ISSN 1831-9424

European Commission

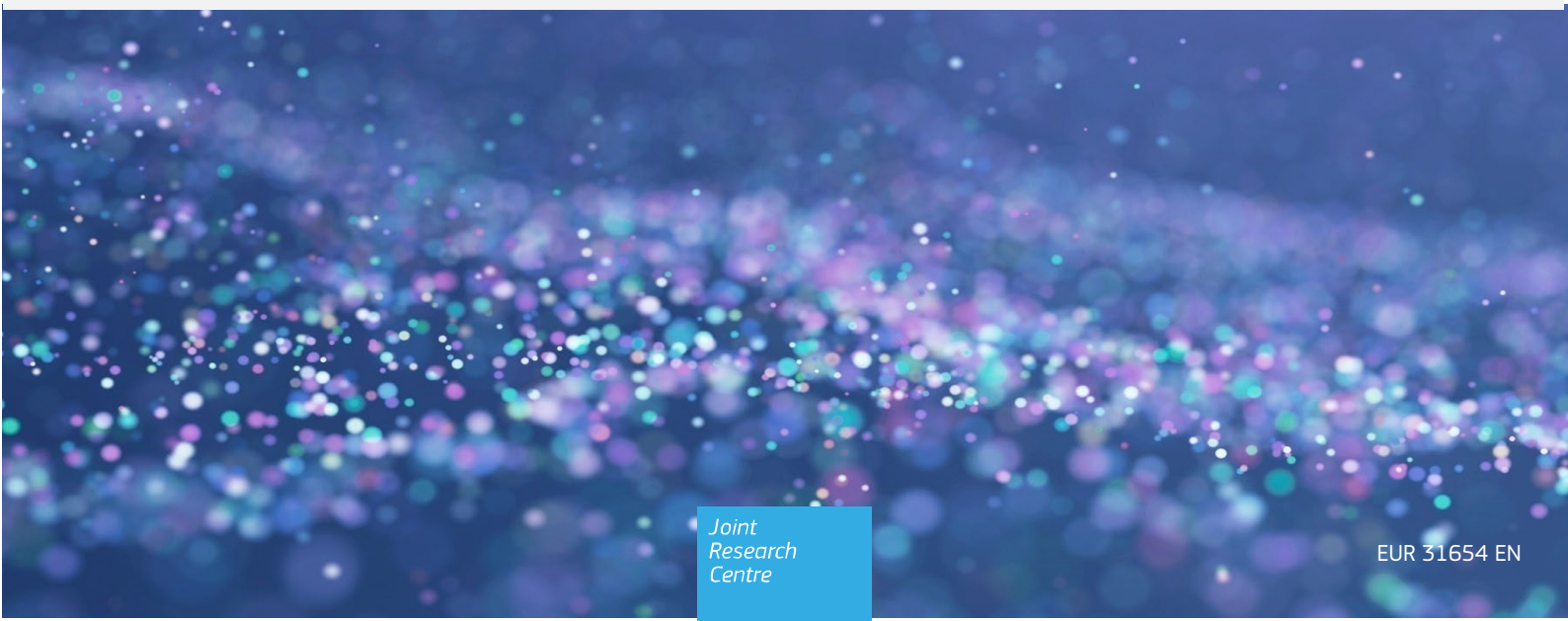
JRC TECHNICAL REPORT

Mapping EU level funding instruments to Digital Decade targets

Application to main digital instruments in 2014-2027

Papazoglou, M., Torrecillas Jodar, J., Cardona, M., Calza, E., Vazquez-Prada Baillet, M., Righi, R., Lopez Cobo, M., De Prato, G.

2023



Joint Research Centre

EUR 31654 EN

Contact information
Address: Edificio Expo, C/ Inca Garcilaso 3, Sevilla 41092, Spain
Email: JRC-T1-SECRETARIAT@ec.europa.eu

EU Science Hub
https://joint-research-centre.ec.europa.eu

JRC134647

EUR 31654 EN

PDF ISBN 978-92-68-07374-2 ISSN 1831-9424 doi:10.2760/986930 KJ-NA-31-654-EN-N

Luxembourg: Publications Office of the European Union, 2023

How to cite this report: Papazoglou, M., Torrecillas Jodar, J., Cardona, M., Calza, E., Vazquez-Prada Baillet, M. and Righi, R., *Mapping EU level funding instruments to Digital Decade targets*, Lopez Cobo, M. and De Prato, G. editor(s), Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/986930, JRC134647.

Contents

Abstract

The Digital Decade Policy Programme aims at accelerating the digital transformation of Europe by fostering developments in key digital areas, while setting ambitious targets to be achieved by 2030. The Digital Decade targets are defined across four cardinal points: digital skills, digital infrastructures, digitalisation of business, and digitalisation of public services. This report presents a unique dataset, containing data on past and planned EU level public investment that supports digital transformation, and estimates their maximum potential contribution along the Digital Decade targets. The mapping of the main EU funding instruments shows a significant potential contribution to the digital transformation of the public sector and digitalisation of businesses. Specific areas such as semiconductors, quantum and the adoption of advanced technologies by firms are expected to benefit from a smaller share of funding. This report provides focused support to monitor the digital landscape of the European Union over the next decade.

Acknowledgements

The authors are grateful for the collaborative work performed throughout the project with the following colleagues from the co-leading team in Directorate-General Communications Networks, Content and Technology (DG CNECT) (in alphabetical order): Paola Annoni, Fabrizia Benini, Julien Burton, Petra Kleininger, Valentina Parziale, Eric Peters, Alexander Riedl, Alexandra Rotileanu, Kristine Schuetterle, Katarzyna Szczuka and Eléonore Wemaere. The authors also thank Carlos Torrecilla, Michael Lutz and Michele Vespe (Joint Research Centre (JRC)) for their continuous support and guidance.

Additionally, the authors would like to express their gratitude for the valuable contribution of the following colleagues from DG CNECT during different stages of the research, in particular for providing raw data as well as useful comments for the validation of the methodological approach and its results (in alphabetical order): Remy Bayou, Lieve Bos, Luis Carlos Busquets Pérez, Marco Ceccarelli, Heidi Cigan, Pedro Das Neves Moreira, Valentina De Vito, Oscar Díez, Tatjana Evas, Leonardo Flores Anover, Maika Fohrenbach, Peter Friess, Jorge Gasos, Dietmar Gattwinkel, Philippe Gelin, Wide Hogenhout, Ana Juan Ferrer, George Kambouroglou, Kristina Kardum, Kamila Kloc, Stefan Lechler, Philippe Lefebvre, Elisabeth Lipiatou, Georges Lobo, Carlos López Rodríguez, Katie Low, Elzbieta Madej, Ëmoke Maembe, Silvia Merisio, Svetoslav Mihaylov, Serge Novaretti, Eoghan O'Neill, Valentina Oberti, Cristian Olimid, Claudia Oros, Yves Paindaveine, Renata Palen, Alexandra Paul, Marcin Piaskowski, Beatrice Plazzotta, Carlota Reyners Fontana, Helena Rodrigues, Ramón Sanmartín Solá, Mario Scillia, Irene Signorelli, Stefano Selleri, Christine Simon, Gudrun Stock, Doru Tanasa, Sabrina Thom, Ceri Thompson, Bartek Tokarz, Maria Tsakali, Martin Ulbrich, Walter Van de Velde, Oana Vasile, Goran Zekovic, Balazs Zorenyi, Arian Zwegers.

Similarly, the authors acknowledge the contribution of the following colleagues for providing raw data and supporting the validation of the approach and results (in alphabetical order): Alexandru Ciungu (ECFIN), Pierluigi Di Francesco (RTD), Helena Hernnäs (ECFIN), Michele Ibba (RTD), Daniel Kitscha (CLIMA), Ramunas Linartas (REGIO), Lucian Luca (REGIO), Mikolaos Mitrakis (RTD), Arturo Polese (REGIO), Sven Schade (RTD), Paul Schlag (RTD), John Walsh (REGIO).

Authors

Papazoglou, Michail

Torrecillas Jódar, Juan

Cardona, Melisande

Calza, Elisa

Vázquez Prada-Baillet, Miguel

Righi, Riccardo

López Cobo, Montserrat (Editor)

De Prato, Giuditta (Editor)

Executive summary

Policy context

The Digital Compass Communication ([1]) and the recently adopted Digital Decade Policy Programme 2030 ([2]) establish targets and general objectives for a successful digital transformation of the European Union (EU) by 2030.

The Policy Programme also establishes a governance mechanism, together with Member States, to ensure that those targets and objectives are achieved. The targets are based on the four main cardinal points defined in the Digital Compass: digital skills, digital infrastructures, digitalisation of business, and digitalisation of public services. Additional tools are set out, including a monitoring mechanism and the possibility to the launch Multi-Country Projects through which Member States can work together to remedy gaps and accelerate progress.

The study presented in this report maps the main EU funding instruments supporting the achievement of the Digital Decade targets and produces a unique dataset on the level of EU funding directed towards each target and, when available, each EU Member State. The EU funds considered are: Recovery and Resilience Facility (RRF); Connecting Europe Facility 2 – Digital (CEF2 Digital); Digital Europe Programme (DEP) – considering Main Work Programme 2021-22, Cybersecurity Work Programme 2021-22 and EDIH Work Programme 2021-2023; Horizon Europe (HE) — comprising the 2021-2024 work programmes, HE European Innovation Council (EIC) calls, HE Joint Undertaking (JUs), and HE predecessor Horizon 2020 2014-2020 (H2020)—; and Cohesion Policy 2021-2027 and its predecessor Cohesion Policy 2014-2020 (also known as European structural and investment funds (ESIF), which include, among others, the European Regional Development Fund (ERDF) and the Cohesion Fund (CF). These and other funds are expected to contribute to the Digital Decade general objectives as well, but this study focuses on the expected support to the achievement of the Digital Decade targets.

Key conclusions

Sufficient private investment, internal demand, and awareness about the benefits of digital technologies are crucial for the successful digital transformation of the EU. EU funding instruments, such as the RRF, CEF2 Digital, DEP, Cohesion Policy and HE play a significant role in supporting the achievement of the Digital Decade targets. EU investment efforts are directed mainly towards the digital transformation of the public sector and the digitalisation of businesses, with more than 65% of digital funding targeting those two cardinal points. Some targets that will be challenging to achieve, such as those regarding *semiconductors*, the deployment of *edge nodes* or the *adoption of advanced technologies by businesses*, will likely receive less public funding from the funds considered in this report and may be relying more heavily on private investments or other type of funds not considered in this analysis.

This study creates a unique dataset that can help researchers and institutions to analyse the allocation of digital investments.

Main findings

The main findings provide an in-depth analysis of the potential role of EU funding instruments in achieving the ambitious targets set for the Digital Decade. The mapping against the Digital Decade targets indicates that the main EU funding instruments provide more than €165 bn that are expected to support Digital Decade targets, with more than 70% of the funds originating from the RRF. Beyond this mapping, it is expected that further funding will support the Digital Decade objective, but this is outside the scope of this study

Allocation by cardinal point is found to be unequally distributed. While the digital transformation of businesses (especially in the areas of late adopters and unicorns), and the digitalisation of the public sector are expected to jointly receive more than 65% of the funds (35.1% and 30.3% respectively), digital infrastructures and digital skills receive 18.2% and 16.4% respectively of the total funding relevant to Digital Decade.

Greece, Romania and Italy are the countries with the highest total planned investments, with about 4.3%, 2.5% and 2.5% of their Gross Domestic Product (GDP) to be invested in digitalisation over the next 6 years

[1] 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) https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021DC0118

[2] Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030 (OJ L 323, 19.12.2022, pp. 4–26). http://data.europa.eu/eli/dec/2022/2481/oj

respectively[3]. On the contrary, Ireland, the Netherlands and Denmark are the ones with the lowest investments with respect their GDP (0.09%, 0.12% and 0.12% respectively).

Related and future JRC work

Since 2006, the JRC study "Prospective Insights in ICT R&D" (PREDICT) analyses the supply of Information and Communications Technologies (ICT) and the investments in Research and Development (R&D) in ICT in Europe, with comparison to major competitors worldwide. The PREDICT dataset and its accompanying reports provide a permanent monitoring tool of ICT sector. Since 2006, they have served to monitor and assess the impact of related policies: the 3% R&D (Lisbon Agenda and EU2020), the Digital Agenda for Europe (Chapter 5), the Member States digital progress in the European Semester through the Digital Economy and Society Index (DESI) and its horizontal chapter 'The EU ICT Sector and its R&D Performance'.

As a continuation of the work of previous years, PREDICT has expanded its scope to support the shaping and monitoring of the Digital Decade. This report is the second in a series of three intended to support the Digital Decade Policy Programme. The first report develops the methodology to project the trajectories of the EU towards the 2030 Digital Decade targets. The third report presents an international benchmark analysis of private investments in the thematic areas covered by the Digital Decade targets comparing the level of investments in the EU and in other advanced digital economies: the United States, China, the United Kingdom, South Korea and Japan.

Future work may involve updating the mapping and results as new work programmes are being adopted, as well as expanding the methodology to include additional funding instruments.

Quick guide

After an introduction to the context and objectives of the study, section 2 offers a detailed explanation of the investment mapping methodology per funding instrument, and section 3 presents the results by funding instrument and target, and when possible, by Member State. Finally, section 4 presents some concluding remarks.

This report is accompanied by a dataset available from the JRC Data Catalogue: https://data.jrc.cec.eu.int/dataset/02a54fa2-2c41-4470-b74c-12d2757a4865

[3] Considering only the funding instruments for which information at Member State level exists, namely: RRF, CP, ESIF and H2020.

1. Introduction

Digital Technology is arguably one of the main drivers of societal and economic change. From labour markets to public services efficiency, technological development has led to profound changes in how citizens, firms and governments work and interact. Declining costs (Graetz & Michaels, 2018) and the recent COVID-19 crisis have helped accelerate the adoption of digital technologies in Europe during the last years (EIB, 2022), highlighting the crucial importance of digitalisation for the European Union.

In spite of its significance, Europe is falling behind in this digital transition. According to 2020 I-DESI data (Tech4i2, 2020), EU countries, on average, exhibit lower levels of digitalisation in their governments, a smaller number of ICT graduates, and less developed connectivity infrastructure compared to other significant Western and East Asian countries, including the US, China, and South Korea. These countries are leading the progress of research and innovation on critical digital technologies, reducing their dependency on foreign actors ([4]) (Gaida et al., 2023). Given that digital technology plays a key role in providing competitive advantages to countries, every effort made by the EU in developing digital technologies and spreading their uptake play a key role in contributing to strategic autonomy and economic security. This is especially relevant amidst further global challenges affecting supply chains, such as the COVID-19 pandemic, the Russian invasion in Ukraine or the approval of the US Inflation Reduction Act ([5]). In this context, policy action programs such as the Digital Decade and instruments like the Recovery and Resilience Facility (RRF) are of utmost importance for the future of the digital transition in Europe.

Following the 2030 Digital Compass Communication ([6]), the Decision establishing the Digital Decade Policy Programme 2030 ([7]) aims at accelerating the digital transformation of Europe by accelerating progress in key digital areas. Among the several objectives are to achieve open strategic autonomy, to promote a human-centred inclusive digital environment, to develop interoperable sustainable and efficient digital infrastructures, to increase trust and accessibility to online public services, and to empower European people and businesses. In this context, the Digital Decade Policy Programme 2030 establishes a series of targets to meet by 2030. These targets are organised into four thematic cardinal points or strategic dimensions, which encompass the population's digital skills, digital infrastructure (including connectivity), and the digitalisation of businesses and the public services. Finally, the Digital Decade Policy Programme seeks to secure the achievement of these targets by establishing a governance framework and fostering a cooperation mechanism between the European Union institutions and the Member States. Table 1 summarises the Digital Decade cardinal points and targets.

A key element of the Digital Decade Policy Programme are the European Digital Infrastructure Consortia (EDICs). EDICs are Multi-Country Projects that will mobilise investments from the EU, Member States and the private sector towards key digital areas, facilitating the achievement of the general objectives and digital targets, but also promoting collaboration so that Member States embrace best practices and share their capabilities. A crucial aspect of this effort is the allocation of investments to support the digital transformation through different EU funding instruments, such as the RRF. The RRF was established as part of the Next Generation EU ([8]) package and is expected to provide around €724bn (in 2022 prices) ([9]) to Member States in grants and loans, with a significant share devoted to digitalisation. While the Digital Decade Policy Programme is a critical element to strengthen Europe's open strategic digital autonomy the RRF serves as a mechanism for Member States to implement digital transformation initiatives through investments and reforms.

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4 In fact, according to the Australian Strategic Policy Institute (ASPI)'s 2023 Critical Technology Tracker, "China is the leading country in 37 of the 44 technologies evaluated", and the US leads in the remaining 7, including development of semiconductors devices, and the research fields of high performance computing and quantum computing, among others. Other countries among the top five in several technologies include the United Kingdom, India and South Korea.

5 The two main objectives of the US Inflation Reduction Act (IRA) are (i) to reduce inflation by removing purchasing power from the US economy by increased taxation; (ii) to fight climate change via tax subsidies, such as subsidising the purchase of electric vehicles. This is expected to increase domestic clean energy production and therefore may have a negative impact of EU exports. It also raises fears of relocation of EU companies to the US. (https://www.europarl.europa.eu/RegData/etudes/IDAN/2023/740087/IPOL_IDA(2023)740087_EN.pdf).

6 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) https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021DC0118

7 Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030 (OJ L 323, 19.12.2022, pp. 4–26). http://data.europa.eu/eli/dec/2022/2481/oj

8 https://europa.eu/next-generation-eu/index_en

9 It was agreed to invest €806.9 billion in current prices. It amounts to €723 billion in 2022 prices (https://next-generation-eu.europa.eu/recovery-and-resilience-facility_en#:~:text=The%20centrepiece%20of%20NextGenerationEUEN,in%20the%20EU%20Member%20States)

Table 1. Summary of Digital Decade cardinal points and targets

Cardinal point	Target
Digital skills: a digitally skilled population and highly skilled digital professionals	Basic Digital Skills: At least 80 % of those aged 16-74 have at least basic digital skills
	ICT specialists: At least 20 million ICT specialists are employed within the Union, while promoting the access of women to this field and increasing the number of ICT graduates
Secure and performant sustainable digital infrastructures	Gigabit coverage: All end users at a fixed location are covered by a gigabit network up to the network termination point
	5G coverage: All populated areas are covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G, in accordance with the principle of technology neutrality
	Semiconductors: Secure, resilient, performant and sustainable digital infrastructures where the production, in accordance with Union law on environmental sustainability, of cutting-edge semiconductors in the Union is at least 20 % of world production in value.
	Edge-nodes: Secure, resilient, performant and sustainable digital infrastructures where at least 10 000 climate-neutral highly secure edge nodes are deployed in the Union, distributed in a way that guarantees access to data services with low latency (i.e. a few milliseconds) wherever businesses are located.
	Quantum computing: Secure, resilient, performant and sustainable digital infrastructures where the Union has, by 2025, its first computer with quantum acceleration, paving the way for the Union to be at the cutting edge of quantum capabilities by 2030.
Digital transformation of businesses	Take-up of technologies: At least 75 % of Union enterprises have taken one of more of the following, in line with their business operations: (i) cloud computing services, (ii) big data, (iii) artificial intelligence
	Digital late adopters: More than 90% of the Union SMEs reaching at least a basic level of digital intensity
	Innovative businesses/scale-ups (Unicorns): The Union facilitates the growth of its innovative scale-ups and improves their access to finance, leading to at least doubling the number of unicorns
Digitalisation of public services	Digital public services: There is 100 % online accessible provision of key public services and, where relevant, it is possible for citizens and businesses in the Union to interact online with public administrations
	Electronic health record: 100 % of Union citizens have access to their electronic health records
	Electronic identification (eID): 100 % of Union citizens have access to secure electronic identification (eID) means that are recognised throughout the Union, enabling them to have full control over identity transactions and shared personal data

Source: Digital Decade Policy Programme

Since 2006, the JRC study "Prospective Insights in ICT R&D" (PREDICT) analyses the supply of Information and Communications Technologies (ICT) and the investments in Research and Development (R&D) in ICT in Europe, with comparison to major competitors worldwide. The PREDICT dataset and its accompanying reports provide a permanent monitoring tool of ICT sector. Since 2006, they have served to monitor and assess the impact of related policies: the 3% R&D (Lisbon Agenda and EU2020), the Digital Agenda for Europe (Chapter 5), the Member States digital progress in the European Semester through the Digital Economy and Society Index (DESI) and its horizontal chapter 'The EU ICT Sector and its R&D Performance'. As a continuation of the work of previous years, PREDICT has expanded its scope to support the shaping and monitoring of the Digital Decade.

This report is the second of a series of three aimed at supporting the Digital Decade Policy Programme. and feeding the Report on the state of Digital Decade 2023 ([10]). The first one (Torrecillas et al., 2023) develops the methodology to project the trajectories of the EU towards the 2030 Digital Decade targets. The third report (Torrecillas et al., 2023) presents an international benchmark analysis of private investments in the thematic areas covered by the Digital Decade targets, comparing the level of investments in the EU and in other advanced digital economies: the United States, China, the United Kingdom, South Korea and Japan.

[10] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Report on the state of the Digital Decade 2023 (COM(2023) 570)

This report presents a unique dataset that contains planned EU investments and their mapping or allocation to each digital decade target. This dataset is generated by mapping EU investment instruments that support digital transformation. We have collected data on planned investments from the key instruments that have a digital component and map the budget allocated to initiatives with a potential impact on the Digital Decade (DD) targets. The methodology consists of three key steps: identifying the digital-related budget, establishing a share of investments expected to support the Digital Decade, and distributing funds among the DD targets. By using predefined digital trackers at a first level, and target shares to break down investment across DD targets, we are able to estimate the budgetary provisions associated with digital objectives that may impact the DD targets. This approach allows us to provide an estimation of the expected contribution of the EU programmes taken into account to the achievement of the DD targets.

Results of the mapping indicate that the main EU funding instruments taken into account in this document are expected to provide more than €165 bn to support Digital Decade targets with about 70% of funds corresponding to the RRF. According to the estimations, allocation by target is unequally distributed, though. While the cardinal points of digital transformation of businesses, (especially the targets on late adopters and unicorns), and the digitalisation of the public sector jointly receive more than 65% of the funds (35.1% and 30.3% respectively), digital infrastructures and digital skills receive 18.2% and 16.4% respectively of the total funding relevant to Digital Decade. Some individual targets receive less funding, for instance those related to semiconductors, quantum and the adoption of advanced technologies by firms jointly receive roughly 18% of total funds.

The findings of this report contribute to the evidence-based policy of the EU by creating a unique dataset that can help researchers and institutions to analyse the allocation of digital investments during this decade.

The remainder of the report is organised as follows. After an introduction to the context and objectives of the study, section 2 offers a detailed explanation of the investment mapping methodology per funding instrument, and section 3 presents the results by funding instrument and target, and when possible, by Member State. Finally, section 4 presents some concluding remarks.

2. Methodological note

2.1. Outline of the methodology

Understanding how investments are channelled towards the achievement of the Digital Decade targets is crucial within the context of the digital transformation of the EU. This study aims to contribute to this direction by creating a novel and unique dataset that systematically maps the main EU public funding instruments to the corresponding Digital Decade targets.

This mapping process provides an in-depth view of fund allocation. The primary objective is to estimate the contribution of the investment instruments to the Digital Decade targets. To achieve this, we adopt a systematic (yet subjective) approach, carefully examining the content of each instrument and linking its budgetary provisions to the relevant Digital Decade targets. The first phase of our study involves an extensive data collection of past and planned investments, focusing on the main instruments with a digital component. The collection is restricted to funds that already have an allocation with sufficient information to be associated with Digital Decade targets. Our approach unveils a clearer picture of how the EU's main funding instruments for digital are driving the digital transformation, providing valuable insights to stakeholders across the EU.

The study considers the following instruments:

- Recovery and Resilience Facility (RRF);
- Connecting Europe Facility 2 – Digital (CEF2 Digital);
- Digital Europe Programme (DEP);
- Horizon Europe (HE) 2021-2024 (and its predecessor Horizon 2020 2014-2020 (H2020)); HE European Innovation Council (EIC) calls, HE Joint Undertaking (JUs);
- and Cohesion Policy 2021-2027 (and its predecessor Cohesion Policy 2014-2020 (also known as European structural and investment funds (ESIF)), which include, among others, the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund (CF) and the European Agricultural Fund for Rural Development (EAFRD)) ([11]).

InvestEU is another relevant instrument to consider, as it is a key financial instrument programme of the EU aiming to steer private investment towards European policy goals ([12]). However, at the closing of this report the limited available data did not allow to link it to Digital Decade targets.

In addition, the European Research Council (ERC) calls ([13,14]) as well as the European Institute of Innovation and Technology (EIT) ([15]) calls, which provide funding for excellent frontier research, are not included in this version of the study due to data limitations.

Future updates of the study will cover as much as possible new work programmes of the funds as they become adopted, as well as other instruments expected to contribute to the Digital Decade targets not included at this stage.

For each fund, we estimate the amount of budgetary provisions that are related to digital objectives, and more concretely, the part that may have a direct impact on the Digital Decade targets. This estimation is based on the examination of available information on the thematic objective, intervention field, call, specific objective, or other categories useful to identify a link with DD targets. This is operationalised by applying, to each of the categories (e.g. intervention field), a digital decade share (*DD share*) that can take the value of 0%, 40% or 100%, depending on how strongly or directly they link to Digital Decade targets. In a second step, the funds are then mapped to the Digital Decade targets, so that the budget can be mapped among them, avoiding double counting. This translates into assigning a share to each of the DD targets (*DD target shares*) that can go from 0% (no direct or clear link between the instrument's category and the target) to 100% (direct and full correspondence of the entire budget to one target).

[11] For more details regarding the respective funding instruments, sources and time coverage, please consult the corresponding paragraphs of sub-section 2.2.2.2.

[12] https://investeu.europa.eu/about-investeu_en

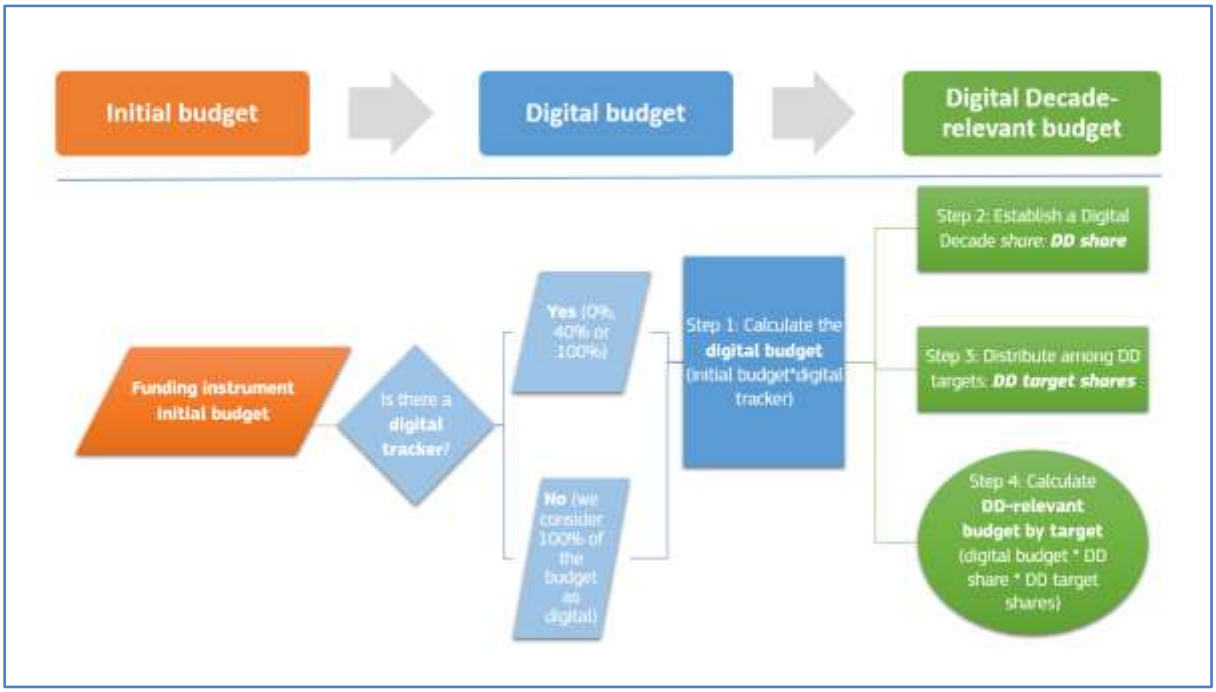
[13] https://erc.europa.eu/about-erc/erc-glance

[14] https://erc.europa.eu/news-events/magazine/mapping-frontiers-science-erc-scientific-council-editorial

[15] https://eit.europa.eu/about-us/eit-glance

Concretely, the methodology to map the funds to Digital Decade targets involves the following steps, also illustrated by Figure 1.

Figure 1. Flowchart of the methodology to map the funds to Digital Decade targets



Source: Authors' elaboration

— Step 1: Identify the digital-related budget

The majority of the funding instruments are monitored using a "tracker" to track expenditures related to different aspects, such as climate or digital. The tracker is a coefficient (which normally takes the values 0%, 40% or 100%) applied to the total budget, which determines the contribution of the specific category towards a particular objective. Whenever available, the predefined digital tracker of each funding instrument was used to define the digital-related budget. For instance, the RRF uses a digital tag to identify digital-relevant spending, while HE and H2020 use predefined digital trackers ([16]). For HE JUs, CP, and ESIF, there is no clear tagging available, but we used the tags proposed by DG RTD and DG REGIO ([17]). In the case of CEF2-Digital and DEP, which are specifically designed to support the goal of digital transformation of the European societies and economies, we assume that the content of the categories is 100% digitally related.

— Step 2: Establish a Digital Decade share*: DD share*

For each fund, and after obtaining the digital-related budget from step 1, we estimate the amount of the budgetary provisions that may have a direct impact on the Digital Decade targets. This is based on the examination of available information on the thematic objective, intervention field, call, specific objective, or other categories used to distribute the instrument budget, and useful to identify a link with DD targets. This is operationalised by applying, to each category (e.g. intervention field), a Digital Decade share (DD share) that can take the value of 0%, 40% or 100% ([18]). The DD share reflects the DD-relevant budget —or budget that is expected to have an impact on DD targets— before distributing it among DD targets. The DD share is 100% when the content of the category is strongly related to at least one Digital Decade target; it is 40% when it may contribute partially or in an indirect way to at least one DD target; and 0% otherwise. The DD share applies to the total digital budget of the category obtained in step 1. For instance, over a total €10 million budget for a

16 Named Digital Agenda tracker

17 For more detailed information regarding the digital tracker used, please refer to the corresponding paragraphs in sub-section2.2.

18 The choice of 0%, 40% and 100% is made to align with the digital trackers or tagging applied to estimate digital investments in several EU funds, e.g. RRF (as described in Annex VII of the Methodology for digital tagging under Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility), Horizon Europe, Digital Europe.

topic, the application of a digital tracker of 40% and a DD share of 40% would mean a DD-relevant budget of 10*40%*40% = €1.6 million. To be more specific, let's consider the following example: the topic "Access to health and care services for people in vulnerable situations" falls under the "Health" cluster of the Horizon Europe 2023-2024 Work Programme. For this particular topic, a digital tracker of 40% has been assigned by DG RTD, considering this specific topic partially related to digital objectives. Next we further assign a DD Share of 40% as, according to our understanding, it is not closely related to the DD targets, but it could partially contribute to the eHealth target. As a result, the initial budget of €30 million allocated to this topic implies a DD-relevant budget of 30*40%*40% = €4.8 million.

— Step 3: Distribute among DD targets: *DD target share*

In a third step, once the DD share has been applied and the DD-relevant budget obtained (€4.8 million in the example), the funds are then mapped towards the Digital Decade targets, so that the DD-relevant budget can be allocated to the individual DD targets. This is translated into assigning a share to each of the DD targets (DD target shares) that can go from 0% (no direct or clear link between the instrument's category and the DD target) to 100% (direct and full correspondence of the entire budget to one DD target). The allocation of the DD shares is made based on the following general rules, although variations may apply:

- If the category of the budget to be broken down (i.e., row in the budget table such as intervention field, topic, policy area) is directly and strongly linked with one target: we attribute 100% of the amount to the relevant target.
- If the category is mainly related to a target (primary target), but it is also indirectly or partially related to other targets (secondary targets): we define the contribution to the primary target (e.g. 60%) and distribute the remaining amount among other relevant targets. If there are one primary and two secondary targets, the 40% is split equally: 60/20/20, or 60/13/13/13 if there are three secondary targets.
- If the category can equally support several targets or there is not enough information to establish to what extent it contributes to each of these targets: the amount is split equally between the relevant targets of the cardinal point, e.g.: 33/33/33; 25/25/25/25, etc. Additionally, it is important to note here that the three sub-targets referring to the uptake of technologies by businesses, namely cloud, big data and AI, are altogether considered as a single target, so the share allocated to them is estimated separately when relevant and then added together. In absence of information on a specific digital technology supported by the fund, the amount allocated to the target on adoption of technologies is the equally split among the three sub-targets.
- In case the dimension used for the allocation refers to the deployment (not adoption) of a specific technology (e.g. AI) we assume that this will have a direct impact also on the adoption, and thus we consider that the total budget of the investment will go to the respective target, even if the target is on technology adoption and not development.

— Step 4: Calculate DD target budget

We apply the DD target shares obtained in step 3 to the estimated amounts obtained by applying the DD share from step 2 to the total instrument's digital budget (step 1). This general methodology to distribute budget per DD target is applied to each instrument considering its specificities.

Furthermore, we defined the following specific criteria for assigning the DD target share in the following cases:

— Digital skills: when measures cannot differentiate between basic and specialised digital skills, a higher coefficient is assigned to the target on basic digital skills. Based on the general nature of those measures, the assumption is that they primarily cover digital skills at various levels, from basic to advanced, and to a lesser extent, specialised ICT skills.

— Digital infrastructure: in the case of the edge and cloud targets, although measures may directly or indirectly contribute to them, they often have a broad scope, such as measures that address the edge-to-cloud compute continuum (e.g. activities under IPCEI-CIS ([19])). It is challenging to isolate and evaluate their contribution to the target. As there is no edge-target specific tagging code in the case of RRF, no amount is attributed to edge under RRF, while it is acknowledged possible spill-over effects that might be produced from interventions in other areas. In the allocation of other funds to targets,

[19] Important Projects of Common European Interest on Next Generation Cloud Infrastructure and Services

when there is a combination of edge and cloud technologies, we attributed 50% to cloud and 50% to edge.

- Digitalisation of businesses:
    - Regarding the targets of adoption of technologies and of basic digital intensity of firms (or late adopters), the mapping considers measures aimed at adopting digital technologies broadly by enterprises. When it is not possible to differentiate among specific technologies, the amount is distributed among targets on technology adoption (cloud, big data, AI) and digital late adopters. Since measures targeting advanced digital technologies generally do not distinguish between the types of technology supported, the targets on cloud, big data, and AI are viewed as one target.
    - Regarding the target on innovative businesses / scale-ups, in particular in the allocation of RRF, as measures in this area have a horizontal nature, the mapping considers as relevant for this target digital-related measures that address innovative firms and start-ups, involve the use of financial instruments, or target the business environment or framework conditions.
- Digitalisation of public services: the mapping excludes measures that promote the use of digital tools and technologies to support processes and decision-making in areas of public interest but that are unlikely to lead to the offering of digital services to citizens or businesses. Examples include the use of digital tools to monitor data on water and assess its impact on the environment.

2.2. Application of the methodology by investment fund

This sub-section provides general information about the funding instruments and explain the particularities of the mapping of each investment fund. The DD share and the DD target shares are defined at different level of granularity, depending on the type of available data from the funding instrument. To describe the mapping of each funding instrument in the following subsections, we use its own nomenclature and hierarchical structure, e.g., pillar, intervention field, topic, call, project, etc.

2.2.1. Recovery and Resilience Facility

On the instrument

The RRF is the key instrument of NextGenerationEU ([20]), the economic recovery package of the EU, designed explicitly to support Member States impacted by the COVID-19 pandemic. The RRF aims at reducing the economic and social impact of the COVID-19 pandemic and make European economies and societies more sustainable, resilient, and better prepared for the challenges and opportunities of the green and digital transitions ([21]). The RRF consists of €723.8 bn in loans and grants available to support reforms and investments undertaken by Member States. It is structured around six pillars (i) green transition, (ii) digital transformation, (iii) economic cohesion, productivity, and competitiveness, (iv) social and territorial cohesion (v) health, economic, social and institutional resilience, and (vi) policies for the next generation[22].

All the Digital Decade cardinal points are expected to benefit from this funding. The total digital expenditure in the 27 adopted Recovery and Resilience plans amounts to €130 billion, about 26% of the total plan allocation[23], as calculated according to the digital tagging methodology, which assigns digital tags to investment measures with values of either 0%,40% or 100% (as described in Annex VII of the Methodology for digital tagging under Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility). These digital tags are applied consistently across the intervention fields in

[20] https://europa.eu/next-generation-eu/index_en

[21] https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en

[22] In response to the hardships and global energy market disruption caused by Russia's invasion of Ukraine, the European Commission is implementing its REPowerEU Plan, a new component of RRF. Launched in May 2022, REPowerEU is helping the EU save energy, produce clean energy and diversify its energy supplies (Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en#how-repowereu-is-funded). However, the mapping of this plan to Digital Decade targets is out of the scope of this report.

[23] To accelerate the green and digital transitions, each Member State must dedicate at least 37% of the expenditures of its recovery and resilience plan (RRP) to measures contributing to climate objectives and at least 20% of the expenditure to digital objectives. The reforms and investments proposed by Member States have exceeded these targets: for the RRF as a whole, estimated climate expenditure amounts to about 40% and digital expenditure to about 26% (Available at: https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/index.html).

alignment with the specific digital nature of each investment. The available data cover the 2020-2026 period and data are available per Member State and year.

Data source: IT tool Fenix (Directorate-General for Economic and Financial Affairs (DG ECFIN)). Last access: 1 September1 September 2023.

On the mapping

The DD share and DD target shares are defined at the level of the digital intervention field, except for the intervention fields "*2-009bis - Investment in digital-related R&I activities*" and "*6-021quater - Investment in advanced technologies such as High-Performance Computing and Quantum computing capacities/Quantum communication*", which are mapped for each individual measure within them to one or more DD targets (depending of the nature of the measure). The reason for this exception is that the measures within these two intervention fields are highly diverse, and therefore require a more granular approach. For instance, the intervention field "1 - 051 - Very High-Capacity broadband network (backbone/backhaul network)", with an RRF digital tag of 100% is assigned a DD share of 100% and allocated 100% to the gigabit target. The intervention field "3 - 016 - Skills development for smart specialisation, industrial transition, entrepreneurship, and adaptability of enterprises to change", with an RRF digital tag of 40% is assigned a DD share of 100% (as it's directly linked to digital skills), and allocated to the targets basic digital skills (60%) and ICT specialists (40%) as explained in section 2.1. Some intervention fields (e.g. those related to transport or smart energy) are expected to support the Digital Decade general objectives, although not considered in these calculations as considered not to directly contribute to Digital Decade targets. The mapping is then validated by experts from DG ECFIN.

2.2.2. Connecting Europe Facility 2 – Digital

On the instrument

The CEF2 is another financial instrument of the European Union aiming at promoting growth, jobs and competitiveness at European level targeting three pillars: Transport, Energy and Digital ([24]). CEF2 Digital allocates €2 bn in European connectivity infrastructures, with the main actions of the programme focusing on four major points; (i) the deployment and access to very high-capacity networks, capable of providing Gigabit connectivity, including 5G systems, (ii) the provision of very high-quality wireless connectivity, (iii) uninterrupted coverage with 5G systems, and (iv) the deployment of new or significant upgrade of existing backbone networks ([25] [26]).

The Digital Decade targets that will benefit from these actions are mainly, but not exclusively, those under cardinal point 2 "Secure and performant sustainable digital infrastructures". The available data on CEF2-Digital covers the budget for the 2021-2023 period, with general indications on total budget for 2021-2027. No digital tracking or tagging is applied to this instrument, so the entire CEF2 Digital budget is considered a priori relevant to digital objectives.

Data source: ANNEX to the Commission Implementing Decision amending implementing Decision C(2021)9463 on the financing of the Connecting Europe Facility – Digital sector and the adoption of the multiannual work programme for 2021-2025 (C(2023) 2533 final - Annex)

On the mapping

The DD share and DD target shares are defined at topic level, which is the second level of granularity of the work programme, using the description of the topic in the work programme. The DD target shares are also defined at topic level, based on their description. The mapping is then validated by experts from Directorate-General Communications Networks, Content and Technology (DG CNECT).

[24] https://digital-strategy.ec.europa.eu/en/activities/cef-digital

[25] https://ec.europa.eu/info/funding-tenders/find-funding/eu-funding-programmes/connecting-europe-facility_en

[26] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_1109

2.2.3. Digital Europe Programme

On the instrument

Digital Europe programme is a key EU key funding programme focused on bringing digital technology to EU businesses, citizens, and public administrations ([27]). DEP provides strategic funding supporting projects in five key areas, namely: (i) supercomputing, (ii) artificial intelligence, (iii) cybersecurity, (iv) advanced digital skills, and (v) wide use of digital technologies across the economy and society ([28]).

The planned overall budget of DEP is €7.5 bn. All DD cardinal points are expected to benefit from this funding. The available data covers the 2021-2022 period (and 2021-2023 for EDIHs). No digital tracker or tagging is applied to this instrument, so the entire DEP budget is considered a priori relevant to digital objectives.

Data sources:

ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and the adoption of the multiannual work programme for 2021 – 2022 (C(2021) 7914 final – Annex)

ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and adoption of the multiannual work programme - Cybersecurity for 2021 – 2022 (C(2021) 7913 final - Annex)

ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and adoption of the multiannual work programme – European Digital Innovation Hubs for 2021 – 2023 (C(2021) 7911 final - Annex)

On the mapping

The DD share is defined at the intervention area level, which is the second level of granularity of the work programmes, and all the topics under the intervention area inherit the DD share. The DD target shares are defined at the topic level as listed in the work programmes, and based on their textual description. The mapping is then validated by experts from DG CNECT.

2.2.4. Horizon Europe (HE), HE European Innovation Council calls, HE Joint Undertakings and Horizon 2020

On the instrument

Horizon Europe is the EU's key funding programme for research and innovation with a budget of €95.5 bn. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth. Its overarching goals are (i) to strengthen the EU's scientific and technological bases and the European Research Area (ERA), (ii) to boost Europe's innovation capacity, competitiveness and jobs, and (iii) to deliver on citizen's priorities and sustain the European socio-economic model and values, with a particular focus on creating impact or the European Green Deal, the digital and sustainability transition and recovery from the coronavirus-crisis ([29]). The DD cardinal points that will benefit from this funding will mainly be skills, secure and sustainable digital infrastructures and digital transformation of businesses. For Horizon Europe the available data are planned budget allocations for the period 2021-2024: HE 2021-2022 and HE 2023-2024 main work programmes.

Data source: Dataset provided by Directorate-General for Research and Innovation (DG RTD). The dataset includes a digital tracker of 0%, 40% or 100% assigned to each project.

Furthermore, the Horizon Europe Joint Undertakings (JUs) are mapped so as to ensure consistency and complete coverage of the HE mapping. HE JUs are public-private partnerships established under the Horizon Europe program. These partnerships bring together industry, academia, and other stakeholders to address specific research and innovation challenges. By fostering collaboration between different stakeholders, JUs aim to maximise the impact of research and innovation and ensure that new discoveries are translated into real-world solutions ([30]). Under this prism, we map the following JUs: Key Digital Technologies (KDT) for 2021-2023,

[27] https://ec.europa.eu/info/funding-tenders/find-funding/eu-funding-programmes/digital-europe-programme_en

[28] https://digital-strategy.ec.europa.eu/en/activities/digital-programme

[29] https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

[30] https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe_en

European High-Performance Computing (EuropHPC) for 2019-2023, Smart Networks and Services (SNS) for the period 2022-2024, and Innovative Health Initiative (IHI) for 2022. The data comes in all cases from their respective work programmes. These JUs are considered mostly relevant to the Digital Agenda targets due to their focus on innovation, research, and development in the digital sector.

Data sources:

Key Digital Technologies JU:

DECISION KDT GB 2022.35 approving the Key Digital Technologies Joint Undertaking's annual budget for the year 2023

DECISION KDT GB 2022.23 adopting the first amendment of the Joint Undertaking's annual budget for the year 2022

DECISION KDT GB 2022.36 Adopting KDT work programme for the year 2023

KDT GB 2022.26 WORK PROGRAMME 2022 V16 – 29 August 2022

KDT ED 2022.27 WORK PROGRAMME 2021 V13_2022-02-24

European High-Performance Computing JU:

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 9/2019 Adopting the amended Joint Undertaking's Work Plan for the year 2019

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 01/2020 Adopting the amended Joint Undertaking's Work Plan for the year 2020

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 01/2021 Amending the Joint Undertaking's Work Plan and Budget for the year 2021

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 07/2022 Amending the Joint Undertaking's Work Plan and Budget for the year 2022 (Work Programme and Budget Amendment no. 2)

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 40/2022 On the Joint Undertaking's Work Programme and Budget 2023

Smart Networks and Services JU:

Annex to the SNS JU Work Programme 2024 SNS R&I Work Programme for 2024 Draft Version 25.05.23 (Orientations - Work in Progress)

ANNEX II TO DECISION No 03/2022 OF THE GOVERNING BOARD OF SMART NETWORKS AND SERVICES JOINT UNDERTAKING

SNS R&I Work Programme 2021-2022

Innovative Health Initiative JU:

Innovative Health Initiative 2022 Amended Work Programme

Innovative Health Initiative 2022 Second Amended Work Programme

The European Innovation Council (EIC), with a budget of €10.1 bn, supports different stages of innovation from early stage research, to proof of concept, technology transfer, and the financing and scale up of start-ups and small and medium-sized enterprises SMEs ([31]). The EIC uses complementary instruments: Pathfinder (R&I grants, from early technology to proof of concept), Transition (R&I grants from proof of concept to pre-commercial) and Accelerator (grants and investment for single SMEs and start-ups, from pre-commercial to market and scale-up).

Data source: Dataset provided by the EIC. The dataset includes a digital tracker of 0%, 40% or 100% assigned to each project.

Horizon 2020 (H2020) is the European Union's research and innovation program for the period 2014-2020, with a budget of €80 bn. The program aimed to support the development of science and technology in Europe, and to promote economic growth and job creation through innovation. H2020 funded research across a wide range of disciplines, including health, energy, and the environment, and provided support for innovative SMEs

[31] https://eic.ec.europa.eu/about-european-innovation-council_en

and start-ups. The program also emphasised the importance of international cooperation, promoting collaboration between European researchers and their counterparts from around the world. Through its funding and support for research and innovation, H2020 aimed to address some of the most pressing challenges faced by Europe and the world, and to create new opportunities for growth and development. The data come from Directorate-General for Research and Innovation (DG RTD) and cover the entire implementation phase from 2014-2020.

Data source: For H2020, we use a DG RTD dataset that identifies funds related to the Digital Agenda (DA) and Digitalising Europe (DE). This dataset includes projects that are related to ICT R&I activities, which are defined as ICT-related research activities within and outside the ICT sector, as well as ICT-related innovation activities such as new products, services, or processes within and outside the ICT sector. The dataset includes a digital tracker of 0%, 40% or 100% assigned to each project.

On the mapping

The mapping covered in the study does not include the European Research Council (ERC) calls and the European Institute of Innovation and Technology (EIT) calls due to data limitations.

Due to the differences between the various pillars and parts of Horizon Europe, there are slight variations in the methodology applied depending on the pillar or HE part. First of all, for Pillar 1 (Excellence Science), clusters under Pillar 2 of Horizon Europe (Global challenges & European industrial competitiveness) and European Innovation Ecosystems under Pillar 3 (Innovative Europe), to ensure the effective allocation of HE funds across the various DD targets, we use the same rigorous process that takes into account the topic level within each call of the work programme as described above. By analysing the name of the topic and exploring the available information coming from the work programmes, we assign the DD shares and DD target shares, respectively. The mapping is then validated by experts from DG RTD and DG CNECT.

Secondly, the EIC calls under Pillar 3 (Innovative Europe) are allocated differently, depending on whether the calls are "open" (e.g. call "HORIZON-EIC-2021-PATHFINDER OPEN-01") or "challenges" (e.g. _call HORIZON-EIC-2021-ACCELERATOR CHALLENGES-01-01). For "challenges" calls, the amount of available information is at higher level, we allocate the budget at the topic level, while for "open" calls, we allocate the budget at the project level, as more detailed information is available. In all cases, we still use the same overall process to allocate DD relevant budget across the DD targets, as outlined in section 2.1. The available data on the HE EIC calls covers the period 2021-2022 and comes from DG CNECT ([32]).

To allocate funds across the selected JUs, we use the digital tag assigned by RTD at the JU level. We then define a DD share and DD target shares at the topic level based on the description of each topic in the work programmes. The mapping is then validated by experts from DG CNECT.

To allocate the H2020 budget across the digital targets, we use the digital tag assigned by RTD at the topic level, which is set at either 40% or 100%. We then define the DD share and DD target shares at the topic level, based on the topic name.

2.2.5. Cohesion Policy 2021-2027 and ESIF 2014-2020

On the instrument

Cohesion Policy 2021-2027 is the EU's main investment policy aimed at reducing regional disparities and promoting economic and social cohesion among its Member States, and delivers on the Union's political priorities, especially the green and digital transition. The policy focuses on investing in the development of infrastructure, human capital, and innovation to foster growth and competitiveness in all regions of the EU. Cohesion Policy 2021-2027 places a strong emphasis on partnerships between regional and local authorities, civil society organisations, and the private sector, to ensure that investments are targeted and have the maximum impact ([33]).The data come from the Directorate-General for Regional and Urban Policy (DG REGIO) and cover the period 2021-2022.

[32] Furthermore, it is important to note that our analysis is based on the available data and information at the time of the analysis, which may change over time. Therefore, the figures and allocations presented in our analysis may not reflect the final figures or allocations.

[33] https://ec.europa.eu/regional_policy/2021-2027_en#:~:text=EU%20Cohesion%20Policy%20contributes%20to,the%20green%20and%20digital%20transition.

ESIF (European Structural and Investment Funds), the predecessor of Cohesion Policy 2021-2027, contributes to strengthening economic, social and territorial cohesion in the EU.

Data source: The available data is publicly accessible ([34]) from the Directorate-General for Regional and Urban Policy (DG REGIO) and cover the entire implementation phase from 2014 to 2020. Last access: 27 March 2023.

On the mapping

As part of the study on mapping EU funding instruments to the Digital Decade targets, we consulted with the Directorate-General for Regional and Urban Policy (DG REGIO) to select the funds and intervention fields with a digital dimension under the Cohesion Policy (CP) for the 2021-2027 programming period. DG REGIO provided us with a list of intervention fields that were similar to the ones identified under the RRF. The following funds are included in the mapping and subsequent estimation: the European Regional Development Fund (ERDF), the Cohesion Fund (CF), and the Interreg - European Territorial cooperation fund (Interreg). No intervention fields from the remaining CP funds are addressed. Therefore, solely these funding instruments from Cohesion Policy are taken into consideration in the estimations. We then applied the methodology to these intervention fields to allocate the DD share and DD target shares to each digital objective intervention field under the CP. The mapping is then validated by experts from DG REGIO and DG CNECT.

Regarding ESIF, it is worth noting that it does not have a specific funding stream dedicated solely to digital projects. Therefore, the determination of digital relevance was made for each combination of the thematic objectives and intervention fields that have a clear digital dimension. This approach allows for a more targeted allocation of funds towards initiatives that are most likely to contribute to the Digital Decade targets. In addition to the abovementioned selection, a DD share has been applied to each combination, so as to identify the DD-relevant budget. Next, a DD target share has been defined for each thematic objective and intervention field combination. The mapping is then validated by experts from DG REGIO and DG CNECT.

2.3. Caveats of budget allocation

It should be noted that the allocation of the budget across DD targets is based on a qualitative assessment, and as such, it has a degree of subjectivity. In order to ensure the accuracy and relevance of our analysis, we consulted regularly with experts from DG CNECT, DG REGIO, DG ECFIN and DG RTD to validate the methodology and its output. This collaborative approach was critical to identify the most relevant categories of each investment instrument and to apply the methodology consistently across all relevant funds.

While we have made every effort to map each measure to a specific DD target, there are cases where it is not possible to establish a clear link to one or more targets. In these cases, the budget is equally split among the relevant DD indicators within the cardinal point. Consequently, the mapping result should be considered as a broad estimate, providing an indication of the possible contribution of investment instruments to the Digital Decade targets and the order of magnitude of this contribution.

Furthermore, we acknowledge that there may be other projects, activities and funding instruments apart from the ones covered in the study, which are relevant to the Digital Decade but are not included in our analysis. Additionally, it is important to note that the estimations are based on the available data and information at the time of the analysis, which may evolve over time due to revisions and newly adopted work programmes[35]. Therefore, the figures presented in the analysis reflect the current situation and should be viewed as an initial estimation subject to possible updates.

Despite these caveats, the methodology developed and used to allocate the budget across the Digital Decade targets is robust and validated by the relevant European Commission's directorate generals. It is worth noting that for RRF, the main investment instrument considered in the analysis, the results aggregated per broad dimension (e.g. human capital, digitalisation of businesses, digital public services, etc.) are similar to those obtained by using the digital tagging and relevant policy areas. This further validates the robustness of the approach and the accuracy of the estimates.

[34] Available at: https://cohesiondata.ec.europa.eu/

[35] Due to updates or amendments of the funding instruments' plans and work programmes, the overall budget may undergo changes in the future. Also, planned amounts may differ from the actual spending, which will impact the final allocations for the DD target. Lastly, as additional work programmes become adopted (e.g. DEP 2023-24), the budget allocated to digital will increase.

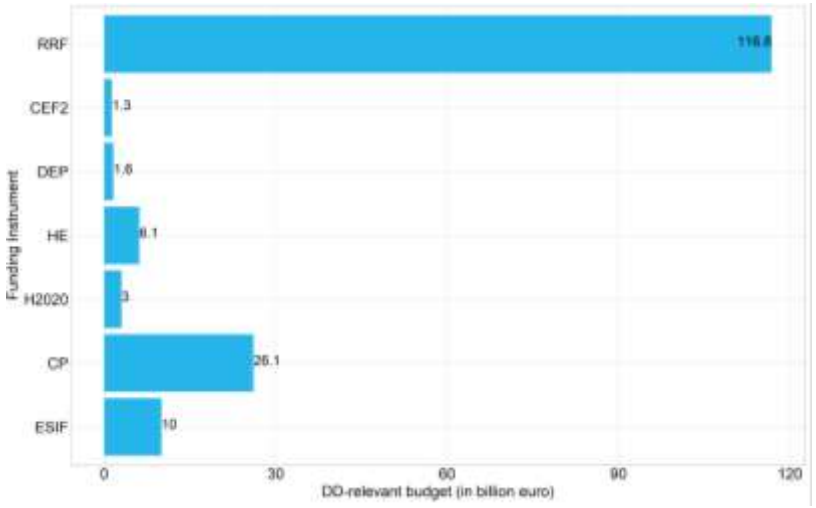
3. Results: EU budget in support of the Digital Decade

This section presents the results of the application of the mapping methodology to the funding instruments covered by the study. Sub-section 3.1 introduces the main results, first by funding instrument, then by cardinal point and target, and finally by a combination of both dimensions. Sub-section 3.2 focuses on the analysis at Member State level for the funds for which this level of detail is available, namely RRF, Cohesion Policy 2021-2027 (in this case referring to pre-allocation of budget), ESIF 2014-2020, and Horizon 2020. More detailed results can be consulted in Annex A. Supplementary tables on mapping of investment funds. Additionally, the report is complemented by a dataset available from the JRC Data Catalogue: https://data.jrc.cec.eu.int/dataset/02a54fa2-2c41-4470-b74c-12d2757a4865

3.1. Digital Decade relevant budget by funding instrument and target

Figure 2 presents the total budget allocation for the Digital Decade targets broken down by the funding instruments included in the study. We can easily observe that the Recovery and Resilience Facility (RRF) is the largest expected contributor with an overall budget estimation towards the DD target of €116.8 bn (70.78% of the total identified relevant budget in support of the DD), followed by Cohesion Policy (CP) with €26.1 bn (15.82%) and the European Structural and Investment Funds (ESIF) with €10 bn (6.07%). Horizon Europe (HE) provides €6.1 bn (3.72%) to support the Digital Decade, and Connecting Europe Facility 2 – Digital (CEF2), Digital Europe Programme (DEP), and Horizon 2020 (H2020) contribute €1.3 bn (0.80%), €1.6 bn (0.96%), and €3 bn (1.84%), respectively. Overall, the relevant budget expected to support the Digital Decade (DD) targets amounts to €165 bn.

Figure 2. Digital Decade relevant budget (€ million bn) by funding instrument



Source: JRC calculations

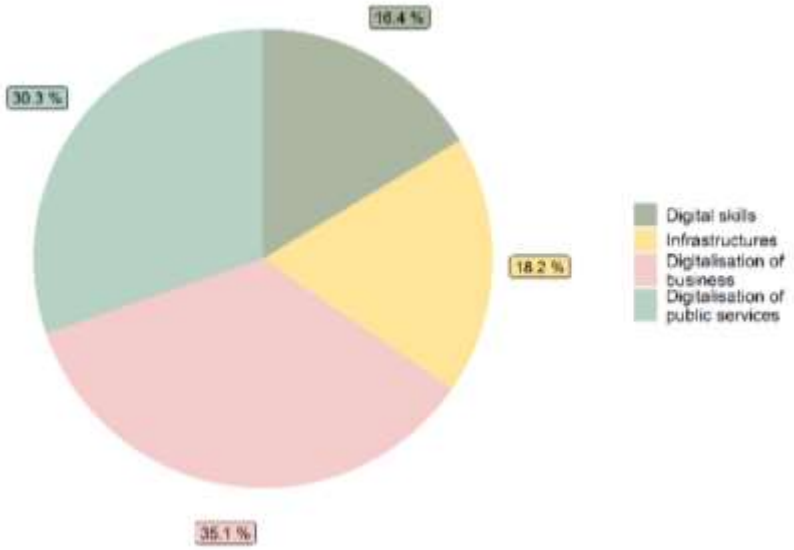
As shown in panel A of Figure 3, investments are heterogeneously allocated across cardinal points. The cardinal points that receive a higher allocation of funds are the digital transformation of businesses, with 35.1% of DD relevant funding, and the digitalisation of the public services, with 30.3% of the budget. However, budget is also unequally distributed across targets within cardinal points, as displayed in Panel B. of Figure 3.

In the cardinal point of digital transformation of businesses, investments in the targets of basic digitalisation of firms (digital late adopters) and unicorns together account for 21% of the total budget (10.8% and 10.3% respectively), which translates into 60% of investments in the cardinal point of digitalisation of businesses. Investments in advanced technologies such as AI, big data or cloud computing, account for 14% of the total budget (around 4-5% each).

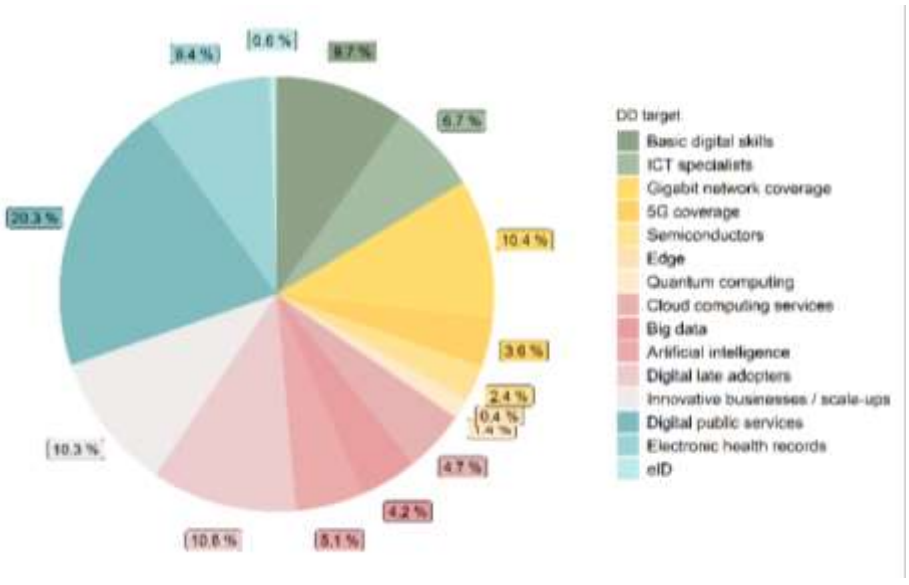
In the cardinal point of digitalisation of public services, the target that accounts for the highest share of DD related investments is the online provision of public services, representing 20% of the total budget. On the other hand, funding allocated to eID accounts for 0.6%, and 9.4% of the budget is directed towards eHealth. The high share can be explained by the fact that most of the efforts in this area usually come from public funding.

Figure 3. Digital Decade relevant budget by cardinal point and target (% over total budget)

Panel A. Budget by cardinal point



Panel B. Budget by DD target



Source: JRC calculations

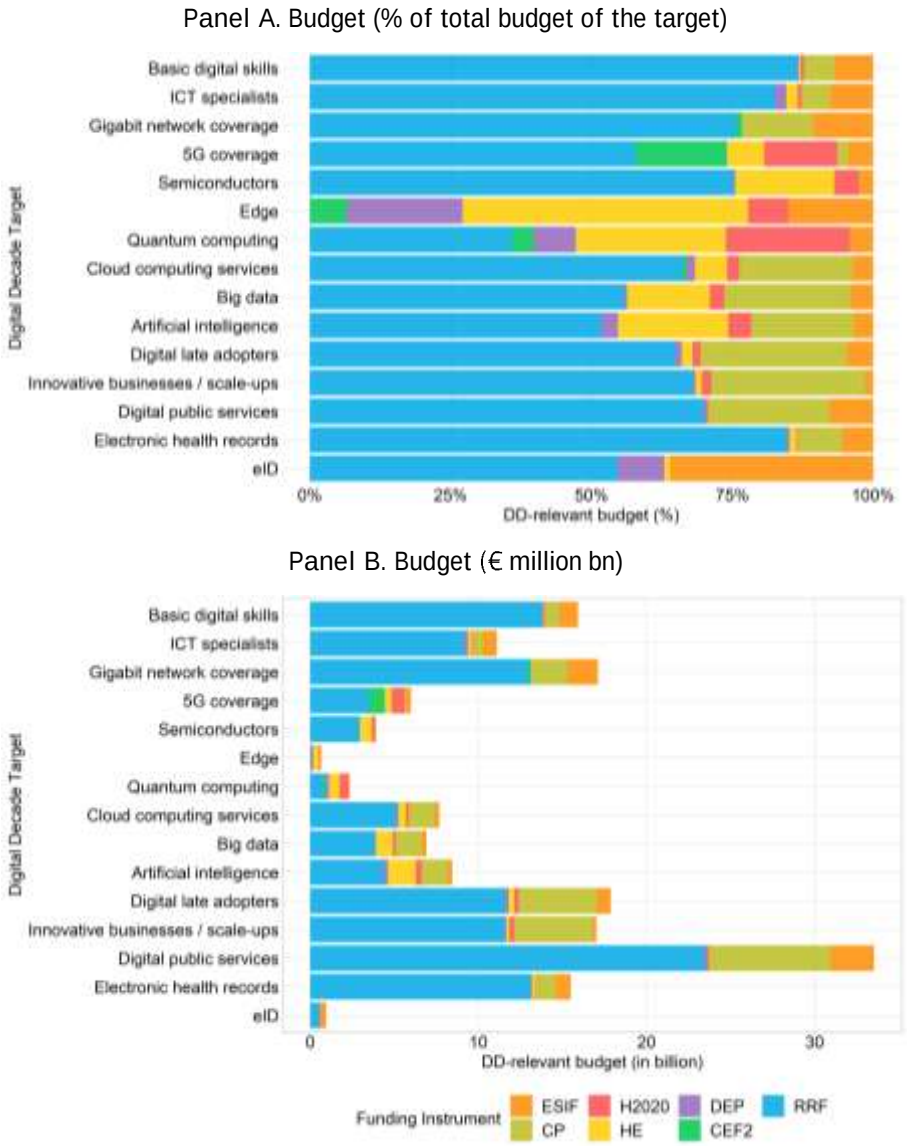
Digital infrastructures follow with 18.1% of the total, with half of these investments directed towards gigabit connectivity. Interestingly, 5G connectivity accounts for only 3.6% of the total budget, probably due to stronger involvement of the private sector and to other funding instruments not considered in this analysis. This could be the case also for semiconductors, which accounts for just 2.4% of the investments as it relies more heavily on alternative funding sources not yet included in the ones covered in the study, such as the provisions planned for the European Chips Act ([36]) and a coordinated European strategy. The same argument can explain the low

[36] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-chips-act_en

amounts budgeted to quantum computing, as it relies on specific funding programmes and public-private partnerships, e.g. the Quantum Technology Flagship ([37]), that altogether expects to invest about €7 bn.

Finally, the digital skills cardinal point represents a 16.4% share of the budget, with very similar amounts of investments directed towards the acquisition of basic digital skills by the population (9.7% of the total budget) and employed ICT specialists (6.7%).

Figure 4. Contribution of funds to each DD target



Source: JRC calculations

In general, the distribution of funds across targets and cardinal points is strongly determined by the nature of the target, the assumptions made in the allocation, the possibilities of private funding and alternative public funding programmes, and the emphasis of Member States in certain areas over others.

In addition, we analyse the funding distribution across instruments and targets. Figure 4 provides a clear illustration of the expected relevance of RRF as the primary contributor to the majority of the targets. Notably, RRF places significant emphasis on basic targets for the digital transition, as it accounts for 86.6% (€13.8 bn) of the budget for basic digital skills, 82.6% of the budget for ICT specialists (€9.2 bn), and 69.9% (€23.4 bn) of

[37] https://digital-strategy.ec.europa.eu/en/policies/quantum-technologies-flagship

the budget for online provision of public services. However, its contribution is lower in other advanced technologies, such as AI and big data, where the RRF funding accounts for 51.8% and 55.9% respectively of the target's budget. Similarly, for 5G, edge and quantum, it is expected that other funding instruments will make a more substantial contribution. Regarding other funding instruments, CEF2 – Digital primarily contributes to 5G, representing 16% (€970 m) of the total budget supporting this target. On the other hand, DEP aims to foster digital innovation and the adoption of emerging technologies through a more evenly distributed funding allocation. DEP will contribute 20.5% of the total budget for edge computing (€134 m) and 2.9% of the budget for AI. Furthermore, H2020 and HE make significant contributions to research and innovation-focused DD targets. For instance, these instruments account for almost 50% of the budget allocated to quantum computing, while HE alone accounts for 50.7% (€332 m) of the budget towards edge technologies. Lastly, Cohesion Policy demonstrates a slight focus on the digitalisation of businesses (particularly unicorns) and online services. Meanwhile, ESIF puts a particular emphasis on promoting the digitalisation of public services, particularly eID, contributing to 36% of the total funds directed towards this target.

3.2. DD-relevant budget by Member State

We now turn our attention to the distribution of the DD-related budget across Member States. It should be noted that, for the distribution of RRF, the maximum financial contribution for non-repayable financial support by Member State follows the established budgetary criteria of the European Union, which takes into account population, the inverse of the GDP per capita, and the average unemployment rate over the past five years ([38,39]). Additionally, 30% of the funding also depends on the GDP loss experienced during 2020[40], rather than solely relying on the unemployment rate. It should also be noted that national RRPs are not final at the time of writing the study, which uses data extracted as of September 1 2023. The figures provided below depict the DD-related budget across Member States considering only the funds for which there is available data at this level: RRF, CP, ESIF and H2020. It is noteworthy that these funds collectively constitute over 94% of the overall DD-related budget considered in this report. Regrettably, no information is currently available regarding the allocation of other funds by Member State, namely CEF2-Digital, DEP, and HE.

Panel A of Figure 5 displays the gross budget by Member State, while panel B indicates the budget as a share of GDP. Countries that will be expected to receive the greatest amount of DD-relevant funding in absolute terms are Italy (€48.1 bn), Spain (€26.2 bn), Germany (€13.7 bn) and Poland (€12.4 bn). When considering the size of the economy, panel B reveals that a significant portion of the DD-relevant budget is expected to be directed towards Southern Europe, Eastern Europe and, to a lesser extent, the Balkans. Total DD-relevant investments are expected to account for approximately 4.3% of Greek GDP, 2.5% of Romanian and Italian GDP, 2.5% of GDP of Portugal and more than 2% of GDP of Poland, Hungary, Estonia, Slovakia, Latvia and Bulgaria. In Western Europe (Ireland, the Netherlands, Luxemburg, Belgium, France, Germany, and Austria) and Nordic countries investments are expected to represent less than 0.5% of GDP.

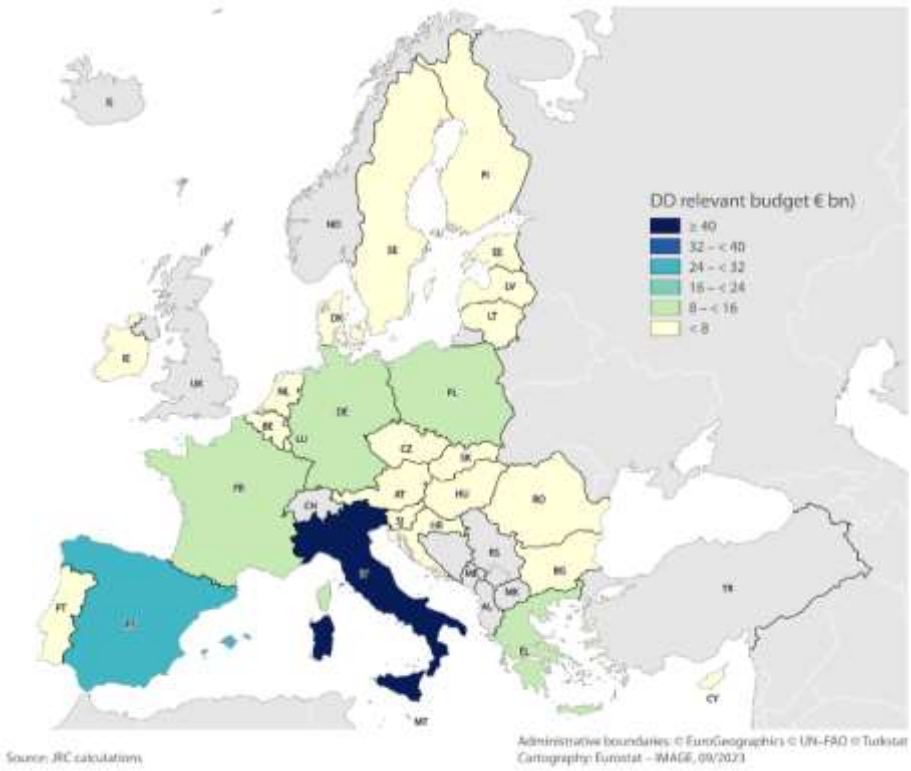
[38] https://commission.europa.eu/document/download/c22c182c-f53e-453f-b45a-dacdcf2d69dd_en?filename=2022%2009%2023%20Note%20on%20RRF%20support%20expenses_version%20to%20council%20and%20EP.pdf

[39] https://ec.europa.eu/commission/presscorner/detail/pt/qanda_21_3014

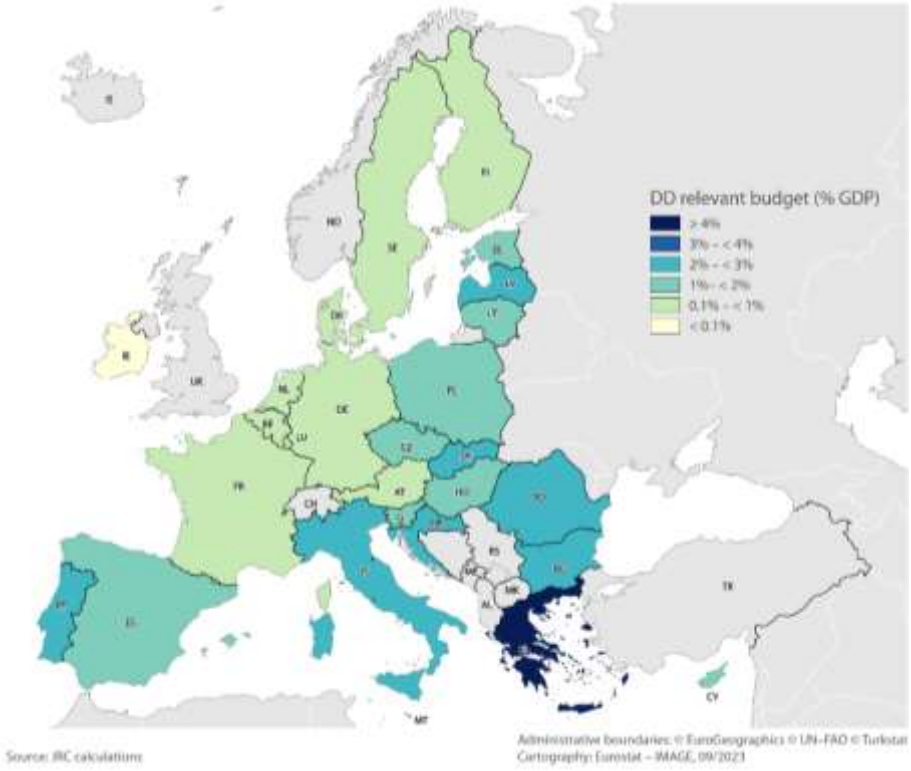
[40] In particular, article 11.1(b) of RRF Regulation states: "for 30 % of the amount referred to in point (a) of Article 6(1), converted into current prices, on the basis of the population, the inverse of the GDP per capita and, in equal proportion, the change in real GDP in 2020 and the aggregated change in real GDP for the period 2020-2021 as set out in the methodology in Annex III. The change in real GDP for 2020 and the aggregated change in real GDP for the period 2020-2021 shall be based on the Commission Autumn 2020 forecasts." (Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility)

Figure 5. Total DD-relevant budget by Member State in absolute values (panel A) and as a share of GDP (panel B)

Panel A. Budget (€ bn)



Panel B. Budget (% of national GDP)

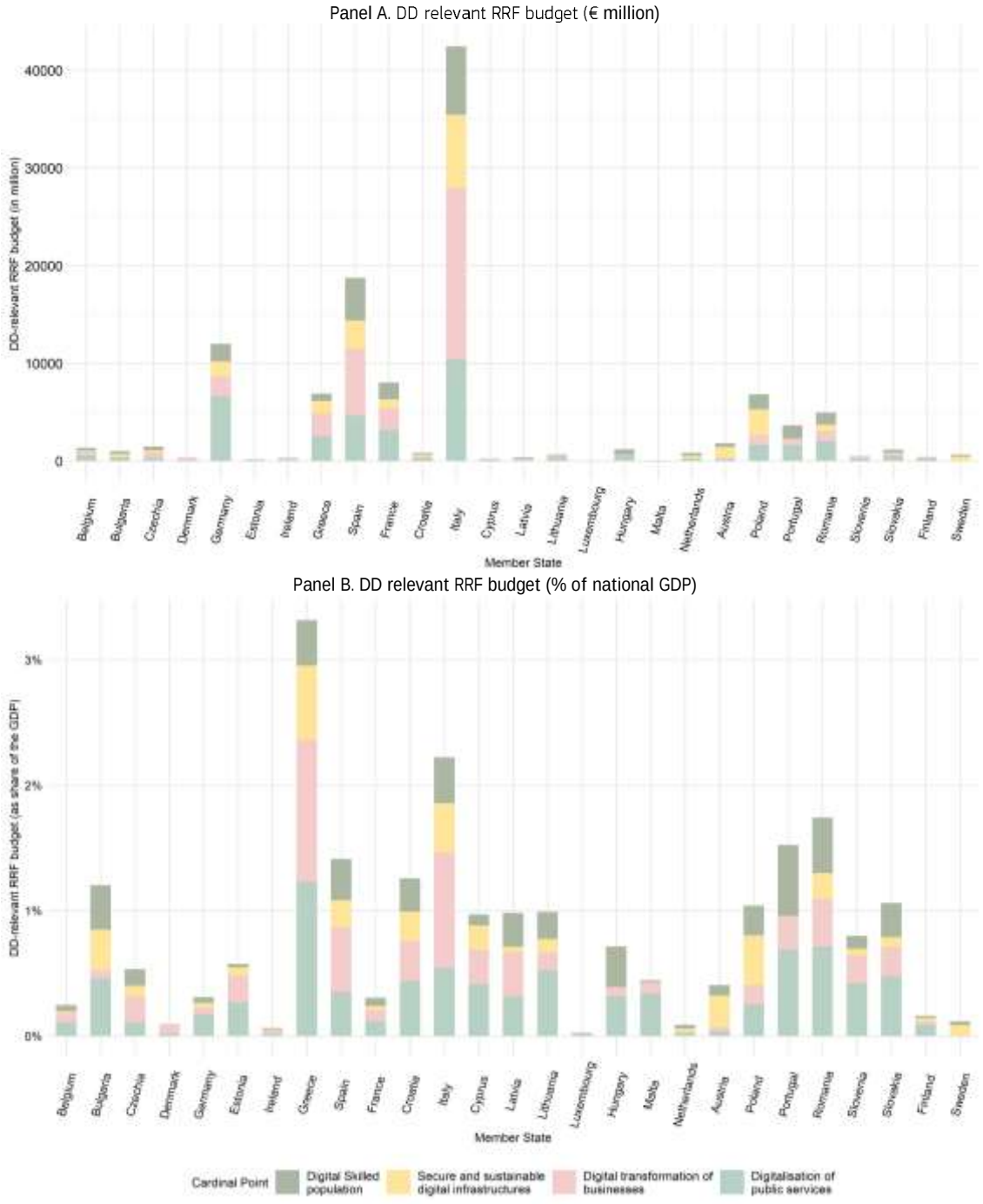


Note: The figures above depict the DD-related budget across Member States from the following instruments: RRF, CP, ESIF and H2020.

3.2.1. Recovery and Resilience Facility

Figure 6 - panel A depicts the estimated DD-relevant RRF budget allocation to each Member State. It is evident that certain MS are expected to receive a larger share of estimated overall funding, with Italy (€42.4 bn), Spain (€18.8 bn), and Germany (€12.0 bn) receiving the largest allocations. When taking into account the size of the economy (GDP), Figure 16 - panel B shows that Greece, Italy, Romania, Portugal and Spain, are expected to receive the largest RRF funding for investing in DD-relevant projects over the 2020-2026 period. On the other hand, Luxemburg, Ireland, the Netherlands and Denmark are in the tail receiving less than 0.1% of their GDP.

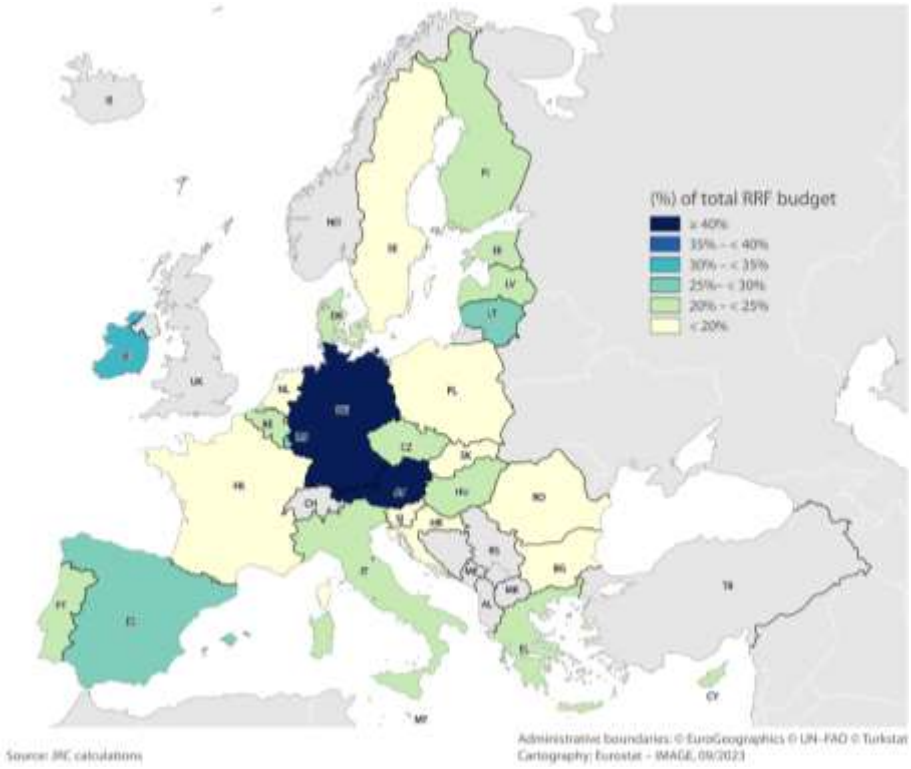
Figure 6. DD relevant RRF budget (in million €) by DD cardinal point in absolute values and as a percentage (%) of GDP



Source: JRC calculations

Finally, we analyse the allocation of DD-relevant funding as a share of the total RRF funding received by the Member State, providing insights into the level of effort dedicated to the digital transition which can be directly attributed to Digital Decade objectives. Figure 7 depicts the considerable variation in efforts towards the Digital Decade among Member States. Austria and Germany emerge as the countries that most heavily invest on the Digital Decade objectives, allocating more than 40% of their national RRF budget. Spain, Lithuania, Ireland and Latvia follow, with around 30% of their RRF budget dedicated on Digital Decade targets. Conversely, Balkan countries such as Croatia, Romania and Bulgaria allocate the smallest share of their budgets to DD targets, investing only about 15% of their total RRF funding ([41]). It is also noteworthy that France, Sweden, and Finland exhibit relatively low levels of investment in DD, around 20% of their received budget. These countries prioritise social and, to a lesser extent, environmental categories, as evidenced by the larger share of their RRF allocation allocated to these areas. These low DD-related investments as a percentage of the total national RRF funding, combined with comparatively lower absolute funding received, indicate a lesser emphasis on the digital transition within their national Recovery and Resilience Plans vis-à-vis social and environmental issues.

Figure 7. DD-relevant RRF budget (% of total RRF national plan)



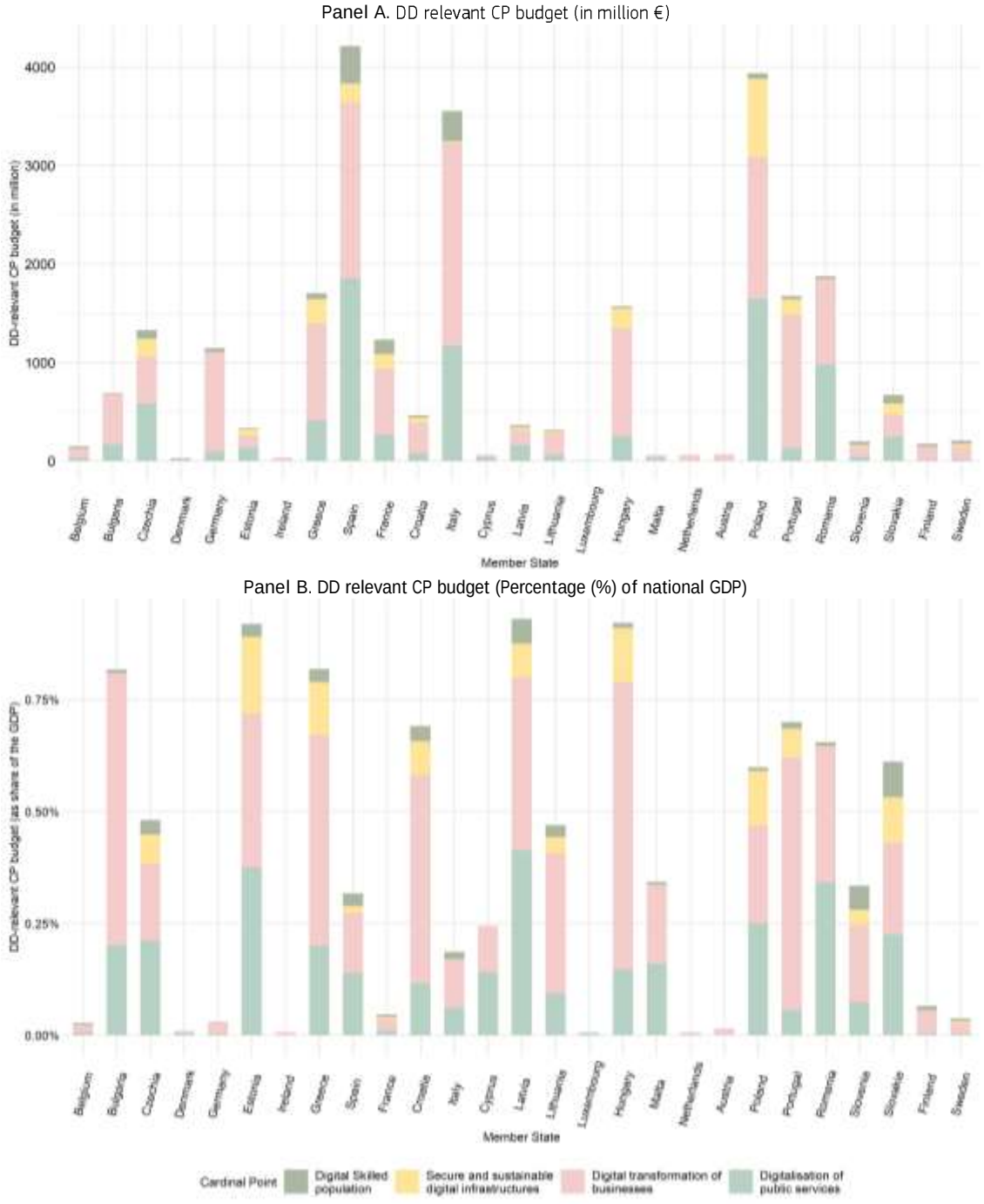
Note: Although one of the pre-requisites of the RRF was to devote at least 20% of the budget to the digital objectives, we recall that here we estimate the amounts supporting the Digital Decade targets. Most of the measures with a digital tagging are expected to directly contribute to Digital Decade targets and the remaining part (e.g. related to transport or smart energy) is also expected to support the Digital Decade general objectives, although not considered in these calculations. Consequently, the resulting share of the measures considered to be directly relevant for the DD targets may lie below 20%.

[41] Although one of the pre-requisites of the RRF was to devote at least 20% of the budget to the digital objectives, we recall that here we estimate the amounts supporting the Digital Decade targets. Most of the measures with a digital tagging are expected to directly contribute to Digital Decade targets and the remaining part (e.g. related to transport or smart energy) is also expected to support the Digital Decade general objectives, although not considered in these calculations. Consequently, the resulting share of the measures considered to be directly relevant for the DD targets may lie below 20%.

3.2.2. Cohesion Policy 2021-2027

Figure 8 - panel A illustrates the absolute values of the DD-relevant budget allocated to each Member State from the CP 2021-2027, which include Cohesion Fund, accounting for most of the funding, ERDF and Interreg. In Figure 8 - panel B, the DD-relevant budget allocated through the Cohesion Policy 2021-2027 for each Member State is presented as a percentage of their GDP. It is visible that Croatia, Estonia and Latvia receive the largest amounts of budget. Furthermore, the majority of the funding is generally concentrated in the Balkans, Baltic countries, and Portugal. This geographical distribution of Cohesion Policy funds aligns with the rationale behind the Cohesion Fund, as it provides support exclusively to Member States with a Gross National Income per capita below 90% of the EU27 average.

Figure 8. DD relevant CP budget (€ million) by DD target in absolute values and as a percentage (%) of GDP

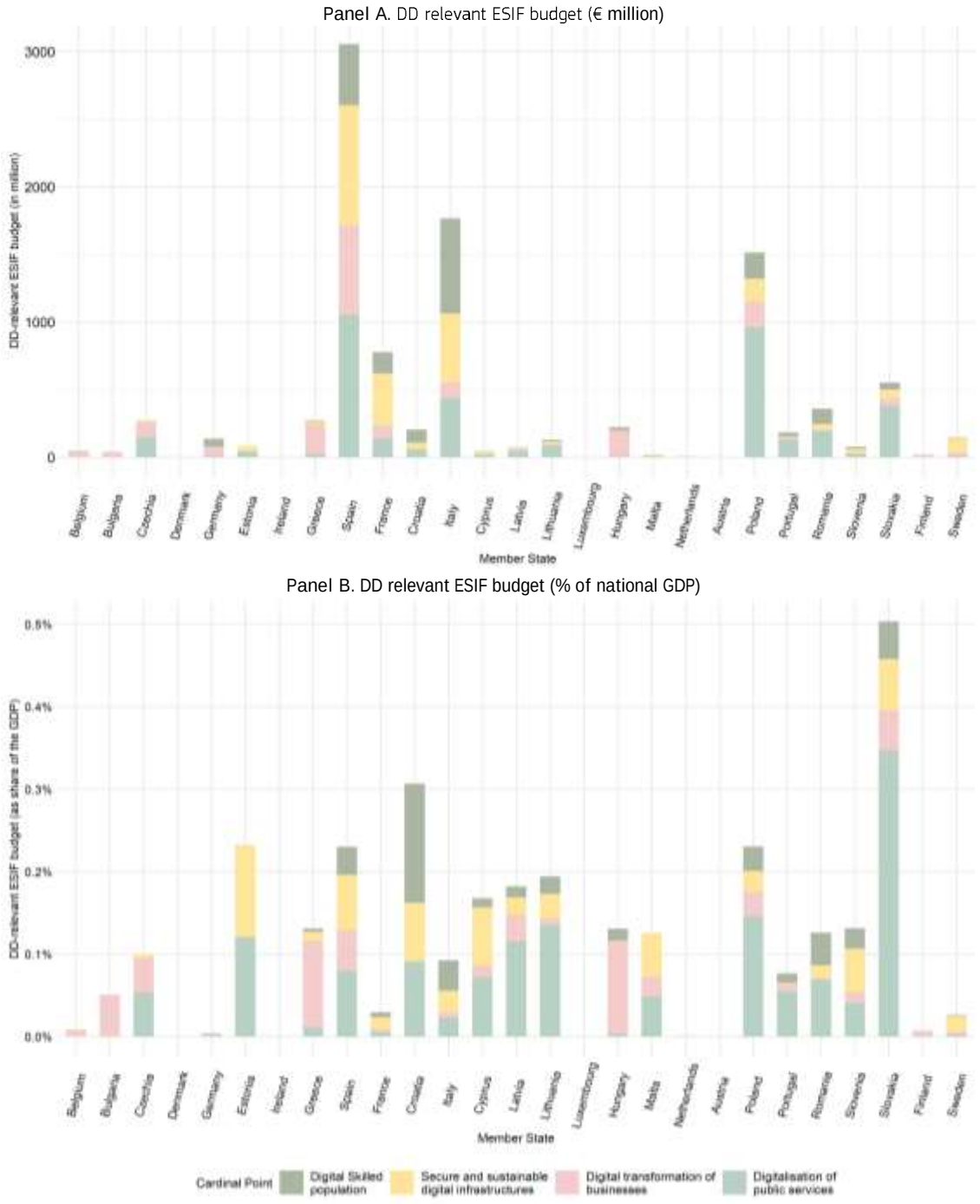


Source: JRC calculations

3.2.3. European Structural and Investment Funds

Figure 9 - panel A, presents the DD-relevant budget allocated through the European Structural and Investment Funds for each Member State. From the figure, it becomes evident that Spain (€3,053 m), Italy (€1,765 m), Poland (€1,513 m) and France (€778 m) have been allocated the largest ESIF budgets for DD-relevant projects. These countries have received substantial support for their digital transformation initiatives, with funds distributed across various project areas, ensuring a balanced approach to digital development. Conversely, countries such as Austria (€0.20 m), the Netherlands (€7.29 m), and Finland (€19.14 m) received relatively lower DD-relevant ESIF support toward the DD targets.

Figure 9. DD relevant ESIF budget (€ million) by DD target in absolute values and as a share (%) of GDP



Source: JRC calculations

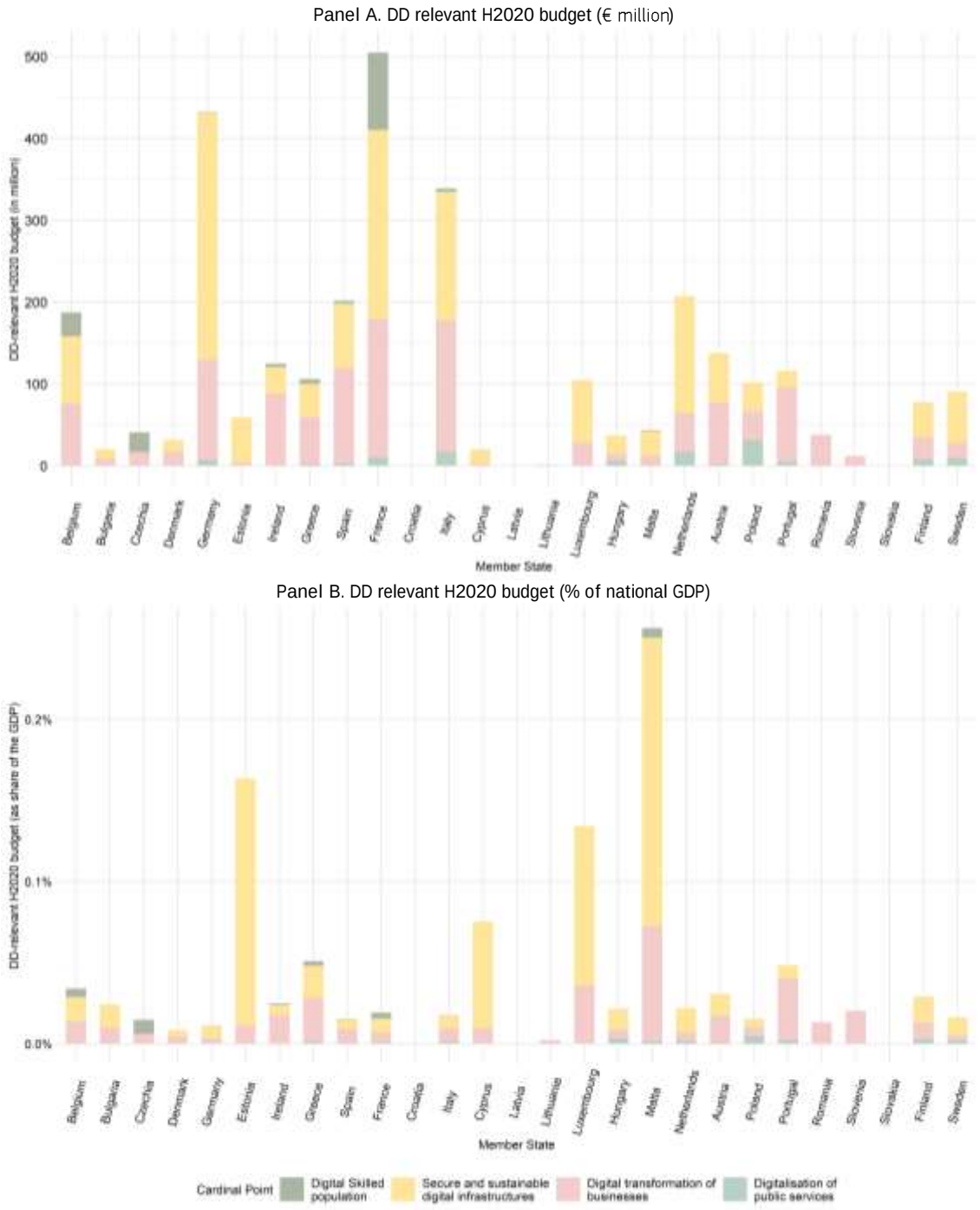
Figure 9 - panel B. illustrates the DD-relevant ESIF budget allocated to each Member State as a share of GDP. The figure shows an unequal distribution of funding across countries. Notably, Croatia (0.3%), Slovakia (0.5%), Spain and Estonia (0.21%) have all allocated the largest amounts relative to their GDP to projects supporting the DD targets, especially to the digitalisation of the public sector. Germany, the Netherlands, Austria and Ireland, as expected, have received a significant smaller share of funding for DD-related projects relative to their GDP (less than 0.01%). This distribution aligns with expectations as ESIF funding is allocated in greater proportion to less developed and transitioning regions.

3.2.4. Horizon 2020

Finally, we explore the DD relevant budget allocation to each Member State through the Horizon 2020 programme. Figure 10 - panel A presents the DD relevant budget in absolute values while Panel B as a percentage of GDP. We can observe that France (€504 million), Germany (€432 million) and Italy (€338 million) receive the highest amounts in absolute values. On the contrary, Lithuania (€1.5 million), Slovenia (€12 million), Cyprus and Bulgaria (€20 million each) receive the lower amounts.

In terms of GDP shares, Malta is the only Member State that received more than 0.2% of its GDP from H2020. It is worth noting that the cardinal point "digital infrastructure" plays a dominant role in H2020. As a research-oriented program, H2020 allocates a considerable amount of its resources to various research-related objectives, including those related to digital infrastructure. This focus on research and development aligns with the broader goal of advancing technological innovation and ensuring secure and sustainable digital systems. Furthermore, the prominence of the digital transformation of businesses cardinal point within H2020 also reflects the programme's emphasis on research-related targets.

Figure 10. DD relevant H2020 budget (€ million) by DD target in absolute values and as a share (%) of GDP



Source: JRC calculations

4. Conclusions

The Digital Decade Policy Programme, proposed by the European Commission and adopted by the European Parliament and the Council, sets out for the first time digital targets and objectives to be collectively achieved by the EU and its Member states with common and synergistic efforts. Yet, information concerning the investments allocated to support these strategic objectives is still scarce. In this report, we construct a novel dataset containing the main EU past and planned investments concurring to the achievement of the Digital Decade targets and present its distribution across targets and Member States.

Our analysis of the estimated aggregate investments shows a clear focus of public investments on the cardinal points of digitalisation of the public services and of digitalisation of businesses. Focusing investments on the public sector seems expectable, as private investments in these areas are likely to be low. Other strategic areas where the achievement of the target by 2030 appears to be more challenging, such as semiconductors or edge computing, receive more modest investments but could possibly rely on public-private partnerships or alternative funding. RRF is the policy instrument with the largest amounts devoted to Digital Decade targets.

In terms of policy implications, results show that the distribution of investments is not even across DD targets. RRF being the main funding instrument to achieve the Digital Decade targets, it allocates large resources to basic technologies and the digitalisation of the public sector, while the adoption of advanced technologies, such as 5G, AI or big data, and other critical targets like quantum computing, edge or semiconductors receive less public support from the considered funding instruments. Since the various DD targets possibly require different levels of investment to be achieved by 2030 (based on, for example, their starting baseline, their nature, and their level of ambition), further investigation would be needed to identify possible funding gaps.

These results leave room for further research. For example, investigation on the effect of public investment on specific targets, using microdata and settings that allow the isolation of a causal effect, would represent a major contribution to the understanding and monitoring of the Digital Decade.

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Text sources feeding the mapping of funding instruments to Digital Decade targets

Connecting Europe Facility 2 – Digital

ANNEX to the Commission Implementing Decision on the financing of the Connecting Europe Facility – Digital sector and the adoption of the multiannual work programme for 2021-2025 (C(2021) 9463 final - Annex)

Digital Europe Programme

ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and the adoption of the multiannual work programme for 2021 – 2022 (C(2021) 7914 final – Annex)

ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and adoption of the multiannual work programme - Cybersecurity for 2021 – 2022 (C(2021) 7913 final - Annex)

ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and adoption of the multiannual work programme – European Digital Innovation Hubs for 2021 – 2023 (C(2021) 7911 final - Annex)

Horizon Europe Joint Undertakings

Key Digital Technologies JU:

DECISION KDT GB 2022.35 approving the Key Digital Technologies Joint Undertaking's annual budget for the year 2023

DECISION KDT GB 2022.23 adopting the first amendment of the Joint Undertaking's annual budget for the year 2022

DECISION KDT GB 2022.36 Adopting KDT work programme for the year 2023

KDT GB 2022.26 WORK PROGRAMME 2022 V16 – 29 August 2022

KDT ED 2022.27 WORK PROGRAMME 2021 V13_2022-02-24

European High-Performance Computing JU:

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 9/2019 Adopting the amended Joint Undertaking's Work Plan for the year 2019

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 01/2020 Adopting the amended Joint Undertaking's Work Plan for the year 2020

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 01/2021 Amending the Joint Undertaking's Work Plan and Budget for the year 2021

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 07/2022 Amending the Joint Undertaking's Work Plan and Budget for the year 2022 (Work Programme and Budget Amendment no. 2)

DECISION OF THE GOVERNING BOARD OF THE EuroHPC JOINT UNDERTAKING No 40/2022 On the Joint Undertaking's Work Programme and Budget 2023

Smart Networks and Services JU:

Annex to the SNS JU Work Programme 2024 SNS R&I Work Programme for 2024 Draft Version 25.05.23 (Orientations - Work in Progress)

ANNEX II TO DECISION No 03/2022 OF THE GOVERNING BOARD OF SMART NETWORKS AND SERVICES JOINT UNDERTAKING

SNS R&I Work Programme 2021-2022

Innovative Health Initiative JU:

Innovative Health Initiative 2022 Amended Work Programme

Innovative Health Initiative 2022 Second Amended Work Programme

List of abbreviations

CEF2	Connecting Europe Facility 2
CF	Cohesion Fund
CP	Cohesion Policy
DD	Digital Decade
DEP	Digital Europe Programme
DG CNECT	Directorate-General Communications Networks, Content and Technology
DG ECFIN	Directorate-General for Economic and Financial Affairs
DG REGIO	Directorate-General for Regional and Urban Policy
DG RTD	Directorate-General for Research and Innovation
EAFRD	European Agricultural Fund for Rural Development
EIC	European Innovation Council
ERC	European Research Council
ERDF	European Regional Development Fund
ESF	European Social Fund
ESF+	European Social Fund Plus
ESIF	European Structural and Investment Funds
EuroHPC	European High Performance Computing
H2020	Horizon 2020
HE	Horizon Europe
I-DESI	International Digital Economy and Society Index
ICT	Information and communications technology
IHI	Innovative Health Initiative
JU	Joint Undertaking
KDT	Key Digital Technologies
PREDICT	Prospective Insights in ICT R&D
R&D	Research and development
RRF	Recovery and Resilience Facility
SNS	Smart Networks and Services

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Annexes

Annex A. Supplementary tables on mapping of investment funds

This report is accompanied by a dataset available from the JRC Data Catalogue: http://data.europa.eu/89h/7aed1a89-c904-43ed-af0f-b024fc9cb92a

Table A.1 Summary table of investment funds by DD target

	Total DD-relevant budget	RRF	CEF2 Digital	DEP	H2020	HE	CP	ESIF
DD target	165,011.04	116,797.29	1,323.20	1,585.55	3,034.38	6,146.46	26,112.63	10,011.54
Basic digital skills	15,931.67	13,797.82	0.00	40.07	94.09	44.75	864.17	1,090.76
ICT Specialists	11,107.81	9,171.58	0.00	224.65	72.55	223.05	576.12	839.86
Gigabit network coverage	17,114.97	12,963.94	160.16	0.80	0.00	0.11	2,164.23	1,825.73
5G coverage	5,998.16	3,470.86	969.70	0.80	780.16	396.13	114.83	265.68
Semiconductors	3,919.91	2,950.00	0.00	10.51	172.15	688.41	0.00	98.83
Edge	654.88	0.00	43.16	134.41	46.51	331.98	0.00	98.83
Quantum computing	2,355.56	846.08	90.00	176.23	517.29	627.14	0.00	98.83
Cloud computing services	7,685.03	5,077.61	60.18	118.15	166.78	434.73	1,549.98	277.60
Big data	6,921.32	3,866.61	0.00	32.85	179.12	1,015.15	1,549.98	277.60
Artificial intelligence	8,451.99	4,376.00	0.00	243.80	346.03	1,658.58	1,549.98	277.60
Digital late adopters	17,866.22	11,599.84	0.00	197.64	250.29	341.39	4,649.94	827.12
Innovative businesses/ scale-ups	17,029.58	11,603.65	0.00	59.52	290.45	183.37	4,649.94	242.65
Digital public services	33,534.04	23,446.73	0.00	180.72	90.68	6.33	7,214.61	2,594.97
Electronic health records	15,495.50	13,110.35	0.00	87.13	28.28	185.86	1,228.84	855.04
eID	944.40	516.21	0.00	78.27	0.00	9.46	0.00	340.45

Source: JRC calculations

Notes:

- CP's data extraction date: 27 March 2023.
- DEP budget includes Main WP 21-22, Cybersecurity WP 21-22, EDIHs WP 21-23.
- HE budget includes WP21-22, WP23-24, Joint Undertakings, and European Innovation Council. It does not include European Research Council.
- RRF's data extraction date: 1 September 2023.
- H2020's data extraction date: 2 June 2023.

Table A.2 Summary of DD-relevant RRF budget by Member State and DD target (€ million)

Country	Total DD-relevant RRF budget	Basic digital skills	ICT specialists	Gigabit network coverage	5G coverage	Semicon-ductors	Edge	Quantum computing	Cloud computing services	Big Data	Artificial intelli-gence	Digital late adopters	Innovative businesses/ scale-ups	Digital public services	Electronic health records	eID
EU	116,797.29	13,797.82	9,171.58	12,963.94	3,470.86	2,950.00	0.00	846.08	5,077.61	3,866.61	4,376.00	11,599.84	11,603.65	23,446.73	13,110.35	516.21
BE	1,359.69	167.59	111.73	77.15	0.00	20.00	0.00	0.00	43.79	43.79	43.79	131.36	131.36	534.15	55.00	0.00
BG	1,018.18	179.56	121.37	272.17	0.00	0.00	0.00	0.51	6.33	6.33	6.33	19.00	19.00	347.50	40.06	0.00
CZ	1,475.39	221.67	147.78	176.22	51.06	0.00	0.00	7.07	62.82	62.82	72.21	188.47	188.47	213.83	82.95	0.00
DK	382.00	0.00	0.00	13.00	0.00	0.00	0.00	0.00	33.33	33.33	33.33	100.00	100.00	67.00	2.00	0.00
DE	11,995.29	1,080.91	720.61	0.00	0.00	1,500.00	0.00	21.01	892.05	142.05	142.05	426.15	426.15	3,644.30	3,000.00	0.00
EE	207.99	6.00	4.00	24.29	0.00	0.00	0.00	0.00	8.47	8.47	8.47	25.42	25.42	97.43	0.00	0.00
IE	312.41	38.10	25.40	0.00	18.70	0.00	0.00	0.00	16.17	16.17	16.17	48.50	48.50	9.70	75.00	0.00
EL	6,899.01	452.59	301.73	1,073.26	160.00	0.00	0.00	0.00	261.99	261.99	261.99	785.98	785.98	2,275.90	277.58	0.00
ES	18,750.80	2,620.85	1,747.23	1,372.00	1,514.60	0.00	0.00	0.00	704.91	704.91	1,204.91	2,114.73	2,114.73	4,311.93	340.00	0.00
FR	7,732.28	994.82	615.22	240.00	300.00	0.00	0.00	350.00	245.10	245.10	245.10	735.30	735.30	993.10	2,002.94	30.30
HR	841.20	94.89	82.62	157.50	0.00	0.00	0.00	0.00	23.67	23.67	23.67	71.01	71.01	234.85	57.40	0.91
IT	42,435.23	4,201.68	2,801.12	6,706.50	14.00	790.00	0.00	0.00	2,345.32	1,895.32	1,895.32	5,685.95	5,685.95	5,726.42	4,402.65	285.00
CY	261.89	14.44	9.63	52.50	0.00	0.00	0.00	0.00	8.13	8.13	8.13	24.40	24.40	101.91	10.22	0.00
LV	383.78	63.78	42.52	4.00	12.50	0.00	0.00	0.00	15.29	15.29	15.29	45.88	45.88	123.35	0.00	0.00
LT	660.65	86.40	57.60	73.50	0.00	0.00	0.00	0.00	10.39	10.39	10.39	31.17	31.17	263.95	85.70	0.00
LU	24.49	0.36	0.24	0.00	0.00	0.00	0.00	0.00	1.11	1.11	1.11	3.33	3.33	12.73	1.16	0.00
HU	1,214.59	331.24	220.83	0.00	0.00	0.00	0.00	0.00	13.55	13.55	13.55	40.66	40.66	60.89	479.65	0.00
MT	74.90	1.56	1.04	0.00	0.00	0.00	0.00	0.00	1.67	1.67	1.67	5.00	5.00	41.80	15.50	0.00
NL	834.40	171.12	114.08	0.00	0.00	0.00	0.00	263.90	4.89	4.89	4.89	14.67	14.67	169.30	72.00	0.00
AT	1,814.15	224.02	149.35	891.28	0.00	125.00	0.00	107.00	16.39	16.39	16.39	49.17	49.17	160.00	10.00	0.00
PL	6,830.00	933.00	622.00	1,200.00	1,400.00	0.00	0.00	0.00	122.67	111.67	111.67	335.00	335.00	659.00	1,000.00	0.00
PT	3,646.20	815.86	543.91	10.38	0.00	0.00	0.00	0.00	71.08	71.08	71.08	213.23	213.23	1,276.36	359.99	0.00
RO	4,980.46	760.16	506.77	94.00	0.00	500.00	0.00	0.00	119.84	119.84	119.84	359.52	359.52	1,370.99	470.00	200.00
SI	470.66	36.21	24.14	30.00	0.00	0.00	0.00	0.00	14.80	14.80	14.80	44.41	44.41	164.08	83.00	0.00
SK	1,163.23	178.77	119.18	0.00	0.00	0.00	0.00	86.59	28.23	28.23	28.23	84.70	88.51	478.03	42.75	0.00
FI	378.72	23.36	15.57	32.00	0.00	15.00	0.00	10.00	5.60	5.60	5.60	16.81	16.81	87.54	144.80	0.00
SE	649.69	98.88	65.92	464.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.69	0.00	0.00

Source: JRC calculations.
Notes: RRF's data extraction date: 1 September 2023.

Table A.3 Summary of DD-relevant CP 21-27 budget by Member State and DD target (€ million)

Country	Total DD-relevant CP budget	Basic digital skills	ICT specialists	Gigabit network coverage	5G coverage	Semicon-ductors	Edge	Quantum computing	Cloud computing services	Big Data	Artificial intelli-gence	Digital late adopters	Innovative businesses/ scale-ups	Digital public services	Electronic health records	eID
EU	26,112.63	864.17	576.12	2,164.23	114.83	0.00	0.00	0.00	1,549.98	1,549.98	1,549.98	4,649.94	4,649.94	7,214.61	1,228.84	0.00
BE	149.53	11.77	7.85	0.00	0.00	0.00	0.00	0.00	10.55	10.55	10.55	31.66	31.66	34.95	0.00	0.00
BG	691.18	4.08	2.72	0.00	0.00	0.00	0.00	0.00	57.18	57.18	57.18	171.54	171.54	133.62	36.14	0.00
CZ	1,330.73	54.04	36.03	182.64	0.00	0.00	0.00	0.00	52.65	52.65	52.65	157.94	157.94	443.74	140.46	0.00
DK	37.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.27	2.27	2.27	6.82	6.82	16.78	0.00	0.00
DE	1,146.42	25.76	17.17	4.00	0.00	0.00	0.00	0.00	111.17	111.17	111.17	333.52	333.52	58.11	40.81	0.00
EE	332.73	6.34	4.23	62.00	0.00	0.00	0.00	0.00	13.80	13.80	13.80	41.39	41.39	136.00	0.00	0.00
IE	34.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.87	3.87	3.87	11.61	11.61	0.00	0.00	0.00
EL	1,703.13	36.68	24.45	246.15	0.00	0.00	0.00	0.00	108.81	108.81	108.81	326.43	326.43	374.02	42.56	0.00
ES	4,209.18	226.78	151.19	155.17	40.79	0.00	0.00	0.00	197.94	197.94	197.94	593.81	593.81	1,558.46	295.38	0.00
FR	1,231.94	87.69	58.46	147.12	0.00	0.00	0.00	0.00	74.59	74.59	74.59	223.77	223.77	202.75	64.61	0.00
HR	462.56	13.57	9.05	50.00	0.00	0.00	0.00	0.00	34.75	34.75	34.75	104.24	104.24	68.74	8.50	0.00
IT	3,550.63	183.88	122.59	15.52	0.80	0.00	0.00	0.00	228.66	228.66	228.66	685.97	685.97	983.73	186.20	0.00
CY	66.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.08	3.08	3.08	9.23	9.23	33.30	5.00	0.00
LV	363.58	12.94	8.62	29.21	0.00	0.00	0.00	0.00	16.76	16.76	16.76	50.29	50.29	139.92	22.02	0.00
LT	313.65	10.66	7.11	21.87	3.13	0.00	0.00	0.00	23.10	23.10	23.10	69.30	69.30	62.97	0.00	0.00
LU	4.34	0.72	0.48	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.08	0.24	0.24	2.41	0.00	0.00
HU	1,569.47	11.44	7.63	207.49	0.00	0.00	0.00	0.00	121.27	121.27	121.27	363.81	363.81	251.48	0.00	0.00
MT	57.82	0.54	0.36	0.00	0.00	0.00	0.00	0.00	3.32	3.32	3.32	9.97	9.97	12.00	15.00	0.00
NL	57.91	1.97	1.32	0.00	0.00	0.00	0.00	0.00	5.74	5.74	5.74	17.21	17.21	0.00	3.00	0.00
AT	68.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.58	7.58	7.58	22.74	22.74	0.00	0.00	0.00
PL	3,934.15	33.82	22.55	738.78	61.26	0.00	0.00	0.00	158.92	158.92	158.92	476.77	476.77	1,460.36	187.07	0.00
PT	1,674.07	20.40	13.60	149.63	4.88	0.00	0.00	0.00	150.30	150.30	150.30	450.91	450.91	118.90	13.93	0.00
RO	1,873.03	14.49	9.66	0.00	0.00	0.00	0.00	0.00	96.94	96.94	96.94	290.81	290.81	818.37	158.08	0.00
SI	197.25	19.12	12.74	18.36	1.30	0.00	0.00	0.00	11.31	11.31	11.31	33.94	33.94	43.91	0.00	0.00
SK	670.45	52.10	34.74	112.10	0.00	0.00	0.00	0.00	25.00	25.00	25.00	74.99	74.99	246.55	0.00	0.00
FI	174.83	14.87	9.91	0.00	0.00	0.00	0.00	0.00	15.72	15.72	15.72	47.16	47.16	0.00	8.57	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: JRC calculations.
Notes: CP's data extraction date: 27 March 2023.

Table A.4 Summary of DD-relevant ESIF budget by Member State and DD target (€ million)

Country	Total DD-relevant ESIF budget	Basic digital skills	ICT specialists	Gigabit network coverage	5G coverage	Semicon-ductors	Edge	Quantum computing	Cloud computing services	Big Data	Artificial intelli-gence	Digital late adopters	Innovative businesses/ scale-ups	Digital public services	Electronic health records	eID
EU	10,011.54	1,090.76	839.86	1,825.73	265.68	98.83	98.83	98.83	277.60	277.60	277.60	827.12	242.65	2,594.97	855.04	340.45
BE	46.36	1.95	1.36	1.07	1.07	1.07	1.07	1.07	4.21	4.21	4.21	12.24	12.24	0.19	0.19	0.19
BG	43.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.79	4.79	4.79	14.38	14.38	0.00	0.00	0.00
CZ	275.76	0.00	0.00	2.48	2.48	2.48	2.48	2.48	18.54	18.54	18.54	55.63	4.44	113.88	19.52	14.24
DK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DE	136.83	34.08	22.72	0.10	0.10	0.10	0.10	0.10	7.96	7.96	7.96	23.88	23.88	1.63	6.05	0.20
EE	84.15	0.00	0.00	20.18	20.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.03	4.38	4.38
IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EL	272.68	4.56	3.84	4.31	4.31	4.31	4.31	4.31	36.12	36.12	36.12	103.54	7.33	14.49	5.05	3.92
ES	3,053.76	269.56	179.71	794.66	76.74	6.41	6.41	6.41	101.26	101.26	101.26	303.77	51.47	682.53	287.01	85.32
FR	778.67	93.67	65.45	317.76	32.46	11.30	11.30	11.30	13.82	13.82	13.82	41.47	15.46	74.54	53.16	9.32
HR	205.22	0.45	96.14	20.74	20.74	1.98	1.98	1.98	0.00	0.00	0.00	0.00	0.00	19.24	27.60	14.38
IT	1,765.78	422.14	281.42	416.28	25.16	21.95	21.95	21.95	14.63	14.63	14.63	43.90	28.81	337.77	58.33	42.22
CY	45.30	1.80	1.20	19.00	0.00	0.00	0.00	0.00	0.63	0.63	0.63	1.90	0.00	11.76	6.27	1.47
LV	71.11	3.09	2.06	1.62	1.62	1.62	1.62	1.62	2.11	2.11	2.11	6.32	0.00	33.94	7.04	4.24
LT	129.80	8.51	5.68	18.06	0.53	0.53	0.53	0.53	0.55	0.55	0.55	1.65	1.65	69.33	12.47	8.67
LU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HU	222.66	14.80	9.87	0.42	0.42	0.42	0.42	0.42	29.70	29.70	29.70	89.11	11.88	0.00	5.82	0.00
MT	21.20	0.00	0.00	1.79	1.79	1.79	1.79	1.79	0.67	0.67	0.67	2.00	0.00	4.82	2.84	0.60
NL	7.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.59	0.59	1.76	1.76	0.00	2.00	0.00
AT	0.20	0.12	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PL	1,513.79	116.21	77.55	33.50	33.50	33.50	33.50	33.50	24.18	24.18	24.18	72.07	48.32	643.05	235.94	80.59
PT	183.24	16.34	10.89	0.44	0.44	0.44	0.44	0.44	3.92	3.92	3.92	11.75	0.00	94.66	23.79	11.83
RO	360.23	67.77	45.18	22.89	22.89	0.00	0.00	0.00	0.67	0.67	0.67	2.00	0.00	153.75	24.53	19.22
SI	77.51	0.96	13.54	25.80	1.31	1.31	1.31	1.31	0.88	0.88	0.88	2.65	2.65	16.64	3.69	3.69
SK	551.92	30.00	20.00	19.94	19.94	9.60	9.60	9.60	6.42	6.42	6.42	19.26	14.26	281.97	63.25	35.25
FI	19.14	0.42	0.28	0.00	0.00	0.00	0.00	0.00	2.63	2.63	2.63	7.88	0.51	0.00	2.17	0.00
SE	145.79	4.33	2.88	104.69	0.00	0.00	0.00	0.00	3.31	3.31	3.31	9.94	3.61	5.75	3.93	0.72

Source: JRC calculations.
Notes: ESIF's data extraction date: 29 September 2022.

Table A.5 Summary of DD-relevant H2020 budget by Member State and DD target (€ million)

Country	Total DD-relevant H2020 budget	Basic digital skills	ICT specialists	Gigabit network coverage	5G coverage	Semicon-ductors	Edge	Quantum computing	Cloud computing services	Big Data	Artificial intelli-gence	Digital late adopters	Innovative businesses/ scale-ups	Digital public services	Electronic health records	eID
EU	3,034.38	94.09	72.55	0.00	780.16	172.15	46.51	517.29	166.78	179.12	346.03	250.29	290.45	90.68	28.28	0.00
BE	187.16	14.46	14.46	0.00	22.52	56.73	0.00	3.13	4.89	6.65	35.01	14.66	14.66	0.00	0.00	0.00
BG	20.54	0.00	0.00	0.00	0.00	0.00	5.00	6.98	5.00	3.55	0.00	0.00	0.00	0.00	0.00	0.00
CZ	40.81	11.95	11.95	0.00	0.00	0.00	0.00	0.00	1.88	1.88	1.88	5.63	5.63	0.00	0.00	0.00
DK	31.60	0.00	0.00	0.00	0.00	12.93	1.50	0.00	3.24	1.74	1.74	5.23	5.23	0.00	0.00	0.00
DE	432.18	0.99	0.00	0.00	173.20	27.23	9.45	91.35	28.33	11.27	31.52	23.22	28.52	6.89	0.20	0.00
EE	59.22	0.00	0.00	0.00	55.10	0.00	0.00	0.00	0.00	4.12	0.00	0.00	0.00	0.00	0.00	0.00
IE	124.77	4.00	0.00	0.00	32.59	0.00	0.00	0.00	8.69	15.09	12.25	26.07	26.07	0.00	0.00	0.00
EL	105.90	5.71	0.00	0.00	15.70	0.00	4.99	20.20	13.44	4.63	13.14	8.22	17.89	0.00	1.99	0.00
ES	201.69	3.35	0.00	0.00	11.24	0.00	9.69	58.36	21.01	20.60	25.09	21.92	27.43	0.00	3.00	0.00
FR	504.81	49.14	45.14	0.00	88.67	13.73	3.81	124.97	20.48	23.37	73.42	22.81	28.78	10.48	0.00	0.00
HR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IT	338.78	4.00	0.00	0.00	104.99	3.11	3.10	46.02	10.82	21.27	59.41	32.47	36.70	16.90	0.00	0.00
CY	20.38	0.00	0.00	0.00	13.33	0.00	0.00	4.52	0.00	0.00	0.54	0.00	1.98	0.00	0.00	0.00
LV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LT	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.17	0.17	0.50	0.50	0.00	0.00	0.00
LU	104.78	0.00	0.00	0.00	48.39	2.84	0.00	25.55	3.11	3.11	3.11	9.33	9.33	0.00	0.00	0.00
HU	36.83	0.00	0.00	0.00	16.00	0.00	0.00	6.39	2.70	3.52	0.32	0.95	0.95	0.00	6.00	0.00
MT	43.24	0.00	1.00	0.00	0.00	0.00	0.00	30.00	0.00	0.00	12.00	0.00	0.00	0.00	0.24	0.00
NL	207.18	0.00	0.00	0.00	126.69	2.53	0.00	13.42	4.24	9.44	4.24	12.73	16.66	16.07	1.16	0.00
AT	137.55	0.00	0.00	0.00	4.00	28.97	0.00	27.63	5.58	14.21	21.73	16.73	16.73	1.98	0.00	0.00
PL	101.83	0.00	0.00	0.00	0.00	24.08	0.00	11.03	7.25	4.94	3.34	10.01	10.01	15.99	15.20	0.00
PT	115.86	0.00	0.00	0.00	14.89	0.00	5.00	0.00	13.39	12.76	14.45	25.16	25.16	5.06	0.00	0.00
RO	37.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00	4.00	11.99	13.99	0.00	0.00	0.00
SI	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	0.00	0.00	0.00	0.00	0.00
SK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FI	77.14	0.50	0.00	0.00	20.55	0.00	3.98	17.34	4.89	9.61	6.83	2.67	2.67	7.62	0.50	0.00
SE	90.70	0.00	0.00	0.00	32.30	0.00	0.00	30.41	3.69	3.20	9.86	0.00	1.57	9.68	0.00	0.00

Source: JRC calculations.
Notes: H2020's data extraction date: 2 June 2023.

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