How to measure the Digital Decade

– recommendations for an evolution of the DESI index

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Key numbers

5

only 5 countries have advanced in DESI by three or more places in the last 6 years

5

number of indicators in which Poland scores above EU average in DESI (out of 33 indicators)

11.9 p.p.

the distance to the leader gained by Italy during the last 6 years (the fastest convergence in the EU)

5

number of indicators that are in the "low hanging fruit" category for Poland – where actions by public administration can bring quick gains

15

number of specific targets proposed by the European Commission for the digital decade (to be achieved by 2030)

58.3 per cent

Poland's score as compared to Finland (European leader)

40.5

Poland's score in the DESI index in 2022 (scale 0 to 100)

Key findings

- **As The European Commission prepares KPIs for its digital targets and the first edition of its report on the state of the Digital Decade in Europe, it is high time to discuss the methodology used to assess the progress made by the EU Member States.** So far, this has been done by the Digital Economy and Society Index (DESI). However, taking into account new targets of the Digital Decade Policy Programme 2030, new monitoring processes and changing technological landscape, DESI should be thoroughly revised and updated. **The aim of this report is to take stock of the DESI methodology over the years, propose changes that will better align the new index to new European targets and help EU member states prepare their national roadmaps towards achieving digital targets.** The report takes the example of Poland to present the key strengths and weaknesses of the current DESI and propose recommendations for its evolution. The recommendations are addressed both to the European Commission and the Member States.

- Poland ranks 24th in the DESI ranking, which points to a moderate level of digitisation compared to other EU member states. At the same time, it is among the countries making the fastest process and catching up with the leaders (convergence in the EU as a whole can also be observed). **How the DESI is constructed and presented makes it more difficult to see this convergence: the index is constructed based on the principle of comparing countries' absolute scores, rather than the change in score over time or the distance from the leaders.**

- The DESI is made up of both indicators from national statistical offices and from research by external entities commissioned by the European Commission. The data processed by external analytical companies are mostly verified by experts from the national administration at the final stage. All the data is updated every year or two, with a delay (the time between the publication of the DESI and the period the data concerns) of up to two years. Some of the indicators may raise certain methodological doubts, but the data is obtained in the same way across the EU, which enables comparison between countries.

- Changes made to the index can have an impact on a given country's position. However, an analysis of potential changes in terms of the methodology used (weighted average) and incorporating new indicators into the index — does not indicate that Poland's position can be improved significantly. Poland's position in other indices comparing countries in terms of the level of digitisation does not diverge strongly from its position in the DESI. At most, Poland stands out compared to other countries when it comes to individual indicators, in various areas.

- The indicators used to create the index are regularly reviewed and modified. The biggest changes occurred in 2021, when a whole pillar measuring citizens' use of digital services was removed from the index. For the European Commission, the current version is meant to correspondent to current strategic targets relating to digitisation. In the near future, the new form of DESI is also meant to serve to monitor individual countries' progress, set targets, analyse the extent to which they are being achieved, and issue recommendations. **The DESI's more managerial nature will result in it having more weight when planning national public policies. It also fosters stimulating discussion on the methodology used, as well as the quality of the index itself and individual indicators.**

- Actions taken by the administration can only have a significant impact on certain indicators used in the current DESI. **In this report, we therefore propose to divide the indicators into four groups, depending on the administration's ability to influence them and the distance from the leader.** We propose to focus on the indicators for which a given country has a lot of catching up to do and public programmes can raise the indicator's value significantly — the "low-hanging fruit". In the case of Poland these are efforts linked to making the 5G network available in Poland and e-invoicing. The second group in which it is worth focusing first are indicators where the administration's influence is significant and the gap between a given country and European leaders narrow. For Poland, these are primarily indicators describing e-Government. In this group of indicators, it is also important to point to convergence and the distance from the leader, rather than an absolute score — Poland is often in a distant place in the ranking, despite a relatively narrow gap between it and the leader.

- The indicators that the administration's actions have the least influence on can be divided into those in which the distance from the leader is significant, and the improvement of which may require cooperation that goes beyond the administration (setting an ambitious target that will be achieved by the administration, private sector and society), and those for which, due to market conditions in Poland, the country is already close to the leaders. The first group primarily includes indicators describing the level of digitisation at enterprises, and the second group the price of broadband services or the share of IT specialists who are women.

- **The recommendations in the report focus on possible extensions do DESI** (to include new areas, such as cybersecurity or innovativeness), **ways to present the results** (more focus on trends and progress rather than on the position of countries) and **actions to be taken by national authorities** (depending on the possibility to influence a given indicator as well as the distance to the European leader).

Introduction

The Digital Economy and Society Index (DESI) is the most important tool used by the European Commission to assess the level of digitisation in EU countries. Published annually since 2015, it takes into account indictors measuring key dimensions of digitisation: infrastructure, digital skills, the use of technology by businesses and citizens, and the level of digitisation in the public administration. Digitisation is one of the main axes of the economic strategies in Europe and the DESI seeks to monitor progress in this area.

With the adoption of the Decision establishing The Digital Decade Policy Programme 2030 (2022/2481) the DESI's role will be increased — from illustrating the state of digitisation to a tool for managing this process in individual member states. Within a year of the documents adoption, the European Commission will present a report on the implementation of digitisation targets agreed on with individual states. The countries will have to prepare national roadmaps presenting their approach to achieving Digital Decade's targets and will have opportunities to cooperate with others and for peer review; however, everything will have to relate to the key performance measures (KPIs) and trajectories set out by the Commission in a separate delegated act.

Poland, together with Romania, Bulgaria and Greece, ranks low in the DESI; in the most recent ranking from 2022, these were the four countries closing the pack (as was almost always in the last 6 years). On the one hand, the change in the index's character offers an opportunity to improve their position, through greater pressure from Brussels to carry out actions that really increase the level of digitisation. On the other hand, there is also a risk of concentrating on wrongly selected or methodologically incorrect indicators, rather than real actions. This report aims to take a close look at how the index is constructed and how individual indicators are selected and measured, so that the DESI's new role properly reflects the state of digitisation in all EU Member States and the progress in this area.

The DESI – the index's structure and Poland's position

The DESI's components

The DESI used in 2022 is made up of four main **dimensions:**

1. Human capital
2. Connectivity
3. Integration of digital technology
4. Digital public services

Each dimension is divided into **sub-dimensions** made up of the relevant **indicators**. In total, the index is made up of 33 indicators, all of them of a quantitive nature. The index itself is formed in two steps: first, the indicators' values are normalised, and then aggregated into sub-dimensions, dimensions and finally the index itself using the weighted average method.

Source of the data for the variables used in the DESI

Types of variables used in the DESI:

Table 1. Source of the data used in the DESI

Eurostat	Data collected and verified by national statistical offices or Eurostat.
Communications Committee (COCOM)	Data collected and verified by national regulatory authorities (by data experts appointed by members of the Communications Committee in each member state).
Broadband coverage studies	Data collected by IHS Markit, Omdia and Point Topic and verified by NRAs (data experts appointed by members of the Communications Committee in each member state).
Retail broadband prices studies	Data collected by Empirica and verified by NRAs (by data experts appointed by members of the Communications Committee in each member state).
e-Government benchmark	Data collected by Empirica and verified by NRAs (by data experts appointed by members of the Communications Committee in each member state).
Survey of businesses on the use of digital technologies	Data collected by Ipsos and iCite, research results verified by the Digital Single Market Strategic Group.
European data portal	Data collected by Capgemini and verified by the relevant ministries in each member state.

Source: prepared by PEI based on European Commission (2022) data.

It is worth noting that some of the data does not come from statistical offices. The data on the electronic communications market, collected via the Communications Committee (COCOM) is sent to market entities; in Poland, this process is led by the Office of Electronic Communications (UKE), which selects, depending on the criteria indicated by the Commission, around 90-99.9% of the entities operating on the market. In contrast, some data is collected and processed by analytical companies commissioned to do so by the European Commission. This kind of data may be less credible and representative than data collected by statistical offices or from the registers of the appropriate national authorities. However, it is verified by national institutions before the DESI is calculated.

In addition, the methodology used to obtain and assess certain variables, especially concerning e-Government, is more difficult to objectify. Analysis performed using qualitative research of the "mystery shopper" type (in which hired analysts visit administrative offices' websites to sort out a given administrative matter) may be less comparable between countries than "hard" quantitive data. This data and the results obtained are also verified before the DESI is calculated.

Moreover, the DESI also contains indicators that are a simple translation of legal actions, such as the 5G network readiness assessment, measured as the percentage of harmonised radio spectrum resources made available for new services. In Poland, the value of this indicator is 0 — so far, no radio spectrum resources harmonised at the EU level for 5G needs have been made available.

For a list of the data sources used in the DESI, along with comments on the methodology, see Appendix 1.

Methodology used to create the DESI

After the data for selected indicators is collected, the raw data is normalised and then aggregated using the weighted average methodology. The values of individual indicators make up ten sub-dimensions. These make up four dimensions, which are equally weighted in the final value of the index.

Normalisation

Once the data has been collected, the indicators are normalised before individual indicators are aggregated into sub-dimensions and dimensions. This is so that each indicator affects the value of the sub-dimensions and index on a similar scale.

Normalisation involves transforming the indicators using the min-max method. Each indicator is assigned a range of values that it can take; usually from 0 to 100 or, in certain cases, other values. Then, the value for individual countries is linearly scaled to the range <0. 1>, where 0 is the minimum value for a given indicator and 1 is the maximum value (the higher the value,

the better). The choice of minimum and maximum values is arbitrary, but it does not affect the countries' relative position.

The weighted average

The weights assigned to individual indicators and sub-dimensions are not equal (see Table 2). On the one hand, introducing different weights at the indicator level seeks to reflect the EU's digital development priorities. On the other hand, it leads to a situation in which individual indicators have an unequal impact on the final value of the index; a change in some has more of an impact on the index than a change in others. Table 2 presents all the indicators, sub-dimensions and dimensions, along with the weights assigned to them.

The unequal emphasis is clearly visible. The digital public services dimension contains just five indicators, all in a single sub-dimension. In contrast, integration of digital technology contains 11 indicators in three sub-dimensions. The impact of digital public services for citizens or businesses (indicators 4a3 and 4a4) on the index is almost six times higher than that of the indicators concerning e-commerce (indicators from 3c1 to 3c3).

Table 2. The DESI of 2022 divided into dimensions, subdimensions and indicators, along with the weights assigned to them

Dimension	Subdimension	Indicator	Indicator weight	Weight in the whole index	Subdimension weight	Dimension weight
1. Human capital	1a. Internet user skills	1a1 At least basic digital skills % population	2	0.063	0.5	0.25
		1a2 Above basic digital skills % population	1	0.031		
		1a3 At least basic digital content creation skills % population	1	0.031		
	1b. Advanced skills and development	1b1 ICT specialists % working population (15-74 years old)	2	0.042	0.5	
		1b2 Female ICT specialists % ICT specialists	2	0.042		
		1b3 Enterprises providing ICT training % enterprises	1	0.021		
		1b4 ICT graduates % graduates	1	0.021		

2. Connectivity	2a. Fixed broad-band take-up	2a1 Overall fixed broadband take-up % households	1	0.021	0.25	0.25
		2a2 At least 100 Mbps fixed broadband take-up % households	1	0.021		
		2a3 At least 1 Gbps take-up % households	1	0.021		
	2b. Fixed broad-band coverage	2b1 Fast broadband (NGA) coverage % households	1	0.016	0.25	
		2b2 Fixed Very High Capacity Network (VHCN) coverage % households	2	0.031		
		2b3 Fibre to the Premises (FTTP) coverage % households	1	0.016		
	2c. Mobile broad-band	2c1 5G spectrum The amount of spectrum assigned and ready for 5G use within the so-called 5G pioneer bands	1	0.025	0.4	
		2c2 5G coverage % populated areas	2	0.050		
		2c3 Mobile broadband take-up % population	1	0.025		
	2d. Broadband prices	2d1 Broadband price index Score (0–100)	1	0.025	0.1	
3. Integration of digital technology	3a. Digital intensity	3a1 SMEs with at least a basic level of digital intensity % SMEs	2	0.038	0.15	0.25
	3b. Digital technologies for businesses	3b1 Electronic information sharing % enterprises	1	0.018	0.7	
		3b2 Social media % enterprises	1	0.018		
		3b3 Big data % enterprises	2	0.035		
		3b4 Cloud % enterprises	2	0.035		
		3b5 Artificial Intelligence % enterprises	2	0.035		
		3b6 ICT for environmental sustainability % enterprises carrying out environmental activities with the use of ICT, which achieved a medium/high level for the indicator measuring the use of digital technologies	1	0.018		
		3b7 e-Invoices % enterprises	1	0.018		
	3c. e-Commerce	3c1 SMEs selling online % SMEs	1	0.013	0.15	
		3c2 e-Commerce turnover % SME turnover	1	0.013		
		3c3 Selling online cross-border % SMEs	1	0.013		

4. Digital public services	4a. e-Government	4a1 e-Government users % Internet users	1	0.036	1	0.25
		4a2 Pre-filled forms Score (0 to 100)	1	0.036		
		4a3 Digital public services for citizens Score (0–100)	2	0.071		
		4a4 Digital public services for businesses Score (0–100)	2	0.071		
		4a5 Open data % maximum score	1	0.036		

Notice: the weight in the index as a whole means the impact of a change in a given indicator on a change in the DESI index as a whole.

Source: prepared by PEI.

Examining Table 2 and the analysis of the weights, a few conclusions on the appropriateness of the DESI's construction for the declared strategic aims and about the ability to change a country's position in the ranking can be drawn:

- The indicators in the Digital public services category have the biggest influence on the final ranking, especially 4a3 Digital public services for citizens and 4a4 Digital public services for businesses. Both these indicators come from the e-government benchmark research (European Commission, 2022a).

- The e-Government subdimension has more of an impact on the final DESI result than any other subdimension (that is, a 1 point increase in this subdimension will result in the largest increase in the index's final value).

- The indicators theoretically corresponding to the EU's strategic goals, i.e. those for which a double weight was applied, are actually among those with the greatest impact on the final index, but each of the indicators from the Digital public services dimension carries more weight than the indicators from the Digital services for business subdimension (3b4, 3b5, 3b6). This points to a certain inconsistency in the selection of weights for the purposes of the index.

- The indicators in the E-commerce subdimension (3c) have the lowest impact on the DESI's final value.

Changes in the DESI

The DESI is reviewed regularly; the indicators are updated or changed. In 2021, the index underwent fundamental change, the largest since it started being published. It went from five to four dimensions; the Internet use category, which contained indicators describing citizens' use of the Internet, was removed. The weight of the Integration of digital technologies and Digital public services dimensions was increased (in 2020, when the DESI was made up of five dimensions, Integration of digital technologies accounted for 20% of the final index, and Digital public services for 15%). Seven indicators were added and ten were assigned double weight (in the DESI 2020, four indicators had double weight). In 2022, further indicator corrections were carried out: the indicator describing 4G network coverage was removed, fibre optic network coverage was added, and the percentage of people with digital skills

was replaced by the percentage with the ability to create digital content (European Commission 2020; 2021a; 2022b).

For Poland, the change of 2021 did not change its position in the ranking significantly — it fell by two places, from 22nd (without counting Great Britain) to 24th place. The top four remained unchanged (the order changed, though), and Italy and Cyprus left the bottom five countries. In the Use of Internet services dimension, Poland was 23rd in 2020, so its removal from the DESI did not have much of an impact on Poland's position.

Comparing the methodological changes in the DESI between individual editions, it is worth paying attention to the choice of dimensions, but also to the definitions and sources of data for individual indicators. Analysis of the indicators in the Connectivity dimension provides a good example. In 2020, Poland ranked relatively high in this dimension: 15th place. In 2021, it had fallen to 21st. The changes involved adding two indicators: 5G network coverage and Use of connections with a speed of at least 1 Gbps. However, the change in the source of the data concerning the use of broadband mobile services was key for the change in Poland's position. The Communications Committee (COCOM) data used in 2020 would have put Poland in first place in the whole EU. However, since 2021, data from Statistics Poland (GUS) surveys have been used; respondents were asked whether they use a mobile device to connect to the Internet. Here, the result for Poland is 83.8%, which currently puts Poland in 21st place in the EU.

The European Commission follows a few principles when adding indicators to the DESI (European Commission, 2022b). The indicators being used:

> must be collected regularly. To perform a monitoring role, the indicators used in the index should ideally be collected annually (or at least with a predetermined regularity);

> must be relevant to the area of analysis. All the indicators in the index must be accepted as appropriate measures in specific areas of public policy;

> cannot be redundant. The index should not contain redundant indicators, in a statistical or an interpretive sense.

Poland's position in the DESI

Poland is currently in 24th place in the DESI. Since the ranking was launched in 2014,[1] it ranked the highest in 2016, in 21st place. However, if we take the current methodology (that is, the indicators used in the DESI in 2022), Poland has not managed to change its position at all since 2017.

In terms of individual dimensions, Poland is 24th in the Human capital and Integration of digital technology dimensions, 25th in Connectivity, and 22nd in Digital public services.

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[1] The DESI published in 2015 also included the ranking for 2014.

When it comes to individual indicators, Poland is above the EU average in just five of them:

→ 2a2 At least 100 Mbps fixed broadband take-up

→ 2b3 Fibre to the Premises (FTTP) coverage

→ 2d1 Broadband price index

→ 4a2 Pre-filled forms

→ 4a5 Open data

It is worth noting that Poland is not above the EU average for any of the indicators in the Human capital and Integration of digital technology dimensions.

Box 1. Statistical analysis of DESI's dependence on external conditions

Regression results

As we show further on in this report, it is very difficult to change a country's position in the DESI ranking. Most countries remain in a similar position for a number of years, despite often significant efforts and spending on digitisation. The following analysis examines this issue at a deeper level by focusing on the external factors that determine the level of the DESI index. The analysis is based on a linear regression model, which determines the impact of selected economic variables on the current value of the DESI index.

Initially, both historical variables — the number of telephone lines per 100 inhabitants in 2000 and GDP per capita in 2012 — and variables reflecting the current situation and conditions in a country — GDP per capita in 2021 and the level of urbanisation (the percentage of inhabitants living in urban areas) — were taken into account. After a result assessing individual variables' statistical significance and the informative value, a final model was selected, in which **the explanatory variables are the level of urbanisation and GDP per capita in 2012.** The explanatory variable is the point value of the DESI index. The model is estimated without the data for Luxembourg; due to its specificity (size, wealth and level of urbanisation), including this country in the regression significantly affects the final results. The model selected explains about 60% of the DESI's variance in 2022.

Table 3. Results of regression analysis of the DESI values

Variable	coeff	std err	t stat	p-value	lower	upper
Intercept **	18.13023	7.60563	2.38379	18.0.02577	2.39678	33.86367
PKB pc PPS 2012 **	0.87318	0.20694	4.21958	0.00033	0.44510	1.30127
URBANpop	0.18295	0.11593	1.57809	0.12820	-0.05687	0.42278

OVERALL FIT

Multiple R	0.77475
R Square	0.60024
Adjusted R Square	0.56547
Standard Error	6.57586
Observations	26

*** - significance at the level of 0.01
** - significance at the level of 0.05

Source: prepared by PEI.

The values obtained indicate that a country's wealth has a significant and positive impact on its score in the DESI. The level of urbanisation, although it is positively correlated with the value of the DESI, is statistically insignificant (Chart 1 and 2).

The following potential explanations for these dependencies can be identified:

- A country's wealth determines development opportunities and is one of the main factors contributing to digitisation. (Vincente, Jesús López, 2011)

- In countries with a higher level of urbanisation, the cost of connecting residents to the Internet is lower. The population's concentration in cities does not require the construction of costly infrastructure in rural areas, which is one of the barriers to achieving full Internet access in Poland.

- Greater urbanisation can also mean benefits for companies concentrated in larger urban centres; they adopt modern technological solutions more rapidly and benefit from the proximity of other entities (clustering).

- Cities can also foster digitisation through the demographic structure of their inhabitants, who are usually younger, better educated and wealthier, which makes them more willing to reach for technological solutions. As a result, companies and the administration adapt to the needs of the community. (Martin, 2019)

- Higher levels of urbanisation have also been cited as contributing to higher levels of digitisation in other empirical studies conducted in the US and other regions. (Pick, Sarkar, Johnson, 2015).

Chart 1.   Comparison of DESI value and countries' level of wealth in 2012
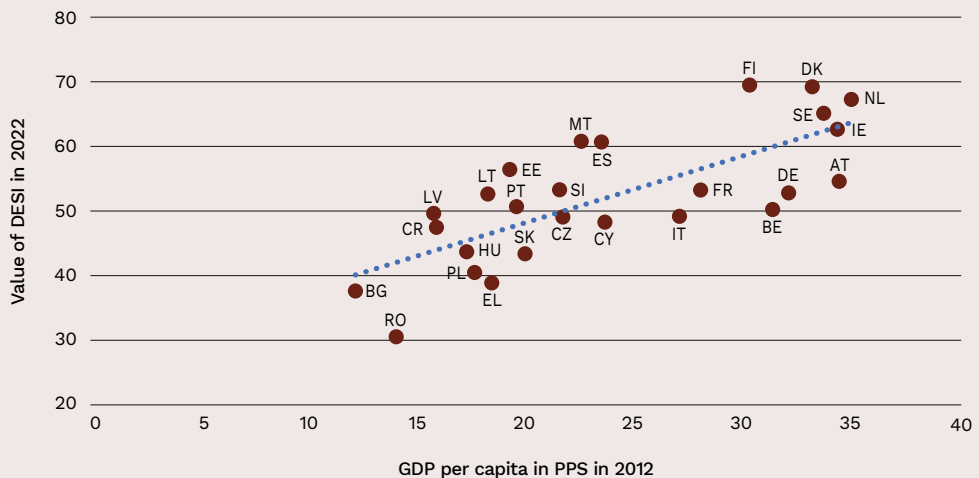
Source: prepared by PEI.

Chart 2. Comparison of DESI value and level of urbanisation
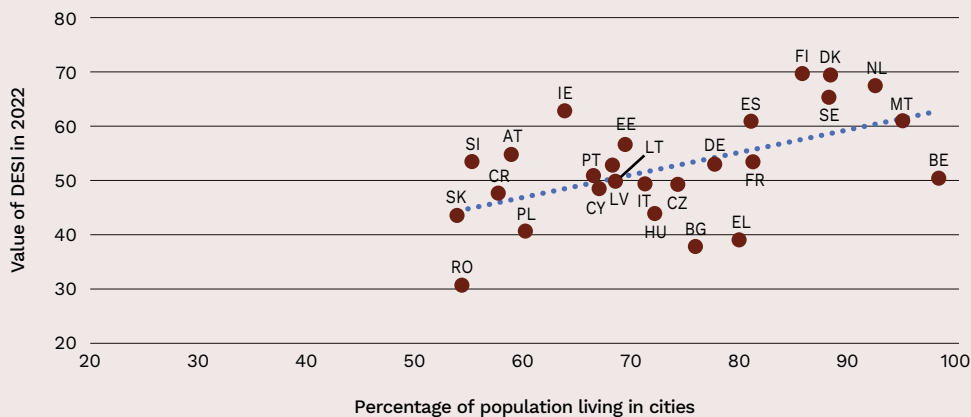
Source: prepared by PEI.

It is worth noting that, taking into account the regression results, Poland is among the countries with a DESI score lower than the values of explanatory variables (the level of urbanisation and GDP per capita) would suggest. This can be interpreted as an indication that **Poland is scoring below its potential and below the possibilities offered by existing structural conditions.** If the score were equal to the results of the estimation, Poland would be in 20th place. **The countries that score higher than suggested by structural conditions** (that is, higher than the values of the dependent variables) **include Estonia, Spain and Finland** (Charts 3 and 4).

Chart 3. Comparison of DESI in 2022 and value predicted based on regression results

■ DESI 2022   ● Predicted DESI value

Source: prepared by PEI.

The DESI – the index's structure and Poland's position
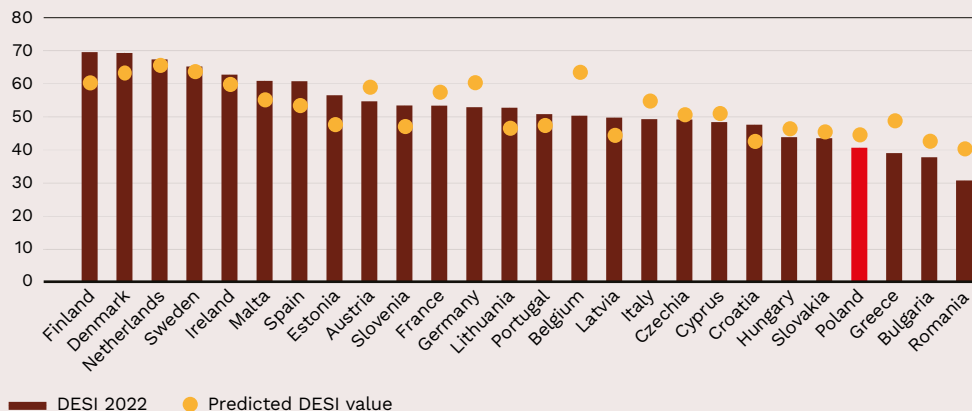
Chart 4. Difference between actual and predicted (resulting from regression) DESI in 2022

These countries achieved a result **below their potential**

These countries achieved a result **above their potential**

Belgium, Greece, Romania, Germany, Italy, Bulgaria, Austria, France, Poland, Cyprus, Hungary, Slovakia, Czechia, Sweden, Netherlands, Ireland, Portugal, Croatia, Latvia, Malta, Denmark, Lithuania, Slovenia, Spain, Estonia, Finland
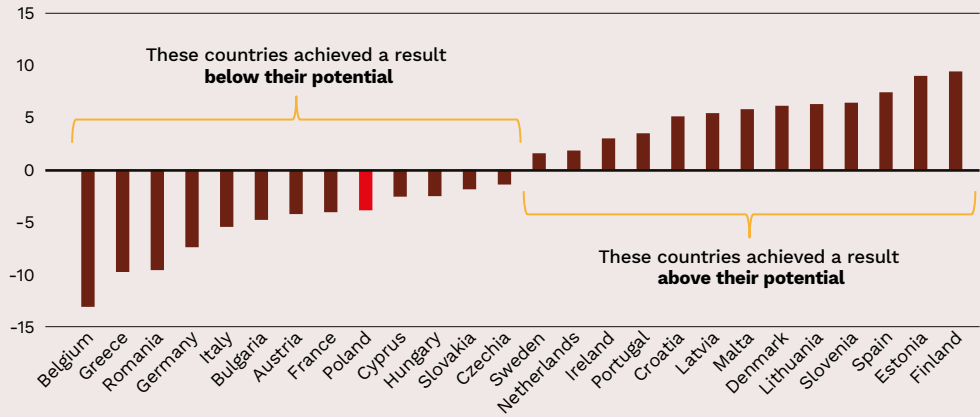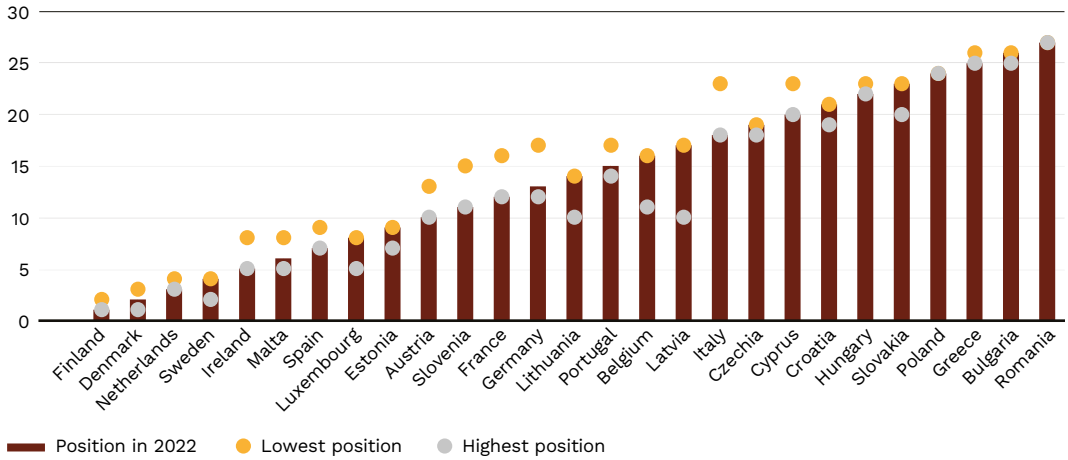
Source: prepared by PEI.

Changes in countries' position in the DESI so far

The changes in countries' position in the DESI ranking can be considered in two ways. Firstly, taking into account the score based on the current indicators and the current methodology, and secondly, by taking into account historical DESI rankings; that is, by looking at the change in countries' position based on the score in a given year.

The first way — **analysing countries' position based on the indicators currently used — shows that a significant change in position in the DESI ranking is difficult to achieve.** Over the past six years,[2] three (Italy, France and Germany) of the EU's 27 member states have increased their position by four or five places, and two (Ireland and Slovenia) by three. Latvia dropped the most sharply in the ranking, by seven places, and four countries dropped by three. The changes in the other 17 countries' positions were insignificant. Seven of them are in the same position as six years ago, and two (Poland and Romania) have not changed position at all during this whole period. Moreover, there were no changes at the top or bottom of the ranking. The top and bottom four remained the same; only the order changed.

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[2] The European Commission's data in line with the current methodology only goes 6 years back.

Chart 5. Countries' position in DESI 2022 and changes in 2017-2022 – based on 2022 methodology

Legend: ■ Position in 2022 ● Lowest position ● Highest position

Source: prepared by PEI based on European Commission data.

Slightly more changes took place if the change in countries' position is analysed in terms of their results in a given year; that is, amid changing indicators. In this case, every country changed position at least once. Nevertheless, six countries are in the same position as in 2015, when the ranking was first published (in other words, they both advanced and fell in the ranking and, as a result, their position did not change).

Chart 6. Countries' position in DESI in 2022 and changes in 2015-2022 – based on methodology in a given year

Legend: ■ Position in 2022 ● Lowest position ● Highest position

Source: prepared by PEI based on European Commission data.

The DESI – the index's structure and Poland's position

Malta (from 14th to 6th place) and Slovenia (from 18th to 11th) advanced the most. Belgium's position dropped the most sharply (from 5th to 16th), followed by Lithuania and Germany (by four places, from 10th and 9th respectively in 2015). Poland started in 22nd place. It advanced one place in 2016 before dropping in the ranking. It is now in 24th place.

As in the case of the analysis of the data according to the 2022 methodology, there was no change in the top four. The three countries at the bottom of the ranking remained the same, too (Greece, Bulgaria and Romania).

Alternative approach – measuring distance from the leader

An alternative to ranking countries based on their score is measuring their distance from the country at the top of the ranking. One of the European Commission's assumptions when creating a digital strategy is achieving convergence and reducing the gap between the leaders and the laggards when it comes to digitisation. This effect can go unnoticed if we only consider countries' position in the ranking.

An approach that combines ranking countries according to absolute values while noting the distance from the average and the progress made can be found in the European Innovation Scoreboard (EIS) ranking of European countries' innovativeness, which is also created annually by the European Commission (European Commission, 2022c). While the EIS divides countries into more and less innovative ones, and bases its lists on the scores achieved, the report and the information on individual countries strongly emphasise changes in the indicators over time and how they relate to the average. This approach provides us with additional information on where development in a given country is taking place, whether certain areas require special care, and whether the development is sustainable. The DESI does not provide this information in its main report; to obtain it, readers need to look more closely at the data and visualisations provided by the Commission.

Italy, Greece, Cyprus and Poland are the countries which reduced the distance to Europe's digital leaders the most. Italy's score rose by almost 12% when measured as a fraction of the leader's score, and Poland's rose from 52.1% of the leader's score to 58.3% (according to the 2022 methodology). Here, it is worth noting that convergence in digital results can be observed in the whole EU. Both the distance between the leader and the laggards and between the leader and the EU average is narrowing. (the leader's score is currently 228% of that of the country at the bottom of the ranking; six years ago, it was 247%).

The pace of convergence slowed down somewhat in 2021 before accelerating again; this may have been a one-off caused by the pandemic. Poland is getting closer to the EU average, too. In 2017, its score was 73.9% of the EU average; it is now 77.6%.

It is also worth noting that all the countries that scored below the EU average in 2016 have made progress when it comes to catching up with the leader and that the European Commission draws attention to the convergence effect, too (2022b).

Chart 7. Change in value of DESI in individual countries compared the leader in 2017-2022
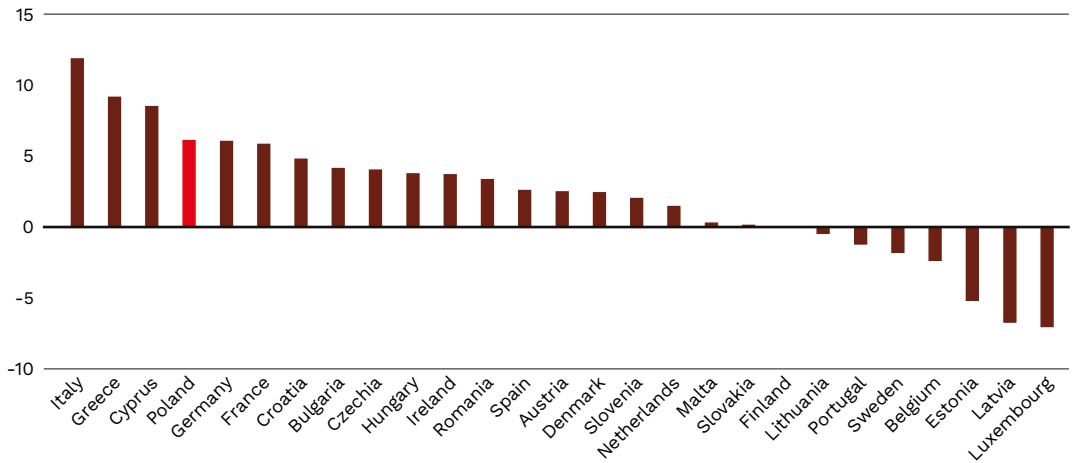
Source: prepared by PEI based on European Commission data.

Convergence within the EU is a positive phenomenon. The digital laggards' progress means that living and business conditions in these countries have improved, and cohesion in the single market can increase the chances for the development of European digital champions. Convergence also points to the success of certain digital policies in the countries seeking to catch up with the EU leaders. In the case of Poland, the distance from the leader narrowed in eight of the ten DESI subdimensions; it gained as much as 44% of the leader's score for 2b Fixed broadband coverage, and 28% of 2a Fixed broadband take-up. **In both these subdimensions, Poland also advanced in the country ranking, but showing the extent to which it is catching up with the leaders is a clear evidence of the effectiveness of the work being done to develop broadband networks in Poland.**

Prioritising DESI indicators for the purposes of public policy

The administration's impact on the DESI indictors

The indicators used in the DESI come from a variety of sources and describe various aspects of digitisation. In this context, it should be emphasised that **public policies' ability to influence the indicators' value varies — not all aspects of digitalisation are affected by the administration's actions to the same extent.**

An example of an indicator dependent on the administration's actions to the largest extent is 2c1 5G spectrum, which describes what share of the band harmonised in the EU for the 5G network's needs has been allocated in the country. The value of this indicator depends almost entirely on administrative decisions and how effectively they are implemented.[3]

Indicator 4a5 Open data has a somewhat similar character. It measures the implementation of the amendment to the Directive on open data and the re-use of public sector information. This is also an indicator for which Poland ranks 4th in the EU as a result of its consistent approach to this aspect of public policy.

However, the inclusion of these kinds of indicators has two aspects. Firstly, they are largely dependent on the actions and decisions of a given member state, which allows for a real assessment of its progress and willingness to act. Secondly, one should consider whether these kinds of indicators should be taken into account at all, since the implementation of legal obligations is monitored by the European Commission independently of the DESI (and the deadlines for the allocation of radio spectrum bands are set out in EU directives).

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[3] In the case of countries on the EU borders international coordination must of course be taken into account. In the case of Poland, this is all the more important as they are related to negotiations with the Russian Federation on the harmonisation of individual radio spectrum bands. Nevertheless, delays in the allocation of the radio spectrum also result from purely domestic conditions; this is the case with the so-called C-Band.

A relatively simple — and proven, in the case of Poland — impact can also be obtained when it comes to broadband coverage in the country (indicators 2b1-2b3). Poland has implemented a number of projects related to the construction of broadband networks during the past two multi-annual financial frameworks. These actions, taken using EU funds, have led to the rapid development of next-generation networks and increased the number of gigabit lines. Poland is one of the leaders in the growth rate of high-speed networks (>30 Mbps), next-generation networks (>100 Mbps) and gigabit networks. It is worth paying attention to the connectivity in rural areas, where most Operational Programme Digital Poland projects are implemented. This is where network coverage and its parameters will increase. The indicators monitoring broadband network coverage can therefore be influenced by the administration's actions, but this impact is spread over many years. As mentioned earlier, success in these areas led to rapidly catching up with the leaders in the corresponding DESI subdimensions.

Another example of indicators subject to regulatory impact and actions by the administration are 4a3 and 4a4, Digital services for citizens and businesses. Here, policymakers have a dual role. Firstly, regulatory and administrative actions — concerning how e-services are offered — can have a major influence. Secondly, the subsidisation of public systems, digitisation of processes and improvement of customer experience is very significant. It is worth adding that the assessment of these indicators comes from qualitative studies (of the mystery shopper type). The value of this type of indicator is based on a questionnaire sent to the relevant administrative office (for example, indicating the websites where selected services are available), then the work of analysts who try to use these services, and finally on results' validation by representatives of the administration. For a national administration to make sure that the final results are relevant it is crucial to indicate the appropriate websites where a given service can be effectively provided, and identify any errors and omissions that could lower the final score. A similar example is the 3b7 e-Invoices indicator. In Italy, the EU leader in terms of the use of e-invoices, it has been a statutory obligation for several years, which contributed to a sharp increase in the value of this indicator (from 41.6% in 2019 to 94.9% today).

There are also DESI **indicators almost entirely unaffected by public policies,** such as the 2d1 Broadband price index or 3b6 ICT for environmental sustainability. The value of the former is shaped on the market, which is extremely competitive in case of Poland. However, the use of the latter may be questionable in terms of interpretation and for methodological reasons. The data comes from surveys, the methodology of which means that the results only reflect the real situation in the countries to a limited extent (European Commission 2021b). Regardless of its methodological shortcomings, the indicator seems dubious in terms of interpretation and contributes little to the index as a whole. Another indicator that may difficult to influence, especially in the short and medium term, is 1b2 Female ICT specialists.

Influencing the digital skills indicators requires complex, multifaceted actions. Developing digital skills is one of the top priorities of all EU digital strategies, including the Digital Decade. Experts concur that this area is key

for Poland's future digital development — the foundation of all the other areas. The scale of the challenge is significant. Education programmes for children and young people may need to be modified. Lifelong learning needs to be implemented in practice: while young Poles' skill level only differs slightly from the EU average, the differences increase after they finish their studies, to Poland's detriment. Finally, separate efforts need to target groups that are particularly vulnerable to digital exclusion and have significantly lower skills and motivation to acquire them, such as senior citizens or people in the lowest-income households.

In Poland, the problem's complexity is addressed by comprehensive pro-grammes, such as the Digital Competences Development Programme (DCDP), but one should not expect a rapid impact on the DESI as a whole. In the absence of changes in the indicators in other countries, even achiev-ing the DCDP's objectives (KPRM, 2022) will only make Poland advance two places in the DESI, and it should be remembered that these objectives are meant to be achieved by 2026 or later. It should also be emphasised that, in subdimension 1a Internet user skills, Poland's distance from the leader increased (it is one of two subdimensions of this kind in the DESI). In subdi-mension 1b Advanced digital skills and development, Poland only gained 4.7% of the points scored by the leaders.

Similarly, it is **difficult to influence the indicators describing the use of digital tools by companies.** When it comes to the use of modern technol-ogy (the DESI currently measures big data, the cloud, AI and social media), an effect can only be achieved in the long term, and requires a comprehen-sive strategy and a change in entrepreneurs' attitudes. The Productivity Strat-egy 2030 adopted by the government of Poland seeks to improve Poland's position by three places in the ranking taking into account only the DESI's third pillar, the integration of digital technologies. This reflects the complex-ity of the situation and the limited ability to influence enterprises' attitudes in the short term.

Criteria for prioritising actions to improve Poland's position in DESI

To determine the possible priorities for actions aimed at improving Poland's position in the DESI, the analysis of the methodology was supplemented by proposing the criteria that should be followed when selecting the indica-tors that should be subject to intervention. To this end, we propose a few selection criteria, which are outlined in the table in Annex 2.

The first criterion is the distance from the leader, the country with the high-est score in the EU for a given indicator. **Comparing Poland's position when it comes to individual indicators with its distance from the leader shows that, in certain cases, this distance is relatively small, but Poland never-theless occupies a distant place in the ranking.** For example, for 4a4 Digital

public services for businesses, Poland is 24th in the EU, although its score is around 70% of Ireland's. For 2c3, Mobile broadband take-up, Poland's score is around 85% of Ireland's, but it is a distant 21st in the EU. Similar dependencies can be observed for 1a3 At least basic digital content creation skills, 2a1 Overall fixed broadband take-up and 2b1 Fast broadband (NGA) coverage. For a comparison encompassing all the indicators, see Annex 2.

The second criterion is a combined view of a given indicator's weight in the DESI and the distance to the leader. Indicators for which two conditions are met — they have a relatively high weight in the DESI and Poland is a significant distance from the leader — are worth special analysis in terms of potential intervention. A high weight will enable a more rapid increase in the entire index's value with a unitary improvement in the indicator, and a big distance from the leader may point to potential for improvement and for drawing on best practices from abroad. Seven indicators of this kind can be identified: 1a2 Above basic digital skills; 1b1 ICT specialists; 2c3 Mobile broadband take-up; 3a1 SMEs with at least a basic level of digital intensity; 3b3 Big data; 3b4 Cloud and 3b5 Artificial Intelligence.

Finally, **the third criterion is the administration's strong impact on a given indicator's level.** As noted above, government action has an uneven impact on individual DESI indicators. Some are directly in the government's or local governments' control, others can be affected only indirectly or only in the distant future, while it seems that others cannot be influenced by them at all. While it is worth focusing on the former to rapidly improve Poland's position in the DESI, the latter will evolve with structural changes in the economy and society. When planning actions focused on Poland's position in the DESI, the administration should not be guided by their level. This criterion was assessed on a scale from 1 (practically no impact) to 5 (the impact may be direct).

The highest scores were achieved by the indicators in the e-Government subdimension and indicators 2c1 5G spectrum and 2b1 Fast broadband (NGA) coverage. The lowest scores were obtained by the indicators in subdimension 3c E-commerce and by 3b5 Artificial Intelligence, 3b2 Social media, 1b2 Female ICT specialists, 1b3 Enterprises providing ICT training and 2d1 Broadband price index.

Chart 8 illustrates the juxtaposition of two criteria — the strength of the administration's influence and the distance to the leader — which enables the DESI indicators to be divided into four main groups. This kind of juxtaposition may be helpful when formulating goals and prioritising actions, especially those that seek to rapidly improve a given country's position in the DESI.

Chart 8. The DESI indicators – assessment in terms of Poland's distance from the leader and the strength of the administration's impact

Source: prepared by PEI.

Chart 8 presents data for Poland, but a similar approach and categorization of DESI indicators can be done for any EU Member State.

Group 1 – *Low hanging fruit* – indicators characterised by **a sizeable distance from the leader, on which the administration has a major impact.** For Poland, it contains five indicators. **Actions should focus on these indicators to ensure rapid advancement in the DESI.** It includes indicators relating to 5G (spectrum allocation — entirely on the side of the administration, and network coverage, which is a function of the available bandwidth and coverage requirements (Święcicki, 2019)) or the use of e-invoices by entrepreneurs.

Group 2 – *The final stretch* – indicators where **the administration has a major impact and the distance from the leader is relatively low** (country's score is above 50% of the leader's). This may mean that **a relatively low additional effort or continuation of existing actions could improve country's position in the DESI.** At the same time, this group may also contain indicators the improvement of which "on the final stretch" will be very difficult — as a country gets closer to the leaders, obtaining each additional point may requite greater effort. It is worth noting that for Poland all the indicators in the e-Government subdimension are in this group.

Group 3 – *Mission economy* – indicators where **a country is far from the leader and actions by the administration may not have the expected results.** In the case of Poland, these are above all indicators describing enterprises' digitisation, including their use of modern digital tools and services. **Solving Poland's problems in this area requires cooperation with the market and setting ambitious targets, which would be jointly adopted by the administration and entrepreneurs** in a spirit of consensus to modernise the economy.

Group 4 – *The market will decide* – indicators where the **government has little influence on the value of the indicator and country's score is more than 50% of the leader's.** For Poland, this includes indicators like the prices of broadband services, the share of women among IT professionals and the use of mobile broadband services. **The values of these indicators are fully market-based or depend on deep trends and social phenomena that are beyond the administration's control** in the medium or even long term.

Table 4 below presents the DESI indicators divided into the four groups (for Poland) described above:

Table 4. Division of DESI indicators based on Poland's distance from the leader and the administration's impact

Group 1 – Low hanging fruit	Group 2 – The final stretch
1b4 ICT graduates 2c1 5G spectrum 2c2 5G Coverage 2a3 At least 1 Gbps take-up 3b7 e-Invoices	1a1 At least basic digital skills 1a3 At least basic digital content creation skills 2a2 At least 100 Mbps fixed broadband take-up 2b1 Fast broadband (NGA) coverage 2b2 Fixed Very High Capacity Network (VHCN) coverage 2b3 Fibre to the Premises (FTTP) coverage 4a1 e-Government users 4a2 Pre-filled forms 4a3 Digital public services for citizens 4a4 Digital public services for businesses 4a5 Open data

Group 3 – Mission economy	Group 4 – The market will decide
1a2 Above basic digital skills 1b1 ICT specialists 1b3 Enterprises providing ICT training 3a1 SMEs with at least a basic level of digital intensity 3b2 Social media 3b3 Big data 3b4 Cloud 3b5 Artificial Intelligence 3c1 SMEs selling online 3c2 e-Commerce turnover 3c3 Selling online cross-border	1b2 Female ICT specialists 2c3 Mobile broadband take-up 2d1 Broadband price index 3b1 Electronic information sharing 3b6 ICT for environmental sustainability

Source: prepared by PEI.

Other rankings measuring the level of digital development

Digitisation is one of the central topics in economic policies worldwide, which is why many institutions and companies are creating their own sets of digital indicators and trying to create international comparisons. These include general summaries, containing indicators from many areas, and ones with a narrower focus (such as e-government or cybersecurity).

Table 5. List of selected indexes measuring countries' level of digital development

Name	Institution	Construction	Poland's position	Number of countries	Years covered
E-Government Development Index	UN	3 pillars: online services, telecommunications infrastructure, human capital	34	193	2003–2022
E-Participation Index	UN	3 pillars: e-information; e-consultation; e-decision making	51	193	2003–2022
Global Cybersecurity Index	ITU	5 pillars: legal; technical; organisational; cooperation; potential development	30	194	2015–2020
IMD Digital competitiveness ranking	IMD	3 pillars: knowledge; technology; future readiness	46	63	2007–2022
Networked readiness index	World Economic Forum / Portulans Institute	4 pillars: technology; people; governance; impact — each with 3 sub-pillars	34	131	2016–2022
Knowledge Economy Index	European Bank for Reconstruction and Development	4 pillars: institutions for innovation; skills for innovation; innovative system, ICT infrastructure	6	46	2019
e-Government Benchmark	European Commission	4 elements (user centricity, transparency, use of key enablers, cross-border service delivery), 8 life events, 14 indicators and 48 survey questions. 93 services	27	35	2013–2022
European Innovation Scoreboard	European Commission	12 sections, 32 indicators	24	38	2014–2022

European Sovereignty Index	European Council of Foreign Relations	6 areas (Climate, Defence, Economy, Health, Migrations, Technologies); 2 dimensions (capabilities, commitments), 2 aspects (AI and data; Hardware, infrastructure and security); 64 indicators in Technologies	21	27	2022
Digital Futures Index	Microsoft	5 sectors (Business, Government & Public, Infrastructure, Digital sector, Human capital), 21 sub-indicators; 44 measures	-	16	2022
OECD Going Digital Toolkit	OECD	7 areas, 42 indicators	No ranking, data from various years		

Source: prepared by PEI.

Analysing various indices and lists of countries in terms of the level of digitisation shows that Poland's position in the DESI is similar to its position in most other rankings. In individual indices, Poland is below the EU average, although it is above the global average in global rankings.

While Poland's position in most international comparisons is similar to that in the DESI, it is possible to name selected, individual indicators in which Poland scores significantly higher than in the DESI, and which thematically and conceptually fit the index and could theoretically be part of it.

Table 6. Selected indicators in which Poland achieves high results compared to the rest of the EU in other indices examining digitisation

Indicator	Index / source	Poland's position/score	Comments
Internet Users experiencing privacy violations	OECD going digital toolkit	PL: 9% EU: 32%	The data comes from the Eurostat survey and is available for 2019. A higher score means that threats appear more frequently
Payment Security concerns prevent individuals from buying online	OECD going digital toolkit	PL: 6% EU: 24.3%	The data comes from the Eurostat survey and is available for 2019
Product return concerns prevent individuals from buying online	OECD going digital toolkit	PL: 1% EU: 5%	The data comes from the Eurostat survey and is available for 2019
Design applications	European Innovation Scoreboard	141% of the EU average	The data relate to the number of design patent applications submitted to EUIPO
% of total students that has access to a computer for schoolwork at home	Digital Futures Index	130.2% of the CEE average	The data comes from 2020, from the OECD
% working from home before COVID-19 pandemic	Digital Futures Index	131.8 % of the CEE average	Eurofund data
Large companies with Very high level of digital intensity index	Digital Intensity Index	15th in the EU	Eurostat
Internet access 1t schools	Network Readiness Index	1 (score 100/100)	UNESCO
Online access to financial account	Network Readiness Index	15 out of 130 countries	World Bank, Global Findex Database
Cooperative measures, Technical measures	Global Cybersecurity Index	20/20	ITU

Source: prepared by PEI.

Analysis of alternative ways of constructing DESI

The DESI is created as a weighted average of individual indicators, aggregated into subdimensions and dimensions. When considering alternative index constructions, a few options can be taken into account:

1. Changing the weighting system.
2. Changing how the index is calculated
   (for example, relative rather than absolute).
3. Changing how the indicators are measured.
4. Changing the list of indicators.

Changing the weighting system

The weighting system used in DESI is meant to reflect the priorities for national digitization plans. There are currently ten indicators with double weight, but the weights given to the subdimension often change the relative weight of particular indicators. As a result, as mentioned before, the indicators with double weights are not necessarily more influential on a final score that those with single weights, but in more weighted subdimensions. Abandoning double weights is of course not without influence on the order of countries – eleven of the would change their position if all weighs were equal, but this would not impact neither top nor last five. However, in this index, the distance between the leader and the laggard is slightly smaller: Romania's score is around 45.9% of Finland's, compared to around 44% in the original index.

Changing how the index is calculated

Changing the approach to how the index as a whole is presented — focusing on convergence and countries' progress, rather than absolute values — will not change the position of a given country in the index, but it will show the narrowing distance between the current laggards and the current leaders.

For example, as shown in the previous section of this report, Poland is one of the countries catching up the fastest, which allows for a slightly more positive assessment of the country's position, compared to focusing on its low position in the DESI as a whole.

Changing how the indicators are measured

Some of the indicators used in the DESI come from surveys conducted by national statistical offices, some are collected in surveys by consulting companies and research institutes, and some, especially in the field of e-government services, from surveys and assessments based on attempts to complete certain adminstrative matters using online services (mystery shopping). A review of the various indices shows that in the latter category, a country can achieve very different results depending on the measurement method used. For example, Poland ranks 22nd in the Digital public services dimension in the DESI, 24th in the Digital services for citizens indicator and 24th in the Digital services for businesses indicator. Meanwhile, in 2020 in the UN's e-Government Development Index, Poland was 12th in the EU. In the online services pillar, it is 10th.[4]

A comparison of these results shows that, in the case of some of the indicators or dimensions used in the DESI, it is difficult to objectively measure their level in individual countries. It should be emphasised that the methodology used in the e-Government Benchmark (the study that the values of the DESI indicators concerning digital administration services are taken from) is very in-depth and constantly being developed. However, it is not the only possible approach to this type of analysis and using alternative methods may give different results.

Changing the list of indicators

The indicators used in the DESI are assessed differently by experts on digitisation. During interviews conducted for the purposes of this project, many interviewees pointed out that some of the indicators are outdated.

The most frequently voiced objections include:

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[4] Poland dropped by 10 positions in the latest UN e-government index, as compared to its position two years earlier.

Analysis of alternative ways of constructing DESI

Table 7. Reservations concerning DESI indicators

Name of indicator	Reservations
4a1 e-Government users	Outdated indicator, contains too wide a range of potential contacts with the administration, even by email. A potential alternative is e.g. users of e-identification (in Poland, the trusted profile, among others).
3b3-3b5 (Big data, Cloud, AI)	The selected technologies are not universal; not every company has to use them. Companies can outsource some services using modern technologies, such as AI in accounting, which distorts the value of the indicator. In countries such as Poland, where there is a high percentage of SMEs, which tend to be less digitised, the indicator's overall value may be affected by this structural aspect of the economy.
4a3 and 4a4 Digital public services for citizens and businesses	The supply of services is measured, not the demand – there is no good measure of how many people or companies have actually used a given service. This kind of measure could replace the indicator or complement the index.
2b1-2b3 Broadband coverage	The data comes from studies commissioned by the European Commission; more precise data could come from national telecommunications infrastructure mapping systems. Based on the Directive establishing the European Electronic Communications Code, these kinds of systems need to be established by December 21, 2023. In Poland, this type of system has already been implemented.

Source: prepared by PEI.

In addition, several areas currently omitted in the DESI, which are of great importance for the digitisation of the economy and society, can be identified. They include:

- ✓ **start-ups and scale-ups:** rapidly developing new digital companies can testify to a country's digital potential. This aspect is not included in the DESI at the moment. While there is no single widely accepted measure of the development of a given start-up market, there are numerous industry rankings comparing the attractiveness of various "ecosystems" (usually cities or regions) for the development of young, innovative companies. In the Global Startup Ecosystem Index 2022 (StartupBlink 2022) ranking, Poland is 33rd globally, 20th in Europe and 13th in the EU. However, this is a worse result than in previous editions; in 2020. Poland ranked 27th globally. The ranking evaluates countries in three areas: quantitative, qualitative, and an assessment of the business environment. Poland fares better when it comes to quantity (the number of start-ups, co-working spaces, accelerators and meet-ups) than quality (including the presence of the largest companies' R&D centres, global corporations' local branches, and the number and size of startup conferences).

The statistics on start-ups come almost entirely from industry analyses and private databases. However, there is no shortage of indicators obtained from outside the official statistics system in the DESI. Given the availability of industry studies focused on assessing the conditions for the creation and development of start-ups, it seems possible that this type of indicator will be incorporated into the DESI in the future. The development of start-ups and scale-ups is also listed as one of the objectives of the Digital Decade Policy Programme.

✓ **cybersecurity** is one of the key areas in the functioning of the economy and the state in today's world. However, it is not currently included in the DESI in any way. However, the decision to include it has already been made and it is likely that the results of statistical surveys conducted by national statistical offices will be used to develop the new indicator. Statistics Poland has been asking questions about ICT security in its survey of companies since 2018. There are also global rankings prepared by the UN, for instance, which compare countries in terms of the development of cybersecurity. In the Global Cybersecurity Index (GCI), Poland ranks 30th globally and 16th in the EU. As part of the implementation of the Digital Decade Policy Programme, the Commission will review the strategic goals in 2026; one of the areas set to receive particular attention is cybersecurity (Decision (EU) 2022/2481).

✓ **investments in the digital economy (spending on ICT) and innovation:** data on investments in R&D, the level of innovation at enterprises, and spending on ICT is regularly collected and published by statistical offices. A cross-sectional report comparing countries in terms of innovation is the European Innovation Scoreboard (EIS) published once a year by the European Commission. Poland is currently 24th; it is only above the EU average in one indicator. At the same time, the Commission points out that Poland is advancing in the ranking more rapidly than the EU average, catching up with the leaders.

Given the existing public statistics and the EIS, the inclusion of selected indicators in the DESI should not be a major problem. At the same time, the direct use of indicators from the EIS may result in overlap between the two indices.

✓ the development of **modern financial tools** (the fintech industry), which are the foundation for many aspects of the digital economy. As in the case of start-ups, there are fintech industry rankings and comparative reports, although there are fewer of them and with a shorter history due to the narrower research area. As in the case of the research on start-ups, they often focus on comparing ecosystems (cities, agglomerations). One example is the Global Fintech Rankings Report (Findexable, 2021), which is based on a similar methodology as the start-up ranking described above (StartupBlink, 2022), evaluating quantitative and qualitative criteria and the business environment. In this ranking, Poland ranked 36th globally and 16th in the EU in 2021.

Incorporating fintech indicators into the DESI may be more problematic than incorporating broader categories of start-ups. On the one hand, due to the narrower thematic area, there are fewer reports and data available. On the other hand, focusing on a single industry (fintech) may have an effect

Analysis of alternative ways of constructing DESI

similar to including only selected technologies in questions for companies — it could rapidly become outdated.

It is also worth paying attention to the **area in which citizens and consumers use digital technologies,** which was removed from the DESI in 2021. This was probably due to the changes in the EU's new strategies, in which more emphasis is placed on the use of technology by companies. However, including this area may provide a broader picture of the processes taking place in the digitisation of European society. In the current situation, though, it will not improve Poland's position in the ranking: in 2020, Poland was 23rd in the Use of Internet services dimension.

The DESI index and the EU's new strategic targets

In theory, the DESI indicators and methodology are modified to better reflect the current strategic goals set by the European Commission. The specific goals are described by the Commission in the "EU 2030 Digital Compass: the European Way for the Digital Decade" (European Commission, 2021c), with nine dimensions and 15 specific numerical targets in four main directions. Some of these targets are already included in DESI (such as the employment of ICT specialists, the balance between women and men, network coverage, the use of modern technologies by enterprises, and the level of the digitisation of public services). Some of the other indicators could potentially be included in the DESI, as they can be assigned numerical values and are formulated in a way that allows their level to be measured in individual countries (for example, access to medical records, use of digital identity solutions, deployment of climate neutral edge nodes, and potentially the number of unicorns).

EU documents also contain clues as to how the DESI might be modified in the coming years. **Energy efficiency and sustainable development in the area of digitisation** is certainly a direction that will receive increasing attention. At the moment, this element is only present in one indicator (3b6 ICT for environmental sustainability, which was discussed earlier). However, the 2030 Digital Compass Communication contains the announcement that the Commission will introduce mechanisms for measuring the energy efficiency of data processing centres and telecommunications networks (European Commission, 2021c, p. 8).

Another topic that emerges from the theme of resilience is **cybersecurity**. As noted earlier, this area is not covered by the DESI at the moment, but it is becoming extremely important for the development of the digital economy and society.

In the studies commissioned by the Commission on broadband coverage in member states, there was an indicator describing the percentage of households within the range of symmetrical lines offering a bit rate of 1 Gb/s both "upstream" and "downstream" (i.e. for sending and downloading data). These changes may indicate which direction the selection of indicators for individual DESI dimensions will go in.

Summary and recommendations

We present **four key recommendations and nine more specific recommendations** below.

The DESI comprehensively describes digitisation in the EU member states. The index is not perfect: its key flaws include its dependence on external conditions (the country's level of development, socio-geographical conditions) and the (occasional) mismatch between it and the rapidly changing reality. However, it is difficult to name another, similarly comprehensive and updated, synthetic index describing digitisation.

Most countries' position in DESI is rather stable, especially those leading and closing the pack. I.e. Poland is roughly 24th out of 27 countries since the Index is published. In the case of Poland, changing this position by altering the ranking's structure or the choice of variables is basically impossible, as shown by our simulations of changes in the weighting system and by our review of other rankings and potential indicators that could be used to supplement the DESI.

In most of the countries an improvement in position in the DESI index will **depend to the largest extent on internal actions** – the ambition of national strategic programmes, the diagnosis of the problems, and choice of remedies. In the case of Poland, most of the key documents in this area have already been developed: operational programmes (especially the European Funds for Digital Development and the European Funds for a Modern Economy Programme), the National Recovery Plan, and national strategies (Productivity Strategy 2030). Certain other documents, setting out actions that will affect the DESI in the coming years (such as the Digital Competence Development Programme), are still being prepared.

Key recommendation 1 -> in accordance with the EC's announcements and the documents agreed on,[5] the DESI's nature is set to change, with it becoming a tool for monitoring countries' digital progress to a greater extent. **The development and implementation of national programmes should therefore focus more on the indicators used in the DESI,** indicating and estimating to what extent a given measure will change Poland's result.

Key recommendation 2 -> References to the DESI or to the indicators used in it appear in many national strategy documents. In accordance with the Decision of the Parliament and the Council "The Digital Decade Policy

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[5] The "Path to the Digital Decade" roadmap for 2030 policy programme was adopted and published in the Official Journal of the European Union on 19 December 2022.

Programme 2030" (European Commission 2022d), each country is also meant to prepare a roadmap for achieving the targets set by the Commission. **The digital goals' coherence and level of ambition recorded in national documents should therefore be monitored,** so that after the planned actions are taken, their intended effect, advancement in the DESI ranking, is achieved. For this purpose, a unit in the administration should be made responsible for monitoring progress in the DESI and individual indicators' values should be included in strategic documents and government programmes.

The DESI index is constructed in such a way that **it is very difficult to improve a country's position significantly.** Since it was launched, only a few countries have done so. This fact may result from the strong path dependencies of historical modernisation processes.

In the case of the DESI, the results of which are strongly historically and structurally conditioned, more attention should be paid to progress made by countries, in particular the process of catching up with the leaders and digital convergence. The current methodology, which only takes into account a country's absolute score, in some cases does not reflect the real processes behind changes in digitisation. Poland is among the countries most rapidly catching up with the European leaders and its progress is visible in all the DESI's pillars. However, this progress is invisible when countries are only ranked based on their total scores – the general convergence effect dominates.

Key recommendation 3 -> In order to achieve European strategic targets in digitization, it is important to achieve convergence among member states. **Future editions of the index should therefore take into account countries' progress — catching up with the leaders — to a greater extent.** An example of this approach is the European Innovation Scoreboard, where individual countries' results are presented in relation to the EU average and compared to the change over the past five and two years.

This recommendation is reinforced by the fact that, when we look at Poland as an example, **its distant position goes hand in hand with a relatively narrow gap between it and the European leaders.** Emphasising this will allow for a more adequate assessment of Poland's and any other country's position and the challenges ahead.

Key recommendation 4 -> seeking to improve a given country's position in **the DESI, the focus should first be on the indicators where the administration has the most influence and where the distance from the leaders is the greatest.** Next, we should look at the indicators in which the impact is large and the distance to be made up is small; for example, in the case of Poland, by reviewing the process of providing e-services in terms of the e-Government benchmark survey questionnaires and of making sure that all the relevant government websites are assessed. Actions taken in areas where the administration has less influence should be wide-ranging, in consultation with representatives of business and society — to build a consensus around digital goals and aspirations.

Recommendation 5 -> an **in-depth analysis of the actions taken in countries that have made the most progress in DESI,** as well as those doing better than the structural analysis would suggest, should be carried out. These countries include **Italy, Spain, Estonia and Finland.**

The European Commission also has the tools to support digitisation at national level, but these are less relevant to improving countries' results in the DESI than national efforts. These tools include the Digital Europe Programme, Horizon Europe and the Connecting Europe Facility. The Commission also creates networks of experts, supports the exchange of best practices between countries, encourages multinational projects, and can also support member states by commissioning academic studies.

Recommendation 6 -> The experts surveyed for this report agreed that the low level of digital skills is hampering Poland's digital development in almost all the other areas. Digital skills should therefore be treated as a catalyst for change in the other DESI categories, rather than as an equal item. Skills are directly included in the DESI, but they also affect the implementation and use of digital solutions by companies, and therefore the development of e-government. **As a result, although the indicators describing digital skills do not have the highest weight in the DESI index as a whole, a significant share of the attention and actions aimed at improving Poland's position in the DESI should focus on them.**

Recommendation 7 -> Any country that aims at improving its position in the DESI should encourage its representatives to actively participate in expert networks and forums for exchanging experiences promoted by the Commission (such as the Digital Skills Forum). At the same time, they should take advantage of opportunities offered by the Commission to gather and share best practices in specific areas covered by the DESI (for example, through the Working Group on the Digital Single Market and the Communications Committee, among others). The Commission can encourage countries to write down their best practices or commission expert opinions on selected topics. These sources of knowledge should be used to determine specific actions that a aspiring member state should take.

Recommendation 8 -> To achieve synergy between actions at the national and the EU level, **national mechanisms for coordinating and overseeing digital targets and horizontal institutions operating in key areas should be strengthened.** For digital skills, which are key to the whole sphere of digitisation, the Broad Agreement on Digital Skills was meant to play this role (in Poland). However, it is basically inoperative now.

Recommendation 9 -> it is also necessary to continue activities that affect the indicators in which Poland is among the EU leaders, such as 4a5 Open data (including identifying and opening subsequent databases, conducting research on the impact and use of public data), and transfer experience to other, similar areas. For example, in the area of services for citizens or services for business (which are in the "The final stretch" group of indicators, in which Poland is relatively close to the leaders), the starting point may be to fully digitise the services surveyed as part of the E-Government Benchmark, until the highest level is reached (full personalisation).

Recommendation 10 -> in the work aimed at improving one's position in the DESI, the announced and potential changes in the indicators used should also be taken into account. Taking into account new targets — for example, in the field of energy savings — at an early stage (for example, by creating national strategies or action plans) will enable a given country to prepare for changes in the DESI in advance. This will ensure a high position in the new indicator rankings or enable it to obtain funds to improve its score.

Recommendation 11 -> taking into account the potential changes in the DESI, one's potential in areas such as cybersecurity should be assessed, so that the country can have a constructive impact on the selection of potential indicators, in terms of a given country's position in relation to other EU countries, at an early stage.

Recommendation 12 -> the indicators used in the DESI do not always comply with the principles recommended by the Commission. For example, the indicators in sub-dimension 2b overlap: Fibre to the Premises (FTTP) coverage (2b3) is a subset of Fixed Very High Capacity Network (VHCN) coverage (2b2), which is a subset of those with fast broadband (NGA) coverage (2b1). Meanwhile, indicator 3b6, ICT for environmental sustainability, raises major methodological doubts. At further stages of the work on changes to the DESI, attention should be paid to these defects and efforts should be made to remove methodologically defective indicators from the index.

Some of the DESI indicators critiqued in previous chapters, including those criticised by experts, correspond directly to the main goals outlined by the Commission in its strategic documents (for example, the use of AI, big data or the cloud, the percentage of women among ICT specialists). As a result, these metrics will be difficult to modify significantly or remove from the index. In the case of the use modern technologies by companies (big data, cloud, AI), attention should be paid to the specificity of large companies and SMEs; depending on the size of the company, they differ in their approach to digitisation, the capital available, and motivation. It may therefore be useful to treat these categories of enterprises separately. Compared to the rest of the EU, Poland fares better when it comes to digitisation of large companies than that of SMEs.

Recommendation 13 -> distinguishing between the use of modern technologies (cloud computing, artificial intelligence, big data) at large companies and at SMEs in the DESI. In the case of SMEs, focusing on the possibility of purchasing (or actual purchase) of these kinds of services on the market; not all small businesses have to use this type of service in-house. In the case of large companies, the indicator may include, as it does at the moment, the in-house use of these technologies or their purchase on the market by companies.

Bibliography

European Commission (2020), *Digital Economy and Society Index (DESI) 2020. Methodological note*, Brussels.

European Commission (2021a), *Digital Economy and Society Index (DESI) 2021. Thematic chapters*, Brussels.

European Commission (2021b), *Survey on the contribution of ICT to the environmental sustainability actions of EU enterprises*, doi: 10.2759/46745, Brussels.

European Commission (2021c), *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee Of The Regions 2030 Digital Compass: the European way for the Digital Decade* COM/2021/118 final, Brussels.

European Commission (2022a), *eGovernment Benchmark 2022. Synchronising Digital Governments*, Brussels.

European Commission (2022b), *Digital Economy and Society Index (DESI) 2022. Thematic chapters*, Brussels.

European Commission (2022c), *European Innovation Scoreboard 2022*, Brussels, doi: 10.27777/309907.

European Commission (2022d), *Decision (EE) 2022/2481 Of The European Parliament And Of The Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030*, Official Journal of the European Union L323/4, 19.12.2022.

Findexable (2021), *Global Fintech Rankings Report. Brigding the Gap*, available at: https://findexable.com/2021-fintech-rankings/ [accessed: 31.12.2022].

KPRM (2022), *Program rozwoju kompetencji cyfrowych. Projekt – lipiec 2022*, https://www.gov.pl/web/cyfryzacja/zaproszenie-do-konsultacji-programu-rozwoju-kompetencji-cyfrowych [accessed: 31.12.2022].

Martin, M. (2019), *Deconstructing the Digital Divide: Identifying the Supply and Demand Factors That Drive Internet Subscription Rates*, SEHSD Working Paper Number: 2019-15, https://www.census.gov/library/working-papers/2019/demo/SEHSD-WP2019-15.html [accessed: 17.10.2022].

Pick J.B., Sarkar, A., Johnson, J. (2015), *United States digital divide: State level analysis of spatial clustering and multivariate determinants of ICT utilization*, "Socio-Economic Planning Sciences", Vol. 49, https://doi.org/10.1016/j.seps.2014.09.001.

StartupBlink (2022), *Global Startup Ecosystem Index 2022*, available at: https://lp.startupblink.com/report/ [accessed: 31.12.2022].

Święcicki, I. (2019), *Model wdrożenia i eksploatacji sieci 5G w Polsce. Uwarunkowania i problemy*, Polski Instytut Ekonomiczny, Warszawa.

Vicente, M.R., Jesús López, A. (2011), *Assessing the regional digital divide across the European Union-27*, "Telecommunications Policy", Vol. 35, Iss. 3, https://doi.org/10.1016/j.telpol.2010.12.013.

List of Annexes

Annex 1. Data sources

The attachment contains a list of all the indicators used in the DESI in 2022 along with the definition, data source, year for which they were collected, the frequency of collection, information about the questionnaire's availability, the administration's ability to validate the data, and other comments. The attachment is the basis for the analyses in this report, providing full methodological information on DESI the indicators.

Annex 2. DESI indicator prioritisation criteria

The attachment contains information about Poland's position in the individual indicators used in the DESI, Poland's distance from the leader (the country with the highest score in a given indicator), a given indicator's weight in the DESI as a whole, and an assessment of the administration's impact on a given indicator's value. This attachment is the basis for the analysis and recommendations on prioritising activities that seek to improve Poland's position in the DESI.

Annex 1. DESI – definitions and data sources

Table A1. List of DESI indicators and data sources

Indicator	Definition	Source	Year of data collection	Year, for which the data reffers	How often is it surveyed	Validation by national administration?	Comments
1a1 **At least basic digital skills** **% population**	Individuals with 'basic' or 'above basic' digital skills in each of the following five dimensions: information, communication, problem solving, software for content creation and safety	National Statistical Office - Information society survey	2021	2020	annualy	N/R	
1a2 **Above basic digital skills** **% population**	Individuals with 'above basic' digital skills in each of the following five dimensions: information, communication, problem solving, software for content creation and safety	National Statistical Office - Information society survey	2021	2020	annualy	N/R	
1a3 **At least basic digital content creation skills** **% population**	Individuals with a basic level in using software for digital content creation	National Statistical Office - Information society survey	2021	2020	annually	N/R	
1b1 **ICT specialists** **% working population** **(15-74 years old)**	Employed ICT specialists. Broad definition based on the ISCO-08 classification and including jobs like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers.	National Statistical Office - labour market survey	2022	2021	quarterly	N/R	ILO-approved classification of occupations
1b2 **Female ICT specialists** **% ICT specialists**	Employed female ICT specialists. Broad definition based on the ISCO-08 classification and including jobs like ICT service managers, ICT professionals, ICT technicians, ICT installers and servicers.	National Statistical Office - labour market survey	2022	2021	quarterly	N/R	ILO-approved classification of occupations
1b3 **Enterprises providing ICT training** **% enterprises**	Enterprises who provided training in ICT to their personnel	National Statistical Office - Information society survey	2021	2020	annualy	N/R	
1b4 **ICT graduates** **% graduates**	Individuals with a degree in ICT	Eurostat data based on national statistical offices	2021	2020	annualy	N/R	

2a1 **Overall fixed broadband take-up** **% households**	Percentage of households subscribing to fixed broadband	National Statistical Office - Information society survey	2021	2020	annualy	N/R	
2a2 **At least 100 Mbps fixed broadband take-up** **% households**	Percentage of households subscribing to fixed broadband of at least 100 Mbps, calculated as overall fixed broadband take-up	European Commission, through the Communications Committee (COCOM) and Eurostat - European Union survey on ICT usage in Households and by Individuals	2021	2021	half-yearly	YES (UKE in Poland)	
2a3 **At least 1 Gbps take-up** **% households**	Percentage of households subscribing to fixed broadband of at least 1 Gbps, calculated as overall fixed broadband take-up	European Commission, through the Communications Committee (COCOM) and Eurostat - European Union survey on ICT usage in Households and by Individuals	2021	2021	half-yearly	YES (UKE in Poland)	abc
2b1 **Fast broadband (NGA) coverage** **% households**	Percentage of households covered by fixed broadband of at least 30 Mbps download. The technologies considered are FTTH, FTTB, Cable Docsis 3.0 and VDS	Percentage of households covered by fixed broadband of at least 30 Mbps download. The technologies considered are FTTH, FTTB, Cable Docsis 3.0 and VDS	2022	2021	annualy	YES (UKE in Poland)	no information on the response rate or the number of surveyed enterprises
2b2 **Fixed Very High Capacity Network (VHCN) coverage** **% households**	Percentage of households covered by any fixed VHCN. The technologies considered are FTTH and FTTB for 2015-2018 and FTTH, FTTB and Cable Docsis 3.1 for 201	Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic	2022	2021	annualy	YES (UKE in Poland)	no information on the response rate or the number of surveyed enterprises
2b3 **Fibre to the Premises (FTTP) coverage** **% households**	Percentage of households covered by FTTH and FTTB	Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic	2022	2021	annualy	YES (UKE in Poland)	no information on the response rate or the number of surveyed enterprises
2c1 **5G spectrum** **The amount of spectrum assigned and ready for 5G use within the so-called 5G pioneer bands.**	The amount of spectrum assigned and ready for 5G use by the end of 2020 within the so-called 5G pioneer bands. These bands are 700 MHz (703-733 MHz and 758-788 MHz), 3.6 GHz (3400-3800 MHz) and 26 GHz (1000 MHz within 24250-27500 MHz). All three spectrum bands have an equal weight	European Commission services, through the Communications Committee (COCOM)	2022	2021		YES (UKE in Poland)	
2c2 **5G coverage** **% populated areas**	Percentage of populated areas with coverage by 5G	Broadband coverage in Europe studies for the European Commission by IHS Markit, Omdia and Point Topic	2022	2021	annualy	YES (UKE in Poland)	no information on the response rate or the number of surveyed enterprises
2c3 **Mobile broadband take-up** **% population**	Number of mobile data subscriptions per 100 people	National Statistical Office - Information society survey	2021	2020	annualy	N/R	
2d1 **Broadband price index** **Score (0–100)**	The broadband price index measures the prices of representative baskets of fixed, mobile and converged broadband offers	Broadband retail prices study, annual studies for the European Commission realised by Empirica	2022	2021	annualy	no, but according to BEREC guidelines	

3a1 **SMEs with at least a basic level of digital intensity** **% SMEs**	The digital intensity score is based on counting how many out of 12 selected technologies are used by enterprises. A basic level requires usage of at least 4 technologies.	National Statistical Office - Information society survey	2021	2020	annualy	N/R	
3b1 **Electronic information sharing** **% enterprises**	Enterprises who have in use an ERP (enterprise resource planning) software package to share information between different functional areas (e.g. accounting, planning, production, marketing)	National Statistical Office - Information society survey	2021	2020	annualy	N/R	Not included in 2022 survey - data from 2021 would be used
3b2 **Social media** **% enterprises**	Enterprises using two or more of the following social media: social networks, enterprise's blog or microblog, multimedia content sharing websites, wiki-based knowledge sharing tools. Using social media means that the enterprise has a user profile, an account or a user license depending on the requirements and the type of the social media.	National Statistical Office - Information society survey	2021	2020	annualy	annualy	Not included in 2022 survey - data from 2021 would be used
3b3 **Big data** **% enterprises**	Enterprises analysing big data from any data source	National Statistical Office - Information society survey	2021	2020	annualy	N/R	Not included in 2022 survey - data from 2021 would be used
3b4 **Cloud** **% enterprises**	Enterprises purchasing at least one of the following cloud computing services: hosting of the enterprise's database, accounting software applications, CRM software, computing power	National Statistical Office - Information society survey	2021	2020	annualy	N/R	Not included in 2022 survey - data from 2021 would be used
3b5 **Artificial Intelligence** **% enterprises**	Enterprises using any AI technology	National Statistical Office - Information society survey	2021	2020	annualy	N/R	Not included in 2022 survey - data from 2021 would be used
3b6 **ICT for environmental sustainability** **% enterprises carrying out environmental activities with the use of ICT, which achieved a medium/ high level for the indicator measuring the use of digital technologies**	The indicator measures the level of support that adopted ICT technologies offered to enterprises to engage in more environmentally-friendly actions. The level of intensity is measured based on the number of environmental actions (maximum 10) reported by enterprises to have been facilitated by the use of ICT. The following categorisation was achieved: low intensity (0 to 4 actions), medium intensity (5 to 7 actions) and high intensity (8 to 10 actions).	Survey of businesses on the use of digital technologies by Ipsos and iCite	2021		not indicated	NO	small sample - 453 enterprises for Poland, with 2 % response rate
3b7 **e-Invoices** **% enterprises**	Enterprises sending e-invoices, suitable for automated processing	National Statistical Office - Information society survey	2021	2020	annualy	N/R	not included in 2021 nor 2022 survey
3c1 **SMEs selling online** **% SMEs**	SMEs selling online (at least 1% of turnover)	National Statistical Office - Information society survey	2021	2020	annualy	N/R	
3c2 **e-Commerce turnover** **% SME turnover**	SMEs total turnover from e-commerce	National Statistical Office - Information society survey	2021	2020	annualy	N/R	
3c3 **Selling online cross-border** **% SMEs**	SMEs that carried out electronic sales to other EU countries	National Statistical Office - Information society survey	2021	2020	annualy	N/R	

4a1 **e-Government users** **% Internet users**	Individuals who used the Internet, in the last 12 months, for interaction with public authorities	National Statistical Office - Information society survey	2021	2020	annualy	annualy	
4a2 **Pre-filled forms** **Score (0–100)**	Amount of data that is pre-filled in public services' online forms	eGovernment Benchmark - research conducted by Capgemini	2021	2020	annually, but life events are rotated every two years	YES	Mystery shopper methodology, with national consultants and verified results.
4a3 **Digital public** **services for citizens** **Score (0–100)**	The share of administrative steps that can be done online for major life events (birth of a child, new residence, etc.) for citizens	eGovernment Benchmark - research conducted by Capgemini	2021	2020	annually, but life events are rotated every two years	YES	Mystery shopper methodology, with national consultants and verified results.
4a4 **Digital public** **services** **for businesses** **Score (0–100)**	The indicator broadly reflects the share of public services needed for starting a business and conducting regular business operations that are available online for domestic as well as foreign users. Services provided through a portal receive a higher score, services which provide only information (but have to be completed offline) receive a more limited score.	eGovernment Benchmark - research conducted by Capgemini	2021	2020	annually	YES	Mystery shopper methodology, with national consultants and verified results.
4a5 **Open data** **% maximum score**	This composite indicator measures to what extent countries have an open data policy in place (including the transposition of the revised PSI Directive), the estimated political, social and economic impact of open data and the characteristics (functionalities, data availability and usage) of the national data portal.	European Data Portal, data collected by Capgemini	2021	2020	annually		based on a survey

Annex 2. Criteria for prioritising action to improve position in the DESI index

Table A2. Criteria for prioritising actions to improve country's position in DESI

Subdimension	Indicator	Weight in the whole DESI	Poland's position in the EU	Criterion 1: Distance to the leader (Poland's score as % of leader's score)	Leader	Criterion 2: High weight in the DESI and a significant distance to the leader	Criterion 3: administration's impact (1 no impact – 5 very large impact)
1a. Internet user skills	1a1 At least basic digital skills % population	0.063	25	54.2%	Finland	NO	3.25
1a. Internet user skills	1a2 Above basic digital skills % population	0.031	23	39.9%	Netherlands	YES	2.5
1a. Internet user skills	1a3 At least basic digital content creation skills % population	0.031	25	68.5%	Netherlands	NO	3.25
1b. Advanced skills and development	1b1 ICT specialists % working population (15-74 years old)	0.042	24	43.8%	Sweden	YES	2.25
1b. Advanced skills and development	1a1 At 1b2 Female ICT specialists % ICT specialists least basic digital skills % population	0.042	24	55.0%	Bulgaria	NO	1.5
1b. Advanced skills and development	1b3 Enterprises providing ICT training % enterprises	0.021	16	47.1%	Finland	NO	1.75
1b. Advanced skills and development	1b4 ICT graduates % graduates	0.021	19	43.0%	Ireland	NO	3.5
2a. Fixed broadband take-up	2a1 Overall fixed broadband take-up % households	0.021	21	71.0%	Netherlands	NO	4
2a. Fixed broadband take-up	2a2 At least 100 Mbps fixed broadband take-up % households	0.021	12	60.1%	Spain	NO	3.75
2a. Fixed broadband take-up	2a3 At least 1 Gbps take-up % households	0.021	11	7.8%	France	NO	3
2b. Fixed broadband coverage	2b1 Fast broadband (NGA) coverage % households	0.016	25	78.2%	Cyprus	NO	4.5

2b. Fixed broadband coverage	**2b2 Fixed Very High Capacity Network (VHCN) coverage % households**	0.031	17	70.0%	Malta	NO	4
2b. Fixed broadband coverage	**2b3 Fibre to the Premises (FTTP) coverage % households**	0.016	17	59.0%	Latvia	NO	4.0
2c. Mobile broadband	**2c1 5G spectrum The amount of spectrum assigned and ready for 5G use within the so-called 5G pioneer bands.**	0.025	26	0.0%	Croatia	NO	5.0
2c. Mobile broadband	**2c2 5G coverage % populated areas**	0.05	15	34.3%	Italy	YES	3.8
2c. Mobile broadband	**2c3 Mobile broadband take-up % population**	0.025	21	85.1%	Ireland	NO	2.3
2d. Broadband prices	**2d1 Broadband price index Score (0–100)**	0.025	3	90.6%	Romania	NO	2
3a. Digital intensity	**3a1 SMEs with at least a basic level of digital intensity % SMEs**	0.038	22	46.3%	Sweden	YES	2.5
3b. Digital technologies for businesses	**3b1 Electronic information sharing % enterprises**	0.018	20	55.8%	Belgium	NO	3
3b. Digital technologies for businesses	**3b2 Social media % enterprises**	0.018	24	35.2%	Finland	NO	1.5
3b. Digital technologies for businesses	**3b2 Social media % enterprises**	0.035	21	28.2%	Malta	YES	2.25
3b. Digital technologies for businesses	**3b4 Cloud % enterprises**	0.035	24	27.7%	Sweden	YES	2.25
3b. Digital technologies for businesses	**3b5 Artificial Intelligence % enterprises**	0.035	24	12.0%	Denmark	YES	1.5
3b. Digital technologies for businesses	**3b6 ICT for environmental sustainability % enterprises carrying out environmental activities with the use of ICT, which achieved a medium/high level for the indicator measuring the use of digital technologies**	0.018	22	69.8%	Portugal	NO	2.25
3b. Digital technologies for businesses	**3b7 e-Invoices % enterprises**	0.018	23	13.9%	Italy	NO	4
3c. e-Commerce	**3c1 SMEs selling online % SMEs**	0.013	21	37.1%	Denmark	NO	1.5
3c. e-Commerce	**3c2 e-Commerce turnover % SME turnover**	0.013	20	38.2%	Ireland	NO	1.5
3c. e-Commerce	**3c3 Selling online cross-border % SMEs**	0.013	25	33.5%	Austria	NO	1.5
4a. e-Government	**4a1 e-Government users % Internet users**	0.036	23	58.6%	Sweden	NO	4.25
4a. e-Government	**4a2 Pre-filled forms Score (0–100)**	0.036	11	78.3%	Netherlands	NO	4.3
4a. e-Government	**4a3 Digital public services for citizens Score (0–100)**	0.071	24	57.5%	Malta	NO	5
4a. e-Government	**4a4 Digital public services for businesses Score (0–100)**	0.071	24	69.6%	Ireland	NO	5
4a. e-Government	**4a5 Open data % maximum score**	0.036	4	96.9%	France	NO	5

List of boxes, charts and tables

The Polish Economic Institute

The Polish Economic Institute is a public economic think tank dating back to 1928. Its research primarily spans macroeconomics, energy and climate, foreign trade, economic foresight, the digital economy and behavioural economics. The Institute provides reports, analyses and recommendations for key areas of the economy and social life in Poland, taking into account the international situation.

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