to increase their ICT skills and knowledge and raise their awareness of the importance of developing and maintaining the skills of their ICT specialists;
- revising the content and organisation of training for ICT experts, taking into account the latest technological developments, the growing importance of cybersecurity, and the needs of companies;
- a pilot programme to redesign the qualification framework for ICT specialists;
- the upskilling and retraining of ICT specialists, including in cybersecurity.

[4] https://oska.kutsekoda.ee/en/future-labour-market-trends/oska-covid-19-study/
[5] https://www.cs.ut.ee/en/studying/it-academy
[6] https://www.educationestonia.org/progetiger/

2 Connectivity

2 Connectivity	Estonia		EU
	rank	score	score
DESI 2021	18	46.6	50.2



	Estonia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up % households	81% 2018	83% 2019	83% 2020	77% 2020
2a2 At least 100 Mbps fixed broadband take-up % households	11% 2018	14% 2019	19% 2020	34% 2020
2a3 At least 1 Gbps take-up % households	NA	<0.01% 2019	<0.01% 2020	1.3% 2020
2b1 Fast broadband (NGA) coverage % households	83% 2018	84% 2019	89% 2020	87% 2020
2b2 Fixed Very High Capacity Network (VHCN) coverage % households	54% 2018	57% 2019	71% 2020	59% 2020
2c1 4G coverage % populated areas	99.3% 2018	99.4% 2019	>99.9% 2020	99.7% 2020
2c2 5G readiness Assigned spectrum as a % of total harmonised 5G spectrum	0% 2019	0% 2020	0% 2021	51% 2021
2c3 5G coverage % populated areas	NA	NA	0% 2020	14% 2020
2c4 Mobile broadband take-up % individuals	68% 2018	75% 2019	75% 2019	71% 2019
2d1 Broadband price index Score (0-100)	NA	70 2019	75 2020	69 2020

With a connectivity score of 46.6, Estonia ranks 18th in the EU. Estonia's coverage in fixed very high capacity network (VHCN) and Next Generation Access (NGA) networks recorded substantial increases in 2020: VHCN coverage was 71% in 2020 (against 59% for the EU), a 14 percentage point increase year on year. The increase in VHCN coverage can be explained by the successful rollout of high-speed internet connections by Enefit Connect OÜ (formerly Elektrilevi), an Estonian electricity provider. All VHCNs are fibre-to-the- premises networks. As to cable networks, they cover 76.7% of all households but only 23.6% of rural households. The future upgrade of cable networks to DOCSIS 3.1 will certainly improve Estonia's performance in fixed connectivity. Indeed, only 20.5% of households in rural areas are currently covered by VHCN.

Both fixed and mobile broadband take-up are high: the former stood at 83% (against 77% in the EU) and the latter stood at 75% (against 71% in the EU). However, take-up of high-speed services is still very low, with only 0.01% of the households subscribing to 1 Gbps services (against 1.3% for the EU). Take-up may be linked to attractive broadband prices: Estonia's broadband price index stood at 75 (against 69 in the EU).

The Estonian market features ubiquitous 4G coverage reaching 99.9 % of the country. Nevertheless, the country lags behind in providing 5G commercial service. This is because all the spectrum resources necessary for 5G operation have not yet been allocated.

Estonia's new Digital Agenda 2030 is currently being drafted and will most likely be adopted in 2021. This strategy will align the country's connectivity targets to those of the Gigabit Society (including the target of making available speeds of 100 Mbps – upgradeable to 1 Gbps – to all residents).

In the meantime, progress has been made under the Estonian project for a broadband-infrastructure network (EstWin)[7]. By January 2020, this project had successfully rolled out approximately 7,000 km of fibre backhaul networks in rural areas and settlements with less than 10,000 inhabitants, where optical networks did not previously exist and where operators had no previous plans to install them. These networks were rolled out by non-profit organisations, which were required to provide wholesale access on equal terms to all operators and public authorities. Furthermore, Enefit Connect OÜ continued to provide high-speed internet connections throughout the country, with an additional 3,000 addresses connected by Q4 2020. In 2018, Elektrilevi, which is part of the Estonian State-owned energy group Eesti Energia, won a dedicated public competition and committed to connect 40,016 addresses in 'white areas' (areas without coverage), thanks to State support worth EUR 20 million. Under the terms of the competition award, Eletrilevi's broadband network should: (i) have a technical capability of 1 Gbps download; (ii) be built over a maximum period of 5 years; and (iii) have a household/business contribution of no more than EUR 200 per connection.

On 5G, a consortia was commissioned in November 2020 to draft a report setting out 5G service needs in the following fields: digital culture; connected automated mobility; energy; smart community; environment; internal security; industry; and agriculture. The report is due by Q4 2021. In September 2020, Estonia signed a memorandum of understanding for the Via Baltica – North initiative, which will develop an experimental 5G cross-border corridor with Poland, Latvia and Lithuania. With the underlying objective of further developing 5G connectivity, the experimental cross-border corridor will notably enable Connected and automated mobility services to be tested.

On spectrum allocation, the Estonian authorities have faced restrictions stemming from cross-border coordination issues with a non-EU country, leading to difficulties in allowing the use of both the 700 MHz band and the 3.6 GHZ band. In addition to those restrictions, the authorities' design of the 3.6 GHZ band auction had been challenged in the Administrative Court and in the Circuit Court by a telecommunications operator in 2019. The Decision of the Administrative Court and the Circuit Court were in favour of the State but were appealed by an operator. The dispute ended in March 2020 when the Supreme Court decided not to take any actions concerning this appeal. The operator had claimed that the auction should have provided for the allocation of four frequency blocks instead of three.

Estonia has assigned 0% of the total harmonised 5G spectrum band in the EU. The 3.6 GHz auction is currently still pending and awaits the implementation of 5G security measures. On the 26 GHz band, a public consultation organised at the end of 2019 showed that there was little market demand for this band. There are currently plans to auction this band in the first half of 2022. However, in November 2020, one operator already started providing 5G commercial service in three major cities, namely Tallinn, Pärnu and Tartu using dynamic spectrum sharing in the 2.1 GHz band.

[7] Approximately 85% of the project costs were financed by the European Regional Development Fund (ERDF), while the remaining 15% of the network construction costs were co-financed by backhaul network operators.

Main market & regulatory developments

On consumption patterns, the Estonian market recorded increases in both mobile- and fixed-broadband users of 4% and 2% respectively between Q2 2019 and Q2 2020[8]. The consumption of mobile data also increased by 17% between Q2 2019 and Q3 2020[9].

On 3 February 2021, Estonia received a letter of formal notice for failure to adopt the necessary measures for transposing the European Electronic Communications Code into Estonian law. The European Electronic Communications Code is planned to be transposed into Estonian law with the electronic communications Act, the Building Code and the State fees amendment bill. The draft amendment bill was adopted by the government on 10 December 2020. On 15 December 2020, the Parliament started its scrutiny of the State fees amendment bill as part of the legislative procedure. The first reading of the draft State fees bill was held during a parliamentary session on 24 March 2021.

In 2020, the Estonian national regulatory authority ECTRA reviewed the market for wholesale voice-call termination on individual mobile networks (market 2 of the 2014 Commission recommendation). Following the review, ECTRA set a new mobile termination rate at 0.70 eurocent/minute for the three operators considered as having significant market power in this market (Telia Eesti AS, Elisa Eesti AS and Tele2 Eesti AS).

ECTRA also notified its review of the market for wholesale local access provided at a fixed location (3 a/2014) and wholesale broadband access (3b/2014). On 19 April 2021, the Commission informed ECTRA and the Body of European Regulators for Electronic Communications of its serious doubts pertaining to: (i) a lack of sufficient evidence supporting the definition of the relevant product market; and (ii) a lack of sufficient evidence that the market for wholesale central access, as notified, justified the imposition of a regulatory obligation. ECTRA withdrew its notification of the above-mentioned markets.

On consumer complaints about electronic communications, the main source of complaints recorded in 2020 pertained to the following topics: (i) comprehensibility of contractual terms; (ii) contractual penalties or other fees regarding early contract termination; and (iii) delay of fulfilment of obligations by service provider.

Overall, Estonia has high levels of fixed VHCN coverage, except in rural areas where this type of technology has not yet been made available to many households. The country's ability to meet the Gigabit society targets will depend on the timely adoption of its digital strategy 2030 and the allocation of the 5G pioneer bands.

[8] Consumer Protection and Technical Regulatory Authority.
[9] Consumer Protection and Technical Regulatory Authority, mobile data volume/user/month, from 18GB to 21GB.

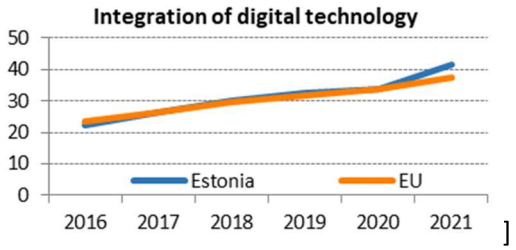
Connectivity in Estonia's Recovery and Resilience Plan

The Estonian RRP includes one specific measure to improve the connectivity of the most remote areas of its territory. The objective of the measure is to improve access to VHCN for households and socioeconomically significant institutions such as hospitals, schools, public services and businesses in remote areas.

A budget of EUR 24.29 million has been earmarked for this measure, and 8,000 sites shall be equipped with VHCN thanks to this investment. The measure consists in providing financial support for the deployment of VHCN in areas of 'market failure' (i.e. areas to which private-sector providers would otherwise not provide service as it would not be profitable). The eligibility and selection criteria used to allocate the funding will ensure an appropriate regional balance and compliance with State aid rules.

3 Integration of digital technology

3 Integration of digital technology	Estonia		EU
	rank	score	score
DESI 2021	9	41.5	37.6



	Estonia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	74% 2020	60% 2020
3b1 Electronic information sharing % enterprises	28% 2017	26% 2019	26% 2019	36% 2019
3b2 Social media % enterprises	13% 2017	16% 2019	16% 2019	23% 2019
3b3 Big data % enterprises	11% 2018	11% 2018	10% 2020	14% 2020
3b4 Cloud % enterprises	26% 2018	26% 2018	48% 2020	26% 2020
3b5 AI % enterprises	NA	NA	15% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	62% 2021	66% 2021
3b7 e-Invoices % enterprises	23% 2018	23% 2018	62% 2020	32% 2020
3c1 SMEs selling online % SMEs	16% 2018	17% 2019	16% 2020	17% 2020
3c2 e-Commerce turnover % SME turnover	12% 2018	12% 2019	12% 2020	12% 2020
3c3 Selling online cross-border % SMEs	8% 2017	9% 2019	9% 2019	8% 2019

On the Integration of digital technology in businesses' activities, Estonia ranks 9th among EU countries. On the new indicator of SMEs with at least a basic level of digital intensity, Estonia scored 74%, 14 percentage points higher than the average EU score, and approaching the 90% target of the Digital Decade Communication[10]. 16% of Estonian SMEs sell online (EU average of 17%), while e-commerce represents 12% of SMEs' turnover, and 9% of SMEs sell across borders. On the use of advanced technologies, in 2020: (i) 15% of Estonian companies used Artificial Intelligence (AI) against an average of 25% in the EU, (ii) 16% of Estonian companies used social media (up from 13% in 2019 and compared to 23% at EU level); (iii) 48% of Estonian companies used cloud services (up from 26% in 2019 and compared to 26% at EU level); and (iv) 10% of Estonian companies accessed big-data services (EU average 14%). Estonia is close to the EU average (4 percentage points below) on the use of ICT for environmental sustainability.

[10] https://eur-lex.europa.eu/resource.html?uri=cellar:12e835e2-81af-11eb-9ac9-1aa75ed71a1.0001.02/DOC_1&format=PDF.

On policy developments, the recently appointed government has highlighted two of its priorities as the digital transformation of enterprises and supporting of the uptake of digital technologies by businesses. Supporting the uptake of digital technology by businesses is an essential feature of the Research, Development, Innovation and Entrepreneurship (RDIE) Development Plan 2021-2035[11] presented in October 2020.

Estonia continues the implementation of its National Artificial Intelligence Strategy 2019-2021[12], which it plans to renew this year to cover 2021-2023. The current strategy sets out the actions the government will take to: (i) promote the take-up of AI in both the private and public sector; (ii) increase the relevant skills and research-and-development base; and (iii) develop the legal environment necessary to promote the use of AI in the country. More than EUR 12 million of public investment has been targeted on AI in the past 2 years, most of which came from European structural funds. A research and development centre, the AI and Robotics Estonia Hub, will soon be set up. It has been selected by Estonia to join the network of European Digital Innovation Hubs (EDIHs)[13]. The AI and Robotics Hub will help SMEs from all sectors to develop knowledge-intensive solutions in AI and robotics. This innovation hub is supported by the Ministry of Economic Affairs and Communications, and its activities will be implemented by Estonian universities and science parks.

In addition, Estonia supports the start-up ecosystem through a State-funded organisation called Startup Estonia[14] (see more in the highlight box below). Entrepreneurs can already contact the administration for advice and support online. But to further improve communication between the government and entrepreneurs, the government drew up a roadmap in 2020 for a single online point of contact for entrepreneurs to speak with the administration. The roadmap contains concrete actions for the period 2021-2025. In addition to reducing administrative burden for companies through customer-centric online services, the Estonian administration also expects these measures to attract foreign entrepreneurs to start businesses in Estonia.

On advanced digital technologies, the Estonian Scientific Computing Infrastructure Consortium (ETAIS)[15] is participating in the EuroHPC Joint Undertaking project EUROCC, with a total budget of EUR 2 million for 2020-2021. The objective is to increase the competitiveness of Estonian computing and data-intensive research disciplines by providing a single entry point for resources in High-Performance Computing (HPC) and High Performance Data Analytics (HPDA). The Estonian Scientific Computing Infrastructure Consortium also joined the EuroHPC joint undertaking pre-exascale supercomputer consortium LUMI to provide Estonian researchers with access to world-class computational resources that are created jointly with partners in Finland. Estonia is contributing EUR 2 million to the project for a six-year period starting in 2021. In September 2020, Estonia joined the EU's cooperation framework on Quantum Communication Infrastructure (QCI)[16]. As part of this framework, Estonia will explore with other EU Member States over the next 12 months how to develop and deploy a QCI across the EU within the next 10 years. The Estonian Ministry of Economy

[11] (In Estonian) https://www.hm.ee/sites/default/files/taie_arengukava_2035_eelnou_riigikogusse_29.10.2020.pdf
[12] https://en.kratid.ee/
[13] https://teaduspark.ee/en/in-autumn-estonian-companies-will-get-advice-on-the-application-of-ai-and-robotics-in-manufacturing/
[14] https://startupestonia.ee/en
[15] https://etais.ee/
[16] https://www.mkm.ee/en/news/estonia-joined-eus-cooperation-framework-quantum-communication-infrastructure

and Communication has set up a working party in charge of developing a long-term strategy in QCI with the participation of private-sector companies and academic institutions.

With these different initiatives, Estonia is strengthening the competitiveness of its business ecosystem to help position Estonia as an innovative country able to compete globally with major companies. It is important that this support also benefits more traditional businesses and economic sectors to ensure that the digitalisation of the Estonian economy is cross-sectoral.

Highlight 2020-2021: A vibrant start-up ecosystem in Estonia

The Estonian start-up ecosystem is very vibrant. There are 1,126 start-ups currently operating in Estonia, according to the most recent data from the Estonian Start-up Database. In 2020, these start-ups generated EUR 782 million in turnover in the country, 43% more than the year before. They also made the labour market more dynamic, employing 6,072 people locally at the end of 2020.

These start-ups benefit from strong and efficient support from State services through the government's Start-up Estonia platform, which aims 'to supercharge the Estonian start-up ecosystem in order to be the birthplace of many more start-up success stories to come'. Start-up Estonia published a white paper in 2020, laying down a strategy for promoting start-ups in the 2021-2027[17] period.

This support and ecosystem has proven to be successful. Estonia is now the country in Europe with the highest number of unicorns per capita. In total there are 7 unicorns founded by Estonians and/or based in Estonia[18]. In the last 2 years, Pipedrive.com (founded in 2010, became a unicorn in 2020.), Zego.com (founded in 2016, became a unicorn in 2021.) and ID.me (founded in 2010, became a unicorn in 2021) joined the 4 already existing Estonian unicorns: Skype.com (founded in 2003, became a unicorn in 2005), Playtech.com (founded in 1999, became a unicorn in 2007), Wise.com (founded in 2010, became a unicorn in 2015) and Bolt (founded in 2013, became a unicorn in 2018).

Integration of digital technology in Estonia's Recovery and Resilience Plan

The principal objective of Component 1 'Digital transformation of enterprises' of the Estonian RRP is to foster the digital transformation of Estonian companies and their competitiveness in export markets. Component 1 will provide financial support to SMEs and micro-enterprises in all economic sectors, at different stages of their digital transformation. It will also make specific contributions to the adoption and deployment of digital solutions in the construction and road-freight-transport sectors in particular.

In total, the RRP will dedicate EUR 76 million (37% of the digital allocation) to support the digitalisation of businesses.

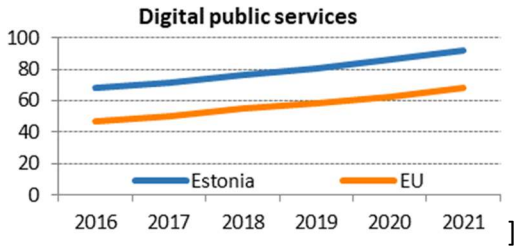
The most important measures for the digitalisation of businesses in Estonia's RRP are set out in the bullet points below.

[17] https://media.voog.com/0000/0037/5345/files/SE_Whitepaper_Web%20(1)-1.pdf
[18] https://startupestonia.ee/blog/estonia-1-in-europe-in-number-of-unicorns-per-capita

- One measure consists in providing financial support to SMEs and microentreprises from all sectors to make investments that will enhance their digital transformation. This financial support must be complemented with the companies' own resources, and must cover one or more of the following aspects: the adoption of digital technologies; the development of industrial data 'clouds'; industrial research; development; testing and piloting activities; feasibility studies; advisory and support services; or training for staff. This measure will support 230 companies (EUR 58 million).
- Another targeted measure supports the digital transformation of the construction sector to increase its productivity, reduce its environmental footprint, and improve the quality of buildings. A total of 120 projects will be supported by this targeted measure (EUR 9 million).
- The RRP contains plans to digitalise the exchange of information in road-freight transport by introducing digital waybills (EUR 6 million).
- Finally, the Estonian RRP includes some specific reforms to support the competitiveness of enterprises – including ICT enterprises – in foreign markets (about EUR 3 million directly relevant to the digital transformation).

4 Digital public services

4 Digital public services	Estonia		EU
	rank	score	score
DESI 2021	1	91.8	68.1



	Estonia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users % internet users	**88%** 2018	**88%** 2019	**89%** 2020	**64%** 2020
4a2 Pre-filled forms Score (0 to 100)	**NA**	**NA**	**97** 2020	**63** 2020
4a3 Digital public services for citizens Score (0 to 100)	**NA**	**NA**	**91** 2020	**75** 2020
4a4 Digital public services for businesses Score (0 to 100)	**NA**	**NA**	**98** 2020	**84** 2020
4a5 Open data % maximum score	**NA**	**NA**	**91%** 2020	**78%** 2020

Estonia ranks 1st place in the EU on Digital public services, and continues to be a strong front-runner in this area. The share of e-government users has slowly increased in recent years, accounting today for 89% of total internet users in the country. Estonia performed better than in 2020 in the number of users using pre-filled forms, scoring 97 (out of 100), and well above the EU average (63). The country is a strong performer in digital public services for citizens (with a score of 91 out of 100, comfortably above the EU average of 75) and for businesses (with a score of 98 against an EU average of 84).

In 2021, Estonia also made progress on open data, increasing its score by 24 percentage points compared to 2019. This significant improvement is because public data are increasingly made available to a wider audience. In early 2021, the Estonian Open Data Portal hosted almost 800 datasets from more than 100 publishers, covering areas such as agriculture, education, energy, health, governance, and transport. These datasets can then be freely used by academic researchers, start-ups and companies to build new services or extend existing ones. In addition, the Estonian authorities also significantly improved the cross-border availability of information. For example, the three Baltic states already allow cross-border exchange of information from their population register[19], and in 2020 Estonia also started sharing information via the X-Tee (X-Road) initiative[20] with the Finnish authorities[21]. The data are only collected once by one specific institution from one country (the 'once-only' principle) and in a secure and confidential manner.

In 2020, Estonia developed a vision for the 'real-time' economy (when all the transactions between business entities are in digital format, increasingly automatically generated, and completed in real-

[19] www.rahvastikuregister.ee
[20] https://www.ria.ee/en/state-information-system/x-tee.html
[21] https://dvv.fi/en/-/population-registers-of-finland-and-estonia-use-suomi.fi-data-exchange-layer-to-exchange-information

time - as they occur) and drew up a roadmap for the development of the real-time economy for 2020-2027[22]. The roadmap and vision aim to implement a structural change in the administration and management of companies by: (i) improving data quality through standardisation; and (ii) applying digital technologies, including AI and blockchain technologies, to automate operations.

Estonia's National Artificial Intelligence Strategy 2019-2021[23] devotes significant attention to the uptake of AI solutions in the public sector. Estonia has continued to implement this strategy, and the country has identified more than 80 different use-cases for AI in the public sector, such as: forecasting the probability of unemployed people getting a job; identifying the factors that influence whether unemployed people find work; and machine translation of government portals.

In its digital agenda 2020[24], as updated in 2018, the country stresses that vital functions must be resilient to cyber threats. This requires a country-wide strategic overview, interoperability, and effective planning. The Cybersecurity strategy (2019-2022)[25] sets out the long-term vision, objectives, priority action areas, roles, and tasks to ensure Estonia's cybersecurity. The strategy is used as a basis for activity planning and resource allocation. The Council on National Cybersecurity Policy was recently set up, and its recommendations will feed into the new digital strategy 2030, which will aim at keeping Estonia's cyber space secure and trustworthy.

Estonia has experimented with cloud technologies and completed a pilot project called 'Estonian government cloud'[26]. This pilot project proved that cloud technology works for public-sector IT applications, and that it is worth considering more widespread use of cloud technology. In parallel, the government is further investigating public-sector use of cloud computing to better understand what kind of data can be kept on the cloud and what cloud services are required. Estonia is working to build its own government cloud to meet these needs.

Estonia was the EU first country to use vaccination certificates (having set up a certificate system in April 2021) and has been a strong advocate of the EU's digital COVID certificate (for vaccination, recovery and testing). In October 2020, the World Health Organization (WHO) and the Estonian government signed a memorandum of understanding to develop distributed digital infrastructure providing health solutions to the COVID-19 pandemic and other public-health needs. In February 2021, the country began working with the WHO on a pilot project to investigate the use of globally recognised, electronic vaccine certificates.

Estonia continues to work on ambitious projects to further improve its leading position in digitalising public services. The recent pandemic has allowed the country to position itself as a world leader in this area, and the new cybersecurity strategy is expected to further bolster Estonia's position as a European and global leader in the digitalisation of its public services.

[22] Real-Time Economy vision and roadmap 2020-2027: https://www.mkm.ee/sites/default/files/real-time_economy_vision_2020-2027.pdf
[23] https://e-estonia.com/nationa-ai-strategy/
[24] https://www.mkm.ee/sites/default/files/digitalagenda2020_final_final.pdf
[25] https://www.mkm.ee/sites/default/files/kyberturvalisuse_strateegia_2022_eng.pdf
[26] https://e-estonia.com/government-cloud-infrastructure-service/

Digital public services in Estonia's Recovery and Resilience Plan

Component 3 of the Estonian RRP ('Digital state') is almost entirely focused on further advancing the already-well-digitalised Estonian public administration. It includes measures to help businesses and the public to take advantage of the opportunities offered by the latest technologies.

Almost half (47%) of the measures supporting the digital transformation in the Estonian plan will aim at further digitalising the administration and public services. The total budget for these investments will be EUR 97.43 million.

The most important measures within the plan are as follows.

- The reconfiguration of basic digital public services and the safe transition of these services to cloud infrastructure to increase their resilience, security and reliability. The IT systems and services of the Estonian public authorities will be migrated to a private cloud and will require large-scale security testing.
- The development of business-event services and a digital gateway to improve efficiency in the delivery of public services and reduce administrative burden for businesses.
- The redesign of several public services (and the underlying IT systems) to enable their automatic delivery on the basis of life events or business events experienced by citizens (such as a marriage, the birth of a child, or the creation of an enterprise).
- Setting-up a national, virtual-assistant platform in the #Bürokrat programme to improve the user-friendliness of access to online public services in Estonia.
- The creation and development of a centre of excellence for data management and open data to foster better management of the data collected and held by the Estonian public authorities. This will aim at improving the quality of the data, increasing its use for decision-making, and making the data available as open data so that it may also be reused by other stakeholders.